Teacher's Reference

For

Competency Based Assessment

Class VIII Science

Bhutan Council for School Examinations and Assessment (BCSEA)

Thimphu: Bhutan

2016

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BACKGROUND

As mandated under Performance Compact Charter 7 of *Accelerating Bhutan's Socio-economic Development (ABSD)*, one significant initiative undertaken by the Bhutan Board of Examinations (BBE) was to develop *Teachers' Guide on Competency Based Assessment (CBA)* for selected subjects for various class levels in 2010 (10th Plan).

Teachers' Reference for Competency Based Assessment (TRCBA) books were first developed for Classes V, VII and IX in three subjects (Dzongkha, English and Mathematics) and introduced to all the secondary schools in 2011. Meanwhile, the erstwhile BBE was renamed as the Bhutan Council for School Examinations and Assessment (BCSEA) as an autonomous body and it was later delinked from the Ministry of Education (MoE) with effect from April 2011.

In the following year, a survey was carried out on the usefulness of these books in teaching-learning. Subsequently, based on the feedbacks received from the teachers in the field, the Ministry of Education endorsed the recommendations to further develop the CBA books as teachers' reference guides for other subjects across the school curricula with an intent to improve both the standard and delivery of quality education in the country.

Broad objectives of CBA are to:

1. *enhance and improve teaching learning assessment of student competencies in schools at various class levels,*
2. *enable teachers to frame their own creative (modular) assessment tools using the booklet as reference guides, and*
3. *provide sample questions/model answers in the guide books.*

INTRODUCTION

What are competencies?

Competencies consist of a description of the essential skills, knowledge, attitudes, and behaviors required for effective performance of a real-world task or activity. These activities may be related to any domain of life, though have typically been linked to the field of work and to social survival in a new environment.

What is Competency Based Education?

Competency Based Education (CBE) focuses on outcomes of learning. CBE addresses what the learners are expected to do rather than on what they are expected to learn about. CBE emerged in the United States in the 1970s and refers to an educational movement that advocates defining educational goals in terms of precise measurable descriptions of knowledge, skills, and behaviors students should possess at the end of a course of study. (Richards and Rodgers)

What is Competency-Based Assessment?

It is a form of assessment that is derived from a specified set of learning outcomes which very clearly states both the general and specific outcomes or competencies (knowledge, skills, values and attitude (KSVA), that assessors, students and stakeholders can make reasonably objective judgements with respect to student achievement of these outcomes/ competencies that equip them to move to the next competency level and prepare them for life and the world of work.

CBA usually measures the higher order thinking skills of the students and it gives scope for assessing the 21st skills that the 21st century learners require in order to meet the emerging challenges and opportunities arising out of globalization and rapid technological changes.

The three important components of competency-based assessment which the definition above encapsulates are:

- *the emphasis on learning outcomes; specifically, multiple learning outcomes, each of which is distinctive and separately considered,*
- *the belief that these outcomes can and should be specified to the point where they are "clear and transparent."Assessors, assessed and the stakeholders should be able to understand what is being assessed and what should be achieved and*
- *the isolating assessment from particular institutions or learning programmes.*

What are Competency Based Questions?

Competency-based questions are tools that assess student outcomes/ competencies using diverse approaches to measure both general and specific skills as opposed to that of the conventional testing approach.

Competency-based questions can be better defined by its salient features as follows:

- *emphasis on testing the **use** of knowledge rather than knowledge itself,*
- *items are context based and related to real life situation,*
- *the terms and concepts are kept subtle,*
- *items are thought provoking and interesting,*
- *items are linked to learning outcomes,*
- *test all levels of cognitive, attitudinal and psychomotor skills and most learning strands,*
- *tendency to move away from conventional testing approach and*
- *learning happens (assessment for learning).*

Purpose of the book

This booklet comprises model questions and their answers that can be used to assess competencies across all the learning strands. It is intended to serve as a guide for teachers to help them in the classroom teaching and also as an item bank from which they may draw questions to assess students' competencies in Science as specified in the strands and learning objectives of the Science curriculum.

However, it is cautioned that the questions and answers given in the booklet are in no way prescriptive; they are rather intended to serve as guides, suggestions, or prompts for the improved construction and designing of the questions and answers that assess students' learning competencies.

How to use this book

The questions and answers in this booklet may be used:

1. as a reference when developing teaching and assessment plans in science lessons with suggested classroom activities and the resources,
2. while planning to assess the student competencies in classroom practice, collecting evidence of learning for assessment and to make immediate connections to assessment and reporting,
3. to assess student competencies (achievements or failures) in the formative or summative learning in the form of class tests, term tests, etc.,
4. as models/samples of reliable questions/answers testing competencies for the construction of questions that may be required for the assessment of skills through other texts and
5. to review the value of using assessment criteria and be able to use them to grade work and give constructive feedbacks.

TABLE OF CONTENTS

UNIT I: LIFE PROCESSES

CHAPTER 1
CELLS

1. CELL PARTS AND THEIR FUNCTIONS

Learning Outcomes

At the end of the lesson, a student should be able to:

1.1.1 Identify the cell organelles present in a plant cell and an animal cell,
1.1.2 Describe the functions of different cell organelles in a plant cell and an animal cell and
1.1.3 Draw cell organelles of a plant cell and an animal cell.

Assessment Items

Question 1. **[Understanding]**

With respect to their surrounding membrane system, which is the odd one out?

A nucleus
B mitochondria
C ribosomes
D endoplasmic reticulum

Answer: *C ribosomes*

Question 2. **[Understanding]**

Look at Figure 1.1 carefully and write down the function of the parts labelled 1, 2 and 3.

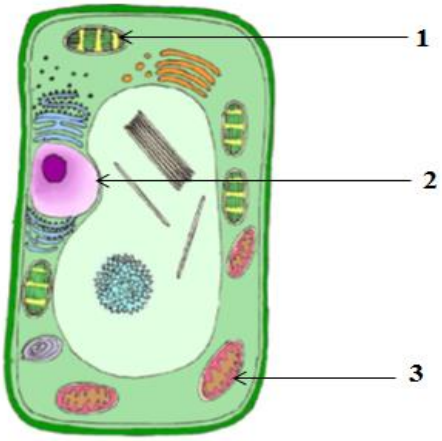


Figure 1.1

Answer: *1 –Helps in photosynthesis 2 – Controls cellular activities 3 – Releases energy*

Question 3. **[Analyzing]**

Match each name of cell organelle in column I against its diagram in column II. Select the correct matching pairs.

Table 1.1

Column I	Column II
1. Cell wall	a. 
2. Cytoplasm	b. 
3. Mitochondria	c. 
4. Endoplasmic reticulum	d. 
	e. 

Answer: *1 - (b) 2 - (d) 3 - (a) 4 - (c)*

Question 4. **[Applying]**

Dorji has labelled Figure 1.2 incorrectly. Re-draw the diagram and label it correctly.

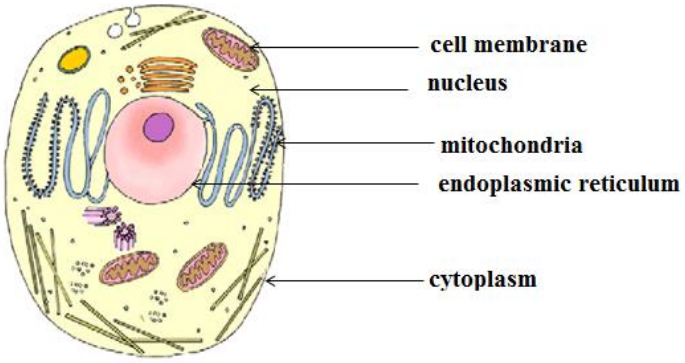
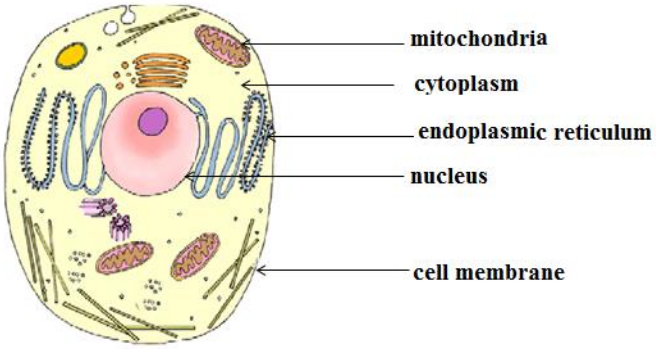


Figure 1.2

Answer: *The correctly labelled diagram is shown below*



Question 5. **[Understanding]**

Which of the following best describes the purpose of cellular respiration?

A To supply carbon-dioxide for photosynthesis**.**
B To release oxygen for breathing.
C To produce sugar for storage of cells.
D To provide energy for cellular activities.

Answer: *D To provide energy for cellular activities.*

Question 6. **[Understanding]**

Which set of cell organelles are involved in cell division?

A lysosome, nucleus
B golgi body, nucleus
C centrosome, nucleus
D mitochondrion, nucleus

Answer: *C centrosome, nucleus*

Question 7. **[Analyzing]**

Read each description and name the cell organelle. Write your answer in the space provided.

i. I am the generator who breaks down food to release energy…..……
ii. I live in the plant cell. I am green and I prepare food. ..……..
iii. I am strong and rigid and I protect my family. ..……
iv. I am known as the 'reservoir'. I am a sac filled with fluid. ..……..

Answer: *i. Mitochondria ii. Chloroplast iii. Cell wall iv. Vacuole*

Question 8. **[Evaluating]**

If an animal cell contains plastids, there will be no food shortage in the world. Do you agree or disagree. Justify with one point?

Answer: **(Sample)**

I agree because the animals do not have to depend on plants for the food as they can prepare their own food. I disagree because the food they produce may not be sufficient.

Question 9. **[Applying]**

Figure 1.3 gives information about a cell. Based on the diagram, answer the question.

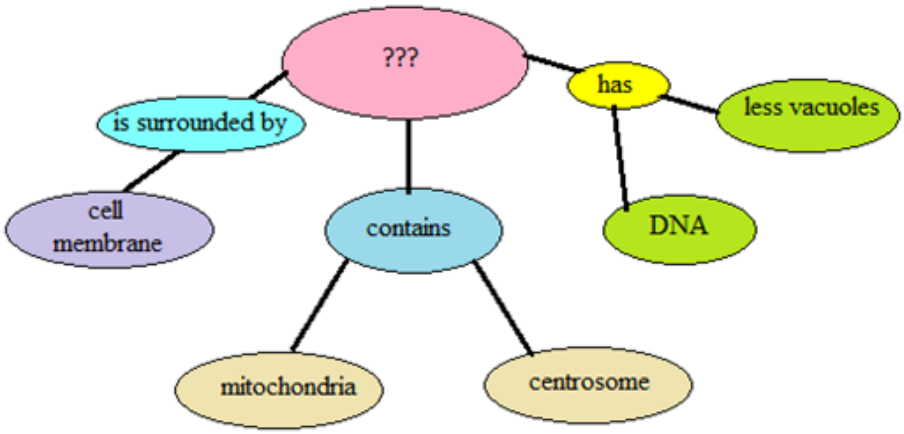


Figure 1.3

Which of the following best completes this concept map?

A yeast cell
B peach cell
C horse cell
D bacteria

Answer: *C* *horse cell*

Question 10. **[Analyzing]**

Cell membrane is compared to a sieve, similarly chloroplast is compared to a

A kitchen.
B factory.
C generator.
D computer.

Answer: *A* *kitchen*

Question 11. **[Analyzing]**

Which of the following cell organelles are correctly matched with its function?

I Ribosomes → synthesis of protein.
II Mitochondria → secretion of enzymes.
III Chloroplast → traps energy from sun.
IV Cell Membrane → freely permeable.

A I and II
B I and III
C II and III
D III and IV

Answer: *B* *I and III*

Question 12. **[Remembering]**

The cell organelle responsible for commanding cellular activities in a cell is the

A nucleus.
B vacuole.
C cytoplasm.
D cell membrane.

Answer: *A nucleus*

Question 13. **[Analyzing]**

Match each item in column A against column B. Re-write the correct matching pairs.

Table 1.2

Column A	Column B
1. Stores water and minerals	a. nucleus
2. Impart colours to the plants	b. lysosome
3. Protects and gives shape to the cell	c. plastids
4. Removes foreign bodies from the cell	d. golgi body
5. Co-ordinates all the cellular activities	e. vacuole
	f. mitochondria
	g. cell wall

Answer: *1-e 2-c 3-g 4-b 5-a*

Question 14. **[Applying]**

Complete the crossword puzzle with the help of the clues given below:

Across

1. *Only certain materials can enter the cell*
2. Garbage disposal of the cell
3. Sunlight converted to sugar
4. A group of tissues
5. Study of cells
6. Stores pigment
7. Site for photosynthesis
8. Internal structures in a cell
9. Genetic data of the cell
10. Powerhouse of the cell
11. Rigid protective barrier in a plant cell

Answer: *1: SELECTIVELY PERMEABLE 2: LYSOSOME 3: PHOTOSYNTHESIS 4: ORGAN 5: CYTOLOGY 6: PLASTID 7: CHLOROPLAST 8: ORGANELLES 9: NUCLEUS 10: MITOCHONDRIA 11: CELL WALL*

Down

1. *Prepares protein for export*
2. Structural and functional unit of life
3. A group of organ system
4. Storage
5. Round structure within nucleus
6. Contains many cell organelles
7. A group of cells
8. Site of protein synthesis

Answer: *1: ENDOPLASMIC RETICULUM 2: CELL 3: ORGANISM 4: VACUOLE 5: NUCLEOLUS 6: CYTOPLASM 7: TISSUE 8: RIBOSOME*

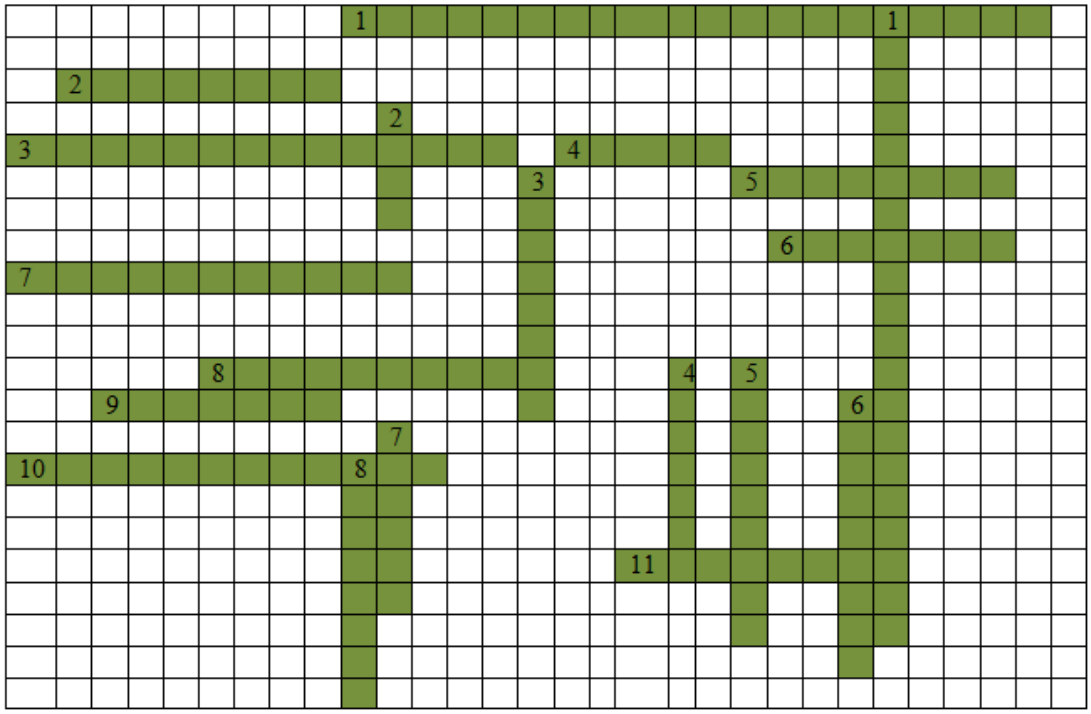


Figure 1.4

Question 15. **[Analyzing]**

Study the Venn diagram given below and answer the questions that follow.

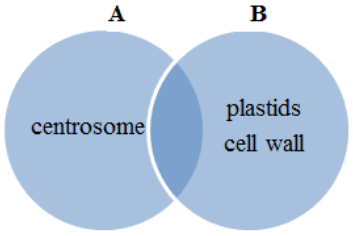


Figure 1.5

i. Identify the cell in figure A and B.
Answer: *A is an animal cell and B is a plant cell.*

ii. Name two cell organelles found in the intersect region of A and B.
Answer: *Mitochondria and vacuole.*

iii. Write the function of cell organelles that you have mentioned in the intersect region?
Answer: *Mitochondria releases energy and vacuole helps to store water.*

iv. State one process that is carried out in figure B and **not** in figure A.
Answer: *Photosynthesis takes place in figure B due to the presence of plastids.*

Question 16.
Make a model of a plant cell using available resources. **[Creating]**

2. THE ORGANIZATION IN A MULTI-CELLULAR ORGANISM

Learning Outcomes

At the end of the lesson, a student should be able to:

1.2.1 Define tissue,
1.2.2 Classify plant tissues and animal tissues with examples,
1.2.3 Explain the structures of plant tissues and animal tissues,
1.2.4 Draw and identify a plant tissue and an animal tissue using a compound microscope and
1.2.5 Tell with examples that cells came from tissues, tissues from organs, organs from organ system and different organ systems make an organism.

Assessment Items

Question 1. **[Remembering]**

It is a living structure with thick cell wall, without intercellular spaces and is found in non-woody plants.

The above statement best describes

A parenchyma.
B sclerenchyma.
C collenchyma.
D phloem.

Answer: *C collenchyma*

Question 2. **[Remembering]**

Sonam is doing research on different types of tissues. The field of his research is known as

A histology.
B pathology.
C cytology.
D zoology.

Answer: *A histology*

Question 3. **[Understanding]**

What type of tissue is shown with arrows in Figure 1.6?

A meristematic tissue
B connective tissue
C permanent tissue
D epithelial tissue

Answer: *A meristematic tissue*

Figure 1.6

Question 4. **[Understanding]**

What is the economic importance of phloem tissue?

Answer: *Phloem fibers of jute are used to manufacture ropes, threads and cord twine.*

Question 5. **[Evaluating]**

'If animal cells have more large vacuoles than plant cells, the efficiency of cellular activities will improve.' Do you agree or disagree? Justify with one point.

Answer: (**Open ended**)

- ✓ *Yes, I agree because in any cellular activities water is very important medium for chemical reactions.*
- ✓ *No, I disagree because most of the space in the cell will be occupied by vacuoles hampering other cell organelle's activities.*

Question 6. **[Remembering]**

Which sequence represents the correct order of levels of organization in a multicellular organism?

A cells → organelles → organs → organ system → tissues

B tissues → organs → organ system → organelles → cells

C organelles → cells → tissues → organs → organ system

D organs → organ system → cells → tissues → organelles

Answer: *C* *organelles → cells → tissues → organs → organ system*

Question 7. **[Understanding]**

Which muscular tissue is present in Figure 1.7?

A striated muscle

B cardiac muscle

C non-striated muscle

D antagonistic muscle

Answer: *B* *cardiac muscle*

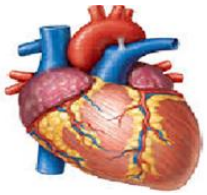


Figure 1.7

Question 8. **[Understanding]**

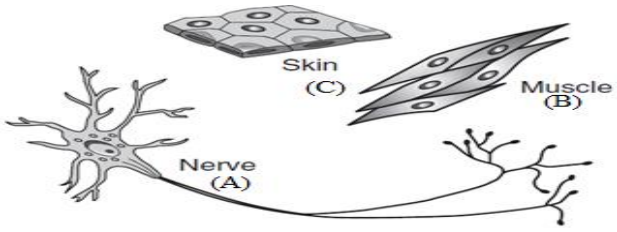


Figure 1.8

With reference to the level of organization explain how the parts in Figure 1.8 differ structurally and functionally.

Answer:

Figure	***Structure***	***Function***
A	*It is a cell.*	*It is the structural and functional unit of life.*
B	*It is a tissue.*	*A group of cells performing a common function.*
C	*It is an organ.*	*A group of tissues performing a specific function.*

Question 9. **[Applying]**

Find ten plant and animal tissues in the word maze.

P	H	K	C	R	X	H	G	T	B	F	D	G
S	J	L	N	T	Y	C	H	F	N	D	H	K
C	D	C	O	L	L	E	N	C	H	Y	M	A
H	B	C	K	Y	E	T	F	G	M	E	H	G
G	L	I	G	A	M	E	N	T	G	T	J	G
L	P	Y	J	H	E	N	E	R	V	O	U	S
O	M	H	C	A	R	D	I	A	C	D	B	R
R	C	G	F	F	I	O	J	H	F	F	U	K
V	D	A	G	H	S	N	V	J	D	V	N	K
G	T	D	H	D	T	T	R	F	G	P	S	F
E	P	I	T	H	E	L	I	A	L	H	D	G
T	E	T	T	T	M	P	Y	Q	H	L	R	E
U	S	R	R	Y	A	H	E	E	J	O	G	N
M	F	C	A	R	T	I	L	A	G	E	H	D
C	J	B	G	H	I	L	F	R	K	M	T	O
K	U	N	E	G	C	G	R	F	L	B	G	N

Figure 1.9

Answer: *COLLENCHYMA XYLEM TENDON LIGAMENT MERISTEMATIC CARDIAC NERVOUS EPITHELIAL CARTILAGE PHLOEM*

Question 10. **[Understanding]**

The tissue which allows various parts of a plant to bend easily is

A sclerenchyma.
B parenchyma.
C meristematic.
D collenchyma.

Answer: *D collenchyma*

Question 11. **[Understanding]**

The permanent tissue present in carrot is

A aerenchyma.
B parenchyma.
C collenchyma.
D sclerenchyma.

Answer: *B parenchyma*

Question 12. **[Remembering]**

Write **TRUE** or **FALSE** against each statement.

1) Cardiac muscles are involuntary muscles.
2) Meristematic tissue has permanent shape.
3) Neurons are the building block of nervous system.
4) Phloem transports water and minerals from the root to other parts of the plant.

Answer: *1.True 2. False 3. True 4. False*

Question 13. **[Analyzing]**

Choose the correct word from the word bank and write it against each tissue.

electrical wire, anchor, rain coat, rubber band, thread, sieve.

i) Muscle……..
ii) Nerve……
iii) Epithelial……...
iv) Connective……

Answer: i) *rubber band* *ii) electrical wire* *iii) rain coat* *iv) thread*

Question 14. **[Analyzing]**

When you bend your arm at the elbow, the bones and muscles in your arms are acting as a system. What simple machine does this system represent?

A inclined plane
B pulley
C wedge
D lever

Answer: *D* *lever*

Question 15. **[Applying]**

Deki carried out an experiment using eosin solution in young sun flower plant and kept it undisturbed for 2-3 hours. She then observed the cross section of the stem under the microscope. The observation is given in the Figure 1.10.

What conclusion did she draw from the experiment?

A Xylem transports water.
B Xylem transports food.
C Phloem transports water.
D Phloem transports minerals.

Answer: *A* *Xylem transports water.*

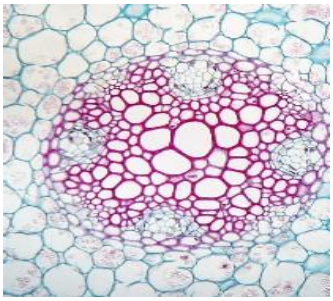


Figure 1.10

Question 16. **[Remembering]**

Sonam has very good body co-ordination to become a free style dancer. Which system is involved in carrying out such co-ordination?

A nervous system
B muscular system
C respiratory system
D circulatory system

Answer: *B* *muscular system*

Question 17. **[Understanding]**

Students were asked to observe four permanent slides labelled as **A, B, C** and **D** under the compound microscope as shown in Figure 1.11.

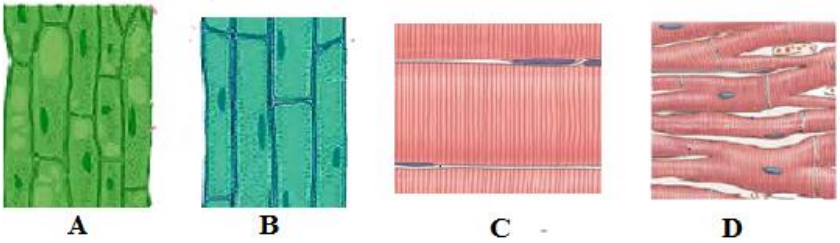


Figure 1.11

Name the specimens labelled A, B, C and D.

Answer: *A Parenchyma B Collenchyma C Striated muscles D Cardiac muscles*

Question 18. **[Analyzing]**

Karma observed a plant tissue under a compound microscope as shown in Figure 1.12. She found the cells were thick, dead and closely packed. The tissue that she observed is

A parenchyma tissue.
B collenchyma tissue.
C sclerenchyma tissue.
D meristematic tissue.

Answer: *C sclerenchyma tissue*

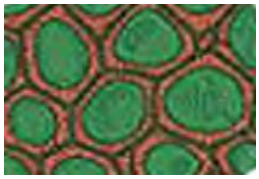


Figure 1.12

Question 19. **[Analyzing]**

Figure 1.13 represents a level of organization in a living thing**.**

Which example would best represent **X**?

A ostrich egg
B ostrich
C muscle
D eye

Answer: *B Ostrich*

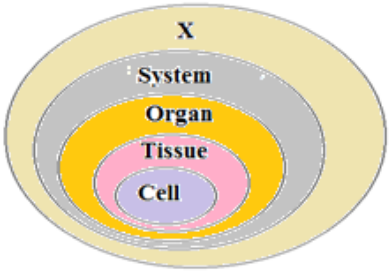


Figure 1.13

Question 20. **[Analyzing]**

Give an analogy for the following pairs.

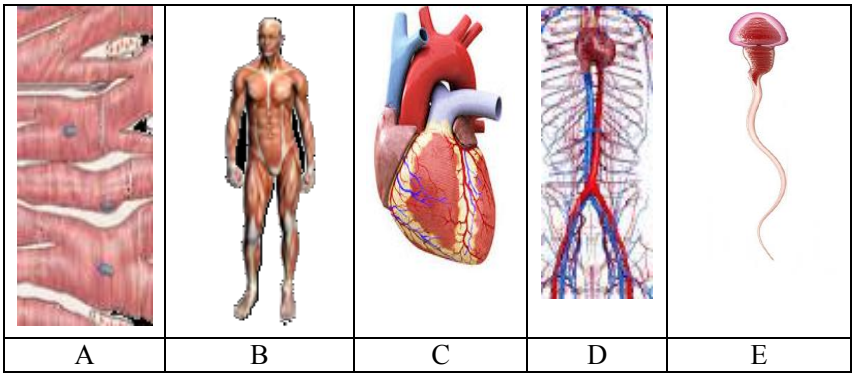
i. Heart: Cardiac muscle : Limbs: ……

ii. Xylem: Water: Phloem: ……..

Answer: *i Striated muscles, ii Food*

Question 21.

Use the pictures in Figure 1.14 and answer the questions (i), (ii) and (iii).

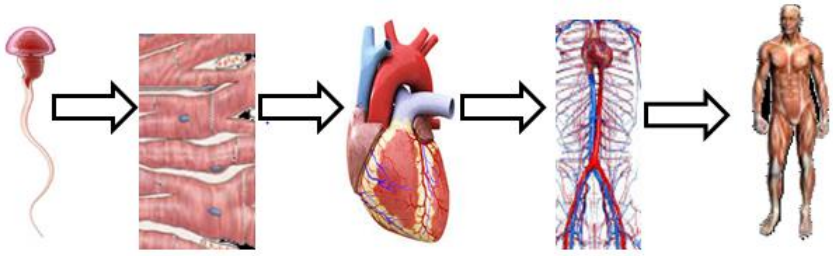


A	B	C	D	E

Figure 1.14

i. Make a flowchart to show the levels of organization in human body. [**Applying]**

Answer:



ii. Differentiate between Figure A and E. **[Understanding]**

Answer:

A	***E***
It is a tissue.	*It is a cell.*

iii. Mention one function of figure C. **[Remembering]**

Answer: *It pumps blood.*

CHAPTER 2
HUMAN AS ORGANISM

1. HUMAN DIGESTIVE SYSTEM

Learning Outcomes

At the end of the lesson, a student should be able to:

2.1.1 Draw and label the key structures of digestive system and state their functions,
2.1.2 Explain the process of digestion and
2.1.3 Tell the significance of the different organ systems.

Assessment Items

Question 1. **[Applying]**

The diagram below shows an incomplete sequence of digestive system.

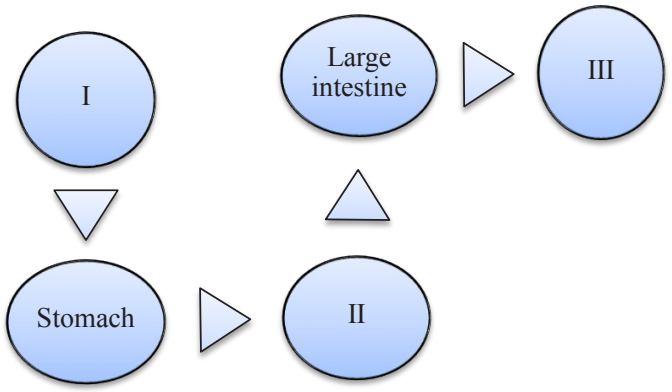


Figure 2.1

The correct sequence of organs in Figure 2.1 is

A I- esophagus, II – liver, III – anus
B I – mouth, II – small intestine, III – anus
C I – esophagus, II – anus, III – small intestine
D I – mouth, II – esophagus, III – small intestine

Answer: *B I – mouth, II – small intestine, III – anus*

Question 2. **[Remembering]**

Chemical digestion occur in all of the following **EXCEPT**

A esophagus.
B intestine.
C stomach.
D mouth.

Answer: *A esophagus*

Question 3. **[Analyzing]**

Which description best explains the parts marked A, B, C, D and E with the explanations given in the boxes numbered 1, 2, 3, 4 and 5 in Figure 2.2?

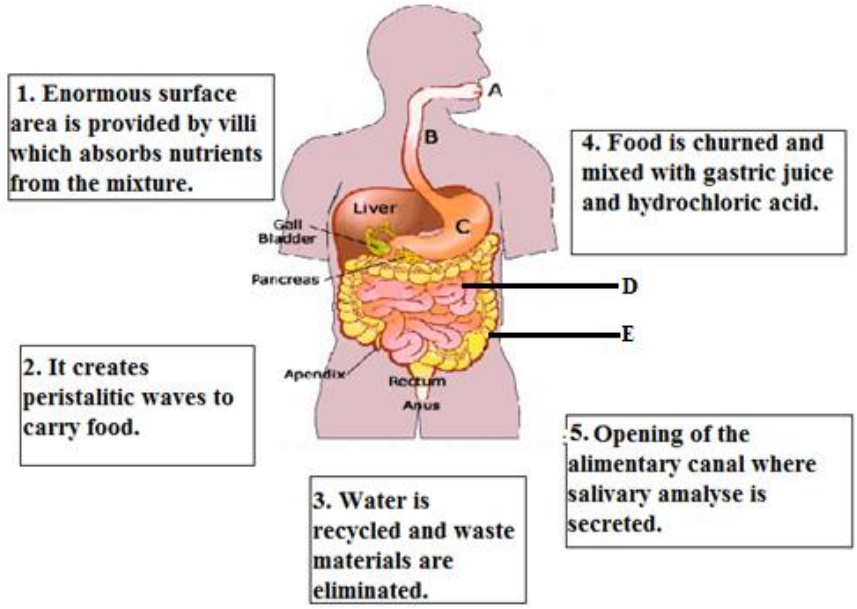


Figure 2.2

Answer*: A – 5 B – 2 C – 4 D – 1 E - 3*

Question 4. **[Analyzing]**

Read each statement given below and name the structures and substances.

1. I am the first organ involved in digestion. ……
2. I break food into pieces. ……
3. I mix food and help to make swallowing easier. ……
4. I roll the food to the back of the mouth. ……
5. I am a tube located between the mouth and the stomach. ……
6. I mix the food. ……..……
7. When digestive juices and food are mixed, they make me. ….……
8. I am 20 to 25 feet long and work to digest the food. ….……
9. The final stage of digestion takes place inside me. …..……
10. I am the exit for the undigested food. ……..…….

Answer: *1. Mouth 2. Teeth 3. Saliva 4. Tongue 5. Esophagus 6. Stomach 7. Chyme 8. Small intestine 9. Large intestine 10. Anus*

Question 5. **[Creating]**

Prepare a power point presentation of about seven slides on digestive system and present it in the class.

Question 6. **[Analyzing]**

Which of the following is the correct order of digestion process?

I The food gets stirred and churned with gastric juice and hydrochloric acid.
II The digested food is absorbed by villi and enters the blood stream.
III The food gets broken and moistened by salivary amylase.
IV The undigested food is removed from the body.
A I, III, IV, II
B III, IV, I, II
C II, IV, III, I
D III, I, II, IV

Answer: *D III, I, II, IV*

Question 7. **[Applying]**

Complete the table below using the appropriate terms.

Table 2.1

Organ	Digestive juices used	Function
1…….	Saliva	Chews and mixes the food with saliva.
Oesophagus	None	2. …….
Stomach	3. …….	It churns the food into liquid to form chyme.
Small intestine	Intestinal juice	4. ……
5. ……..	None	Absorbs water.

Answer: *1. Mouth 2. Peristalsis 3. Hydrochloric acid and gastric juice*
4. Absorbs nutrients from the digested food 5. Large Intestine

Question 8. **[Evaluating]**

"Among all the ten organ systems, the nervous system is the most important one".
Do you agree or disagree with the above statement? Justify with one point.

Answer: (Open ended)

- ✓ I agree because nervous system controls all the other systems.
- ✓ I disagree because nervous system depends on other systems to perform its own function.

Question 9. **[Creating]**

Use the knowledge of digestive system and complete the following story.
Once, all the organs held a meeting to nominate 'Mr. Most Important' organ. The major players; the heart and the brain claimed for the title and every organ supported. Other organs like the lungs, liver and stomach each had their say on their supremacy. Finally, after everyone had a turn, a timid voice was raised from the rear, "What about me?" It was the large intestine……

Answer: (Open ended*)*

Once, all the organs held a meeting to nominate 'Mr. Most Important' organ. The major players; the heart and the brain claimed for the title and every organ supported. Other organs like the lungs, liver and stomach each had their say on their supremacy. Finally, after everyone had a turn, a timid voice was raised from the rear, "What about me?" It was the large intestine.

Every organ looked at him and laughed. "What can you do better than us?", shouted the heart and the brain together. "Nothing", replied the large intestine and walked out. True to his words he quitted his job and did nothing.
Eventually things started getting uncomfortable and all the organs became sluggish and slimy. They realized the importance of the work done by the large intestine and begged him to resume his work.
Finally, the large intestine was conferred the title of "Mr. Most Important".

Question 10. **[Applying]**
Study the human digestive system given in Figure 2.3 and complete the passage given below.
.

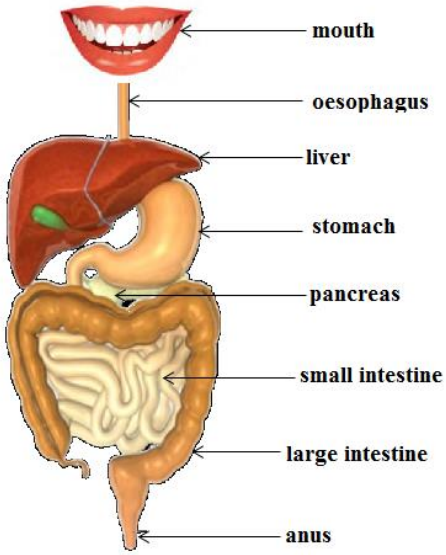


Figure 2.3 *(DCRD, VIII Science,Page 18)*

The …… (i)…… is a group of organs that work together to break down the food. Digestion begins as soon as food enters the …..(ii)…… The …… (iii)…… in the mouth helps in breaking the food into smaller particles. Saliva converts the starch into simpler form with the help of an enzyme called ……..(iv)…...
The food goes through…….. (v)…..before it reaches the stomach. Hydrochloric acid produced in the stomach converts the food into semi solid state called …… (vi) ….. After few hours the chyme moves into the …… (vii)…..The pancreas secretes pancreatic juice and the …….. (vii)…..secretes bile which further breaks down the food. Most of the digested food is absorbed in the small intestine with the help of fingerlike projections called …. (ix)……
The undigested food goes into the large intestine which is finally passed out of the body through the ……(x)…..

Answer: *i - digestive system ii – mouth iii –teeth iv-salivary amylase v-esophagus vi – chyme vii-small intestine viii-liver ix- villi x - anus*

Question 11. **[Applying]**

Imagine yourself as an organ and you are applying for the job vacancy announced in a prestigious organization called 'Human Body Organization'. Complete the resume given below.

Organ Application Form

Recent photograph of the organ applicant

i. Organ Name …….

ii. Applying to the position in [tick the system]

a. Respiratory system ☐

b. Digestive system ☐

c. Skeletal system ☐

d. Muscular system ☐

iii. Are you available for part time or full time job?

……..

iv. Which organs do you have experienced working with?

……

v. What skill do you have?

……

vi. Why should Human Body Organization hire you?

……

Answer: (Sample)

Organ Application Form.

Recent photograph of the organ applicant

i. Organ Name: Stomach

ii. Applying to the position in [tick the system]

a. Respiratory system ☐

b. Digestive system ✓

c. Skeleton system ☐

d. Muscular system ☐

iii. Are you available for part time or full time job?

Answer: *Full time.*

iv. What organs do you have experienced working with?
Answer: *Liver, pancreas, small intestine, esophagus.*

v. What skills do you have?
Answer: *I can churn and break the food into simpler forms by mixing with different digestive juices.*

vi. Why should Human Body Organization hire you?
Answer: *I have a major role in storing and breaking down the food particles. If I am not there, food particles cannot be changed into simpler form. As a result, cells will not get the required nutrients to carry out their cellular activities.*

2. MUSCLES, JOINTS AND MOVEMENTS

Learning Outcomes

At the end of the lesson, a student should be able to:

2.2.1 Draw and describe different types of muscles with examples and state their functions,
2.2.2 Explain the working of antagonistic muscles and
2.2.3 Describe different types of joints with examples and state their functions.

Assessment Items

Question 1. **[Remembering]**

The interaction of the skeletal and muscular systems help in locomotion. Which human body system coordinates it?

A Endocrine system
B Circulatory system
C Excretory system
D Nervous system

Answer: *D Nervous system*

Question 2. **[Remembering]**

Pema is a national football player, he practices the game from 6 am to 6pm and gets very limited time to rest. The muscle in his body that works without rest is the

A cardiac muscle.
B striated muscle.
C non-striated muscle.
D antagonistic muscle.

Answer: *A cardiac muscle*

Question 3. **[Applying]**

Which columns correctly describe the characteristics of the muscles given in Figure 2.4**?**

I II III

Figure 2.4

Table 2.2

I	II	III
• Striated • Elongated • Voluntary	• Striated • Branched • Voluntary	• Non-striated • Not branched • Involuntary

A I and II
B I and III
C II and III
D I, II and III
Answer: *B I and III*

Question 4. **[Applying]**
Re-arrange the jumbled letters given in the word bank and fill in the blanks appropriately.

Tnemagil	**ceptri**	**Denton**	**tristaed**

1. The connective tissue that connects two or more bones at the joint is ---------
2. Muscle is connected to bone by----------
3.When we lower the arm ----------muscle contracts.
4. The voluntary muscle with stripes is----------
Answer: *1.ligament 2. tendon 3. tricep 4. striated*

Question 5. **[Analyzing]**
The diagram below shows a part of a human body system.
The possible movement represented by the arrows in Figure 2.5 is coordinated by which pair?

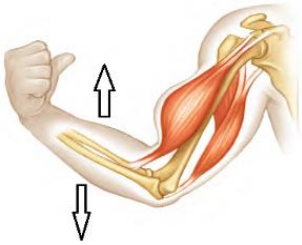


Figure 2.5

I circulatory system
II excretory system
III muscular system
IV skeletal system
A I and II
B II and III
C III and IV
D I and IV
Answer: *C III and IV*

Question 6. **[Understanding]**
Movement in human beings is produced by the combined action of the skeleton, muscles and tissues. Which of the following is a tough connective tissue that is attached to muscles which control the movement of the joints?
A ligament
B cartilage
C tendon
D nerve
Answer: *C tendon*

Question 7. **[Understanding]**
Does muscle help in pulling and pushing?
Answer: *Muscles can only pull by shortening in order to move a bone, a pair of muscles act in opposite direction.*

Question 8. **[Applying]**

When Norphel lifts the ball, the muscles in his arm move.

i. Complete the table:

Table 2.3

Step	Contracts	Relaxes
Step 1		
Step 2		

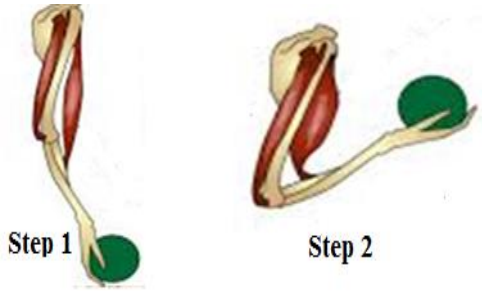


Figure. 2.6

Answer:

Step	*Contracts*	*Relaxes*
Step 1	*Triceps*	*Biceps*
Step 2	*Biceps*	*Triceps*

ii. The contracting and relaxing muscles together are called antagonistic muscles. Explain why the muscles in step 1 and 2 are antagonistic muscles.

Answer: *The contracting and relaxing muscles are called antagonistic muscles because one muscle opposes the action of another.*

Question 9. **[Understanding]**

Figure 2.7 shows

A pivot.

B hinge joint.

C gliding joint.

D ball and socket.

Answer: *D ball and socket*

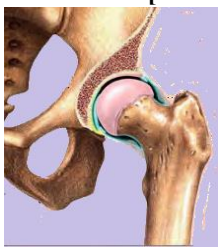


Figure 2.7

Question 10. **[Applying]**

Identify the type of joint labelled A to D in Figure 2.8.

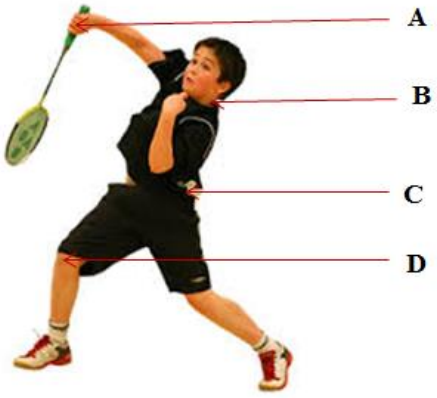


Figure 2.8

Answer: *A Gliding joint* *B Pivot joint*
C Ball and socket joint *D Hinge joint*

Question 11. **[Applying]**

Study the model of a joint given in Figure 2.9 and identify the type of movable joint.

A pivot joint
B hinge joint
C gliding joint
D ball and socket joint

Answer: *A pivot joint*

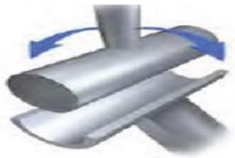
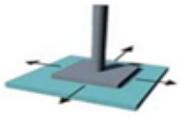
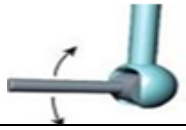
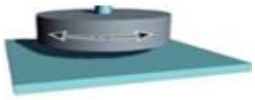
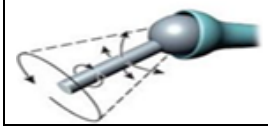


Figure 2.9

Question 12. **[Applying]**

Study table 2.4 below and match the models in column I with the human joints in column II.

Table 2.4

Column I	Column II
1. 	a. 
2. 	b. 
3. 	c. 
4. 	d. 
	e. 

Answer: *1 – b 2 – e 3 – a 4 - c*

3. THE HUMAN RESPIRATORY SYSTEM

Learning Outcomes

At the end of the lesson, a student should be able to:

2.3.1 Explain the role of lungs in the gaseous exchange,
2.3.2 Explain the effects of smoking on health, family and economy and
2.3.3 Compare anaerobic respiration in plants with that of animals.

Assessment Items

Question 1. **[Analyzing]**

Green plants help to purify the air. Which organ does it correlate with in our body?

A heart
B lungs
C ears
D eyes

Answer: *B lungs*

Question 2. **[Applying]**

Figure 2.10 represents a magnified view of an air sac in the human lung. The parts labelled I and II inside the capillary indicate

A I- oxygenated blood, II- oxygenated blood.
B I- deoxygenated blood, II- deoxygenated blood.
C I– oxygenated blood, II – deoxygenated blood.
D I – deoxygenated blood, II – oxygenated blood.

Answer: *C I– oxygenated blood, II – deoxygenated blood*

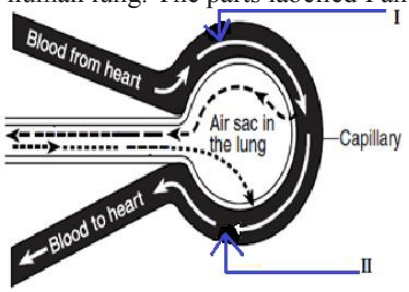


Figure 2.10

Question 3. **[Applying]**

Figure 2.11 shows a portion of an air sac in the human lungs. Which of the labelled part contains higher concentration of Oxygen?

A Q
B X
C Y
D Z

Answer: *C Y*

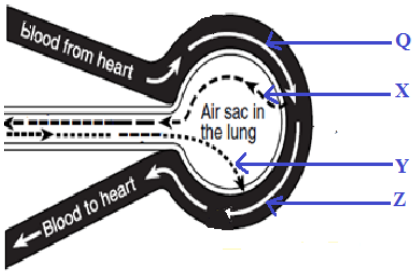


Figure 2.11

Question 4. **[Understanding]**

Which reaction summarizes the process of respiration?

A $H_2O + CO_2 + energy \longrightarrow C_6H12O_6 + O_2$

B $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 38$ ATP

C $6CO_2 + 6O_2 + 6H_20 \longrightarrow C_6H_{12}O_6 + 38$ ATP

D $C_6H_{12}O6 + CO_2 + energy \longrightarrow 6O_2 + H_2O$

Answer: *B* *$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 38$ ATP*

Question 5. **[Remembering]**

Kinley is a chain smoker. Which body system would be mostly affected?

A nervous system

B digestive system

C respiratory system

D circulatory system

Answer: *C* *respiratory system*

Question 6. **[Analyzing]**

Give an analogy for the following pairs:

I Alcohol : Liver : Cigarette:----------

II Alveoli : Gas exchange: Trachea: ----------

Answer: *I Lungs* *II Air passage*

Question 7. **[Evaluating]**

"……..The tobacco control Act 2010 does not allow sale of any form of tobacco product in Bhutan and the 82nd session banned the sale of tobacco throughout the country. It was also resolved that a 100 percent duty would be levied on all products being brought into the country for personal consumption……..." (***Kuenselonline June 1st, 2015)***

Do you think banning of tobacco in our country is the right decision made by our government to reduce tobacco related diseases? Justify with one point.

Answer: Open ended (Sample answer)

- ✓ *Yes, because it will prevent the people getting tobacco related diseases.*
- ✓ *No, this is not the right decision because even if people do not take tobacco they suffer from respiratory diseases. Air pollution can also lead to such diseases. Moreover, there are substances containing tobacco products available in market which equally affect the health of people.*

Question 8. **[Remembering]**

The numbers of ATP molecules produced during anaerobic and aerobic respiration are

A 2 and 38.

B 4 and 38.

C 6 and 38.

D 8 and 38.

Answer: *A* *2 and 38*

Question 9.
The following pie chart shows the annual expenditure made by Sonam from his salary. Study the pie chart to answer the following questions.

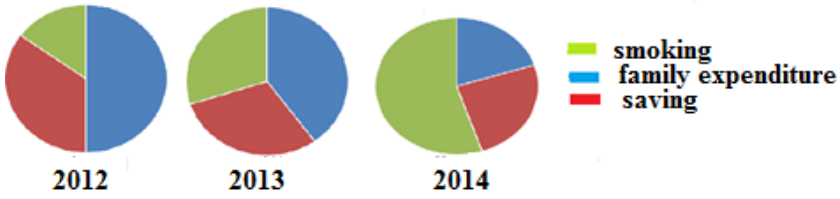


Figure 2.12

i. With reference to Figure 2.12, list two effects of smoking on Sonam. **[Understanding]**
Answer: *His saving and expenditure on family decreases.*

ii. What conclusion can you draw about Sonam's smoking behaviour from the above pie-chart**?** **[Analyzing]**
Answer: *It shows that Sonam is getting addicted as his expenditure on smoking is increasing.*

iii. Write one effect of smoking which is not shown by the pie-charts? **[Applying]**
Answer: *Smoking is very harmful to our health. It can damage our lungs.*

Question 10. **[Understanding]**
Dechen ran a marathon to commemorate 60th birth anniversary of 4th Druk Gyalpo. She experienced a cramp and fatigue in her leg. This is due to the accumulation of
A carbon dioxide.
B lactic acid.
C ethanol.
D heat.
Answer: *B lactic acid*

Question 11. **[Remembering]**
Which of the following is the correct order of the stages of respiration?
A I-gaseous transport, II-breathing, III-tissues, IV-cells
B I-breathing, II-gaseous transport, III-tissues, IV-cells
C I- breathing, I-gaseous transport, III-cells, IV-tissues
D I-breathing, I-tissues, III-cells, IV-gaseous transport
Answer: *B I-breathing, II-gaseous transport, III-tissues, IV–cells*

Question 12.

Karma baked bread using flour, sugar, milk, butter, egg and yeast. His bread was moist and fluffy.

Figure 2.13

i. Which ingredient increased the volume of the bread? **[Understanding]**

Answer: *Yeast*

ii. Why do we see holes in the bread? **[Applying]**

Answer: *In bread making, yeast is added to the flour, water and salt to make dough and allowed to stand for some time before baking. Due to fermentation, the yeast undergoes anaerobic respiration producing carbon dioxide inside the dough increasing the volume of the dough, as it forms bubbles inside. When the dough is baked, the bubbles expand and 'blow up' the bread, leaving holes in the bread.*

4. FERTILIZATION AND DEVELOPMENT OF FOETUS

Learning Outcomes

At the end of the lesson, a student should be able to:

2.4.1 Explain the processes involved from fertilization to birth and
2.4.2 State the importance of safety, hygiene and health during pregnancy.

Assessment Items

Question 1. **[Understanding]**

Figure 2.14 represents a fetal development.
The function of structure A is to

A provide nutrients to the foetus.
B supply nutrients and oxygen to the foetus.
C act as a shock absorber and protect the embryo from damage.
D carry carbon dioxide and waste materials away from the foetus.

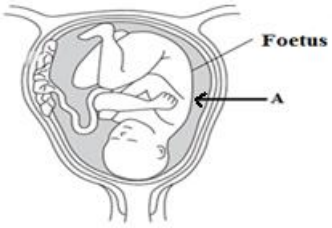


Figure 2.14

Answer: *C act as a shock absorber and protects the embryo from damage*

Question 2. **[Remembering]**

Which reproductive organ is correctly paired with its function?

A Uterus – site for fertilization
B Testis – production of sperm
C Placenta – location of egg development
D Fallopian tube – development of embryo

Answer: *B Testis – production of sperm*

Question 3. **[Analyzing]**

Pregnant woman get tired very easily, so she must

A drink enough fluid.
B visit health centers frequently.
C take frequent naps during the day.
D keep herself active throughout the day.

Answer: *C take frequent naps during the day*

Question 4. **[Analyzing]**

Which of the following should a pregnant woman avoid?

A Food rich in protein, carbohydrate and fat.
B Smoking cigarettes and skipping meals.
C Having adequate medical supervision.
D Going for a walk and staying fit.

Answer: *B Smoking cigarettes and skipping meals.*

Question 5. **[Applying]**

Which diagram best illustrates an event in sexual reproduction that would most directly lead to the formation of a human embryo?

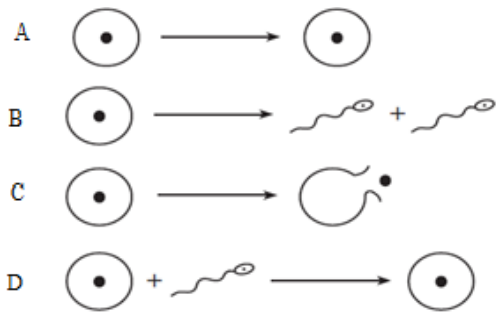
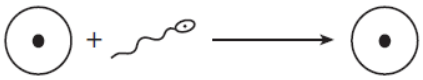


Figure 2.15

Answer: D 

Question 6. **[Applying]**

The diagram below shows information about the reproduction and development of a rabbit. Which number in Figure 2.16 represents fertilization?

A I
B II
C III
D IV

Answer: *C III*

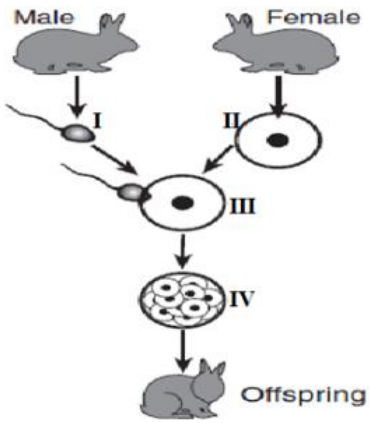


Figure 2.16

Question 7. **[Evaluating]**

'The Parliament of Bhutan increased the three-month paid maternity leave to six months in December 2015'. Is this a good decision? Argue the above statement.

Answer: (Sample)

Yes, longer maternity leave will create less maternity problems. The child can be brought up by the mother who would take the best possible care. It would provide favorable conditions for breast feeding giving opportunity to exclusive breast feeding for six months. Breast feeding promotes health of the individual significantly which contributes to economic development as it lowers the investment on health. It also decreases maternal morbidity and child mortality.

No, it will create a lot of problem as there will be acute human resource shortage. Paid maternity leave will be very expensive for the country. If this policy is applied for private or informal sectors,

gender preference will prevail women which will worsen the already low women employment rate in the country.

Question 8. **[Creating]**

Design a poster to create awareness regarding the health and safety of a pregnant woman.

Question 9. **[Applying]**

Figure 2.17 shows the human female reproductive system.

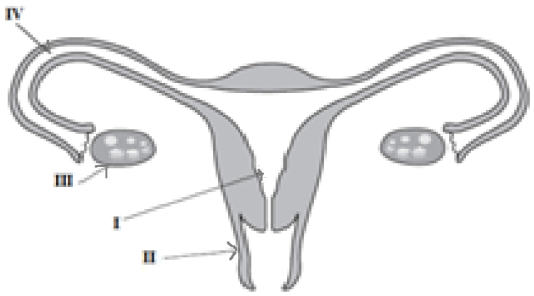


Figure 2.17

Which structure is correctly matched with its function?

A I – location for fertilization
B II - nourishes a developing embryo
C III – produces and releases eggs
D IV – deposits sperm during sexual intercourse

Answer: *C III – produces and releases eggs*

Question 10.

Figure 2.18 represents a model of sexual reproduction in humans. Two stages are labeled **A** and **B.** Answer question (i) and (ii) based on the diagram.

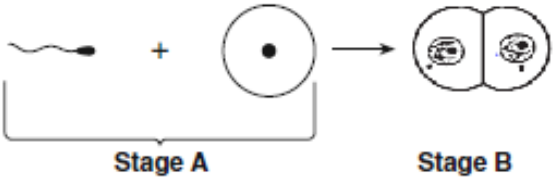


Figure 2.18

i. Identify the cells represented at stage *A*. **[Understanding]**

Answer:  *Sperm/male sex cell*

 *Egg/female sex cell*

ii. Identify the cell represented at stage B. **[Understanding]**

Answer: *Fertilized egg/zygote*

5. SENSE ORGANS

Learning Outcomes

At the end of the lesson, a student should be able to:

2.5.1 Describe the structure of an eye and their functions,
2.5.2 Describe the structure of an ear and their functions,
2.5.3 Identify the types of taste receptors and their functions,
2.5.4 Describe the structure of nose and skin and state their functions and
2.5.5 State the measures of taking care of our sense organs.

Assessment Items

Question 1. **[Remembering]**

When a person sees an object, the message from the eye is carried to the brain by

A arteries.
B glands.
C nerves.
D veins.

Answer: *C nerves*

Question 2.

Two human sense organs shown in Figure 2.19 perform several functions for the whole organism. Choose either diagram ① or ② and answer questions (i), (ii) and (iii).

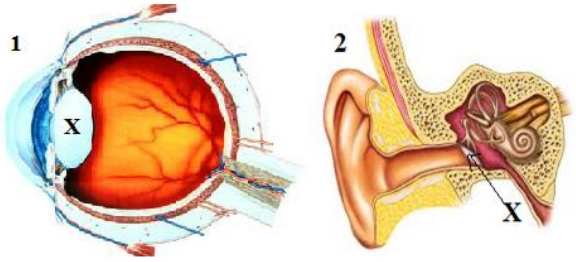


Figure 2.19

i. Name the organ that you have chosen and write what sense it stimulates**. [Remembering]**

Answer: *1 Eye -Sense of seeing OR 2 Ear – Sense of hearning.*

ii. Identify the part **X** and write one function. **[Applying]**

Answer: *1 Lens - To focus light on the retina.*

OR

2 Ear drum/trumpanic membrane– Receives the sound waves and causes vibrations.

iii. What would happen if **X** is damaged? **[Analyzing]**

Answer: *1- When X is damaged, light cannot be focussed on the retina. As a result the image formed will not be clear. OR*

2 - When X is damaged, there will be no vibration. As a result the sense of hearing will be lost.

Question 3.

Study Figure 2.20 of the human eyes and answer the questions that follow.

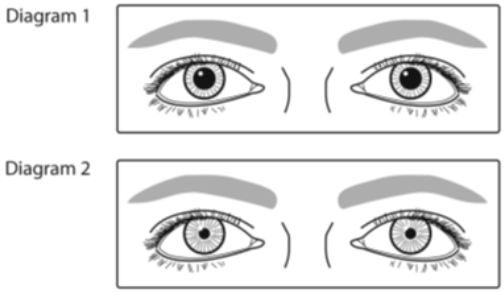


Figure 2.20

i. What is the environmental condition in each diagram? **[Analyzing]**

Answer: *Diagram 1 is exposed to dim light.*
Diagram 2 is exposed to bright light.

ii. Mention one difference between diagram 1 and diagram 2. **[Understanding]**

Answer: *In diagram 1 the pupil is dilated and in diagram 2 the pupil is constricted.*

iii. What does the pupil facilitate?**[Remembering**]

Answer: *The pupil regulates the amount of light entering the eye.*

Question 4. **[Remembering]**

Write **TRUE** or **FALSE** against each statement.

1. Human eyes can distinguish only four colours.
2. The yellow spot is the area of best vision.
3. The outermost layer of my eye is called choroid layer.
4. My ears help in hearing only.
5. Ears are divided into three parts.

Answer: *1-Fasle 2-True 3-False 3-False 5-True*

Question 5. **[Understanding]**

The receptor that is sensitive to taste and smell is

A mixed
B motor
C sensory
D olfactory

Answer: *D olfactory*

Question 6. **[Understanding]**

Study the pictures given in Figure 2.21 and name the sense organ mostly involved to carry out each activity.

Figure 2.21

Answer: *1 – Eye 2 – Ear*
3 – Tongue 4 – Nose

Question 7. **[Applying]**

Study Figure 2.22 and write the correct names of the structures in the blank spaces.

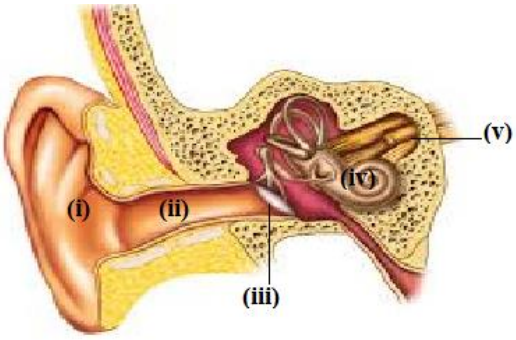


Figure 2.22

Sound waves are vibrations of air particles. As these vibrations strike the outer ear, the … (i)…., funnels and amplifies them, sending them down the ear canal. At the end of the …… (ii)…..the vibrations move and vibrate the ……(iii)….. The …..(iv)….., converts the vibrations to nerve impulses which move to the brain along the …..(v)……. nerve where the sound is interpreted.

Answer: *(i) pinna (ii) auditory canal (iii) tympanic membrane (iv) cochlea (v) auditory*

Question 8. **[Understanding]**

What is the advantage of having two ears?

Answer: *By having two ears we can tell the distance and direction of the sound.*

Question 9. **[Evaluating]**

People use different brands of creams to keep their skin healthy. Do you think it will help? Justify with one point.

Answer: (Open ended)

- ✓ *Yes, because the ingredients of a cream provide a range of benefits to the skin that keeps our skin healthy.*
- ✓ *No, because eating fresh fruits and vegetables can keep our skin healthy.*

Question 10. **[Applying]**

Dawa carried out an experiment using the following materials.

✓ 4 cups containing salt, sugar, lemon juice, instant coffee and tooth picks

He used toothpicks to apply lemon juice to the tip, back and sides of the tongue and repeated the procedure for the other three items. Table 2.5 shows the result obtained from the experiment

Table 2.5

Items	Tip	Back	Sides
Sugar	✓		
Salt			✓
Coffee		✓	
Lemon juice			✓

i. What is the aim of the experiment?

Answer: *To find out locations of different taste buds.*

ii. What do you conclude from the above experiment?
Answer: *We can conclude that different taste buds are located in different region of the tongue.*

iii. Using figure 2.23 given below, label the location of taste buds 1, 2, 3 and 4.

Answer: *1 - bitter 2 – sour*
3 – salty 4- sweet

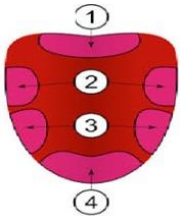


Figure 2.23

Question 11. **[Analyzing]**
Is taste independent from smell?
Answer: *No, the olfactory cells in the nose work with the tasting sensors in the mouth.*

Question 12. **[Analyzing]**
Match the structure in column I against its function in column II after identifying the correct matching pairs.
Table 2.6

Column I	Column II
1. Nasal cavity	a. Passage of air from nose to throat
2. Olfactory cells	b. Respond to the odour
3. Olfactory nerve	c. Receive the stimuli of odour
4. Nasopharynx	d. Carry message to the brain
	e. Filter the air

Answer: *1(e) 2(c) 3(d) 4(a)*

Question 13. **[Understanding]**
A change in an environment parameter that generates a response is
A touch.
B olfactory.
C stimulus.
D labyrinth.
Answer: *C stimulus*

Question 14. **[Remembering]**
Nasal cavity is linked with
A tympanum.
B mucous membrane.
C basilar membrane.
D corneous membrane.
Answer: *B mucous membrane*

Question 15. **[Applying]**

Complete the flow chart given in Figure 2.24.

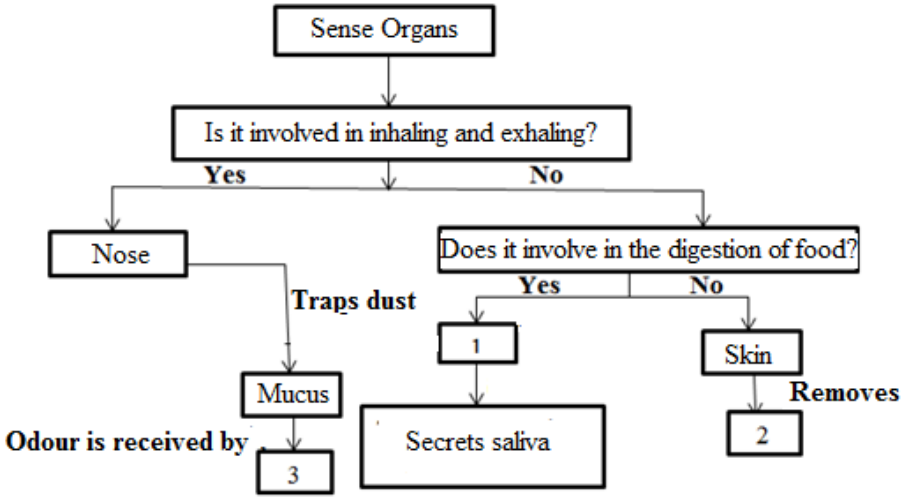


Figure 2.24

Answer: *1-Tongue* *2- Metabolic wastes* *3-Olfactory cells*

Question 16. **[Remembering]**

Which among the following is the largest sense organ?

A eyes
B nose
C ears
D skin

Answer: *D* *skin*

Question 17. **[Applying]**

Write the function of the part numbered 1, 2, 3 and 4

Answer:

1 Epidermis - forms new cells through cell division.
2 Dermis - provides flexibility and strength to skin.
3 Sebaceous gland - secretes oil.
4 Sweat gland - secretes sweat.

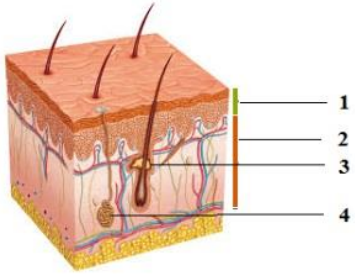


Figure 2.25

6. ENVIRONMENT, LIFESTYLE AND HEALTH

Learning Outcomes

At the end of the lesson, a student should be able to:

2.6.1 Explain how various environmental factors, unhealthy habits and lifestyles affect our health and

2.6.2 Explain the importance of healthy lifestyle to maintain good health, families and community.

Assessment Items

Question 1. **[Understanding]**

Figure 2.26 shows a concept map on diseases caused by pollution.

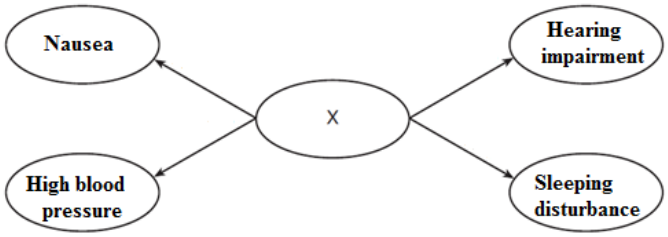


Figure 2.26

What does X best represent?

A water pollution
B land pollution
C sound pollution
D environment pollution

Answer: *C sound pollution*

Question 2. **[Understanding]**

Each year many Bhutanese are diagnosed with pharyngeal cancer or pre-cancerous lesions. The major cause of this is due to

A smoking.
B alcohol.
C doma.
D drugs

Answer: *C doma*

Question 3. **[Understanding]**

Which of these daily acts can most directly reduce air pollution in the city?

A recycling papers
B using private cars
C using public transport
D using bio-degradable materials

Answer: *C using public transport*

Question 4. **[Understanding]**

Case Study

"……the Meuse Valley in Belgium contains many farms, villages, steel mills, factories and chemical plants. Its main claim to fame is an 80 year old mystery, still the subject of speculation today.
Early in December of 1930 a thick fog lay over much of the country. Over three days, from December 2 through December 5, many people who lived in the Meuse Valley complained of nausea, difficulty breathing, stinging eyes, and burning throats. By the end of the three days, 60 people had died and thousands more were ill with an unknown "disease."……."

(***Source:www.vcapcd.org/air the film/pubs)***

Referring to the above complaints, which among the following disease is suspected by doctor?

A cholera
B emphysema
C liver cirrhosis
D genetic damage

Answer: *B emphysema*

Question 5. **[Creating]**

"...Yet we believe you cannot have a prosperous nation in the long run that does not conserve its natural environment or take care of the wellbeing of its people, which is being borne out by what is happening to the outside world. GNH is an aspiration, a set of guiding principles through which we are navigating our path towards a sustainable environment ..."

(Lyonpo T.S. Powdel)

Develop a strategic plan which would contribute towards conserving the environment sustainably.

Answer: (Sample)

- ✓ *Make green plan – Plant and save trees, proper waste management, and plant trees on the birthday of child instead of distributing sweets in the school.*

Question 6. **[Creating]**

The focus of Bhutan's waste management and recycling firm 'Greener Way' has made positive impact on managing waste. However, the community still needs education on waste management. Support Greener Way by drawing strategies to create awareness in the community?

Answer: (Sample)

- ✓ *Segregate bio-degradable from non-degradable waste.*
- ✓ *Campaign and educate people on proper waste management.*
- ✓ *Promote 3Rs (Reduce, Reuse and Recycle*)

Question 7.
The graph below shows the carbon emission of two cities. With reference to the graph, answer the following questions.

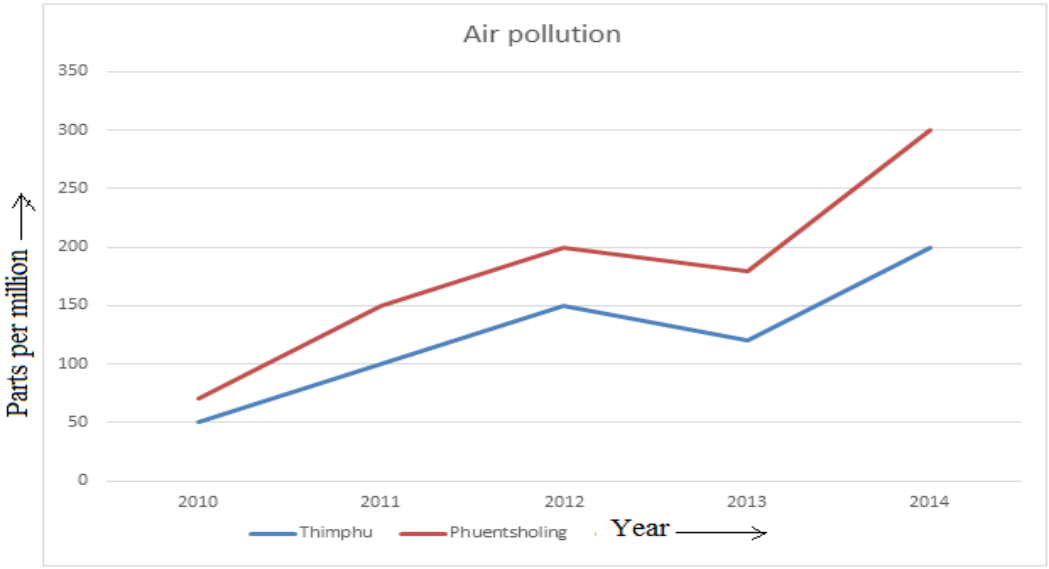


Figure 2.27

i. Name the city which is more polluted? **[Understanding]**
Answer: *Phuentsholing*

ii. What could be the reason for the fall of air pollution in the year 2013? **[Analyzing]**
Answer: (Suggestive)
Government banned the import of vehicles.

iii. Write any two impacts of pollution on environment. **[Applying]**
Answer: (Suggestive)

- ✓ *It increases the temperature causing global warming.*
- ✓ *Contaminates water killing aquatic plants and animals.*
- ✓ *Contaminates soil reducing crop yields and affecting ecosystem.*

iv. The Thrompons of Thimphu and Phuentsholing want to plant trees around the city to reduce air pollution. Do you think it's a good idea? Justify your answer with one point.
Answer- (Open ended)

- ✓ *Yes, because trees help to absorb carbon dioxide.*
- ✓ *No, because people can use public transport services, walk to office or use bicycles to avoid air pollution.*

Question 8.
Look at Figure 2.28 and answer questions (i), (ii) and (iii)

Figure 2.28

i. Identify the type of pollution shown above. **[Understanding]**
Answer: *Water pollution*

ii. Explain three human activities that contribute to such type of pollution? **[Understanding]**
Answer: (Sample)
Industrialization, inorganic farming and sewerage.

iii. State three impacts of the form of pollution shown in the picture. **[Applying]**
Answer: (Sample)
Water pollution can be toxic to aquatic life and can affect the rest of the food chain. This means that the entire biological community can badly get affected and our drinking water can get contaminated too.

CHAPTER 3
GREEN PLANTS

1. ABSORPTION BY ROOTS

Learning Outcomes

At the end of the lesson, a student should be able to:

3.1.1 Draw and identify different parts of the two main types of root systems,
3.1.2 Explain the absorption of water and minerals by root hairs,
3.1.3 Carry out an experiment to demonstrate osmosis and diffusion and
3.1.4 Tell the applications of osmosis and diffusion in our daily life.

Assessment Items

Question 1. **[Remembering]**

The first root that emerges from a seed is called

A taproot.
B root hair.
C primary root.
D secondary root.

Answer: *C primary root*

Question 2. **[Understanding]**

Which of the root systems labelled as X and Y given in Figure 3.1 is present in the following pairs of plant?

Figure 3.1

Table 3.1

	X	Y
A	Banana	Radish
B	Chilli	Paddy
C	Wheat	Peach tree
D	Grass	Carrot

Answer: *B (X) Chilli (Y) Paddy*

Question 3. **[Understanding]**

The main difference between a taproot system and a fibrous root system is

A fibrous roots can access water sources deep under the ground, while taproots cannot.
B fibrous roots have an epidermal cell layer, while taproots do not.
C tap roots can store a lot of food, while fibrous roots do not.
D tap roots absorb water, while fibrous roots cannot.

Answer: *C tap roots can store a lot of food, while fibrous roots do not*

Question 4. **[Applying]**

Leekzin carried out an experiment on osmosis using potato osmoscope. She observed a rise in the water level inside the cavity of potato osmoscope. This is due to the

I high concentration of water inside the osmoscope.
II low concentration of water inside the osmoscope.
III low concentration of water outside the osmoscope.
IV high concentration of water outside the osmoscope.
A I and II
B II and IV
C III and IV
D I and IV

Answer: *B II and IV*

Question 5. **[Applying]**

What phenomenon is displayed by Figure 3.2?

A Osmosis
B Diffusion
C Plasmolysis
D Active transport

Answer: *B Diffusion*

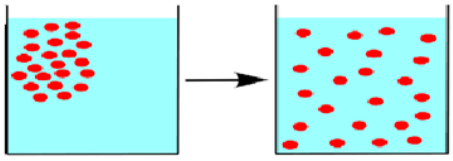


Figure 3.2

Question 6. **[Analyzing]**

While conducting an experiment, Rigden added saline water to a pot with a tomato plant. The plant wilted after 15 minutes. Based on the above observation answer the following questions:

i. What caused the tomato plant to wilt?

Answer: *Osmosis*

ii. Explain the phenomenon that is observed in the experiment. **[Understanding]**

Answer: *The concentration of water surrounding the plant is lower than the concentration of water inside the plant. Due to this the water molecules move from their region of higher concentration to their region of lower concentration.*

iii. What can he do to avoid wilting of the plant? **[Applying]**

Answer: *He can add more water which will dilute the concentration of salt.*

Question 7. **[Analyzing]**

The diagram below shows the process of osmosis.

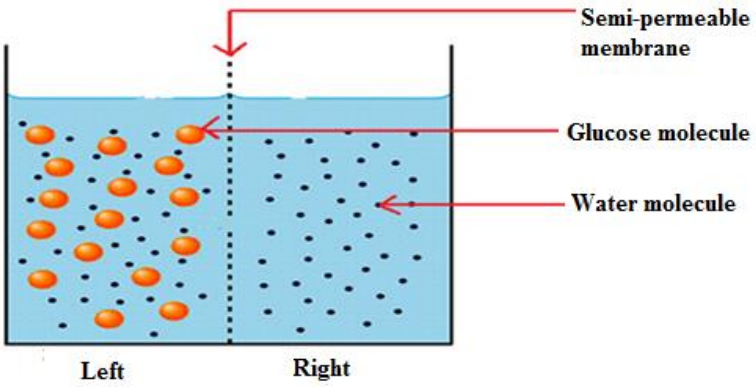


Figure 3.3

Which one of the following will occur?

A Glucose molecules will move to left.
B Water molecules will move to left.
C Water molecules will move to right.
D Glucose molecules will move to right.

Answer: *B* *Water molecules will move to left.*

Question 8. **[Analyzing]**

Figure 3.4 shows a specialized cell located in the root of a plant. The arrows in the diagram indicate the movement of water and mineral ions into the cell.

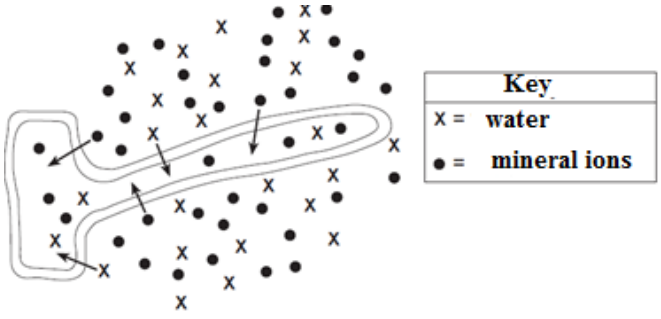


Figure 3.4

Which of the following identifies the process responsible for the movement of each type of molecule?

Table 3.2

	Water	**Mineral ions**
A	diffusion	osmosis
B	osmosis	active transport
C	active transport	diffusion
D	active transport	active transport

Answer: *B* *osmosis* *diffusion*

Question 9. **[Analyzing]**

Table 3.3 shows the factors that influence the rate of diffusion. Which of the following is correct?

Table 3.3

	I	II	III	
Factors	Temperature ↑	Size of particles ↑	Concentration gradient ↑	Key word ↑ - Increases
Process	Diffusion ↑	Diffusion ↑	Diffusion ↑	

	Column I	Column II	Column III
A	True	True	False
B	True	False	True
C	False	True	True
D	False	True	False

Answer: *B I-True II –False III-True*

Question 10. **[Understanding]**

When Thukten went for evening walk he smelt sweet fragrance of flowers. Which process causes this phenomenon?

A Diffusion
B Osmosis
C Plasmolysis
D Active transport

Answer: *A Diffusion*

Question 11. **[Analyzing]**

Classify the following daily activities related to diffusion and osmosis in the table given below.

Table 3.4

Stirring sugar into the coffee	Process of breathing
Absorption of water by roots	Dialysis in kidney failure
Spreading of the aroma of cookies while baking	

Answer:

Osmosis	***Diffusion***
Absorption of water by roots	*Spreading of the aroma of cookies while baking*
Dialysis in kidney failure	*Stirring sugar into the coffee*
	Process of breathing

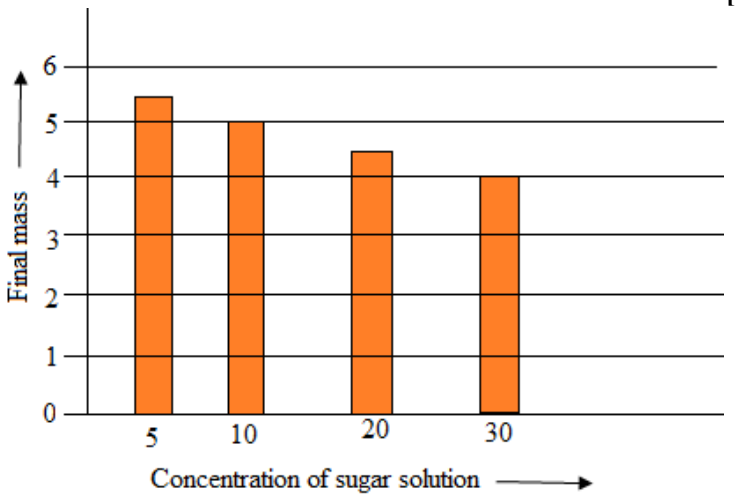
Question 12.
An experiment was conducted to determine the concentration of cell sap in potato.
The following are the procedures.
Step 1 – Four different concentrations of sugar solutions were added to four different test tubes as shown in the data table 3.5 below.
Step 2 - Four potato discs (made from the same potato) were weighed and one disc was added to each test tube.
Step 3 – After twenty four hours the potato discs were removed, blotted dry and weighed again.

Table 3.5

Test tube	Sugar solution %	Initial mass (g) of potato disc	Final mass (g) of potato disc
1	30	5	4.0
2	20	5	4.5
3	10	5	5.0
4	5	5	5.5

i. Define the process that caused the change in mass of potato discs. **[Understanding]**
Answer: *Osmosis – It is the process in which water molecules move from its higher concentration to its lower concentration through a semi permeable membrane.*

ii. Draw a graph to show the concentration of sugar solution and the final mass of the potato. Plot the concentration of sugar solution on X-axis and final mass of potato disc on Y-axis.
Answer: **[Applying]**



iii. Explain the change in mass of potato in test **tube 1** and test **tube 4**. **[Analyzing]**
Answer: ***In test tube 1****, the concentration of sugar solution is higher than the cell sap of potato, as a result water molecules from the potato move out decreasing the mass of potato disc.*
In test tube 4*, the concentration of sugar solution is lower than the cell sap of potato, as a result water from the surrounding move inside the potato disc leading to the increase in mass.*

2. ORGANIC AND INORGANIC FARMING

Learning Outcomes

At the end of the lesson, a student should be able to:

3.2.1 Distinguish between organic and inorganic farming,
3.2.2 Explain different methods of organic farming,
3.2.3 Name some of the common chemical fertilizers,
3.2.4 Explain advantages and disadvantages of organic as well as inorganic farming and
3.2.5 Explain how inorganic farming and organic farming can affect soil health.

Assessment Items

Question 1. **[Applying]**

AumYangsel has a huge maize field. She noticed her maize leaves turning yellow. Which fertilizer should she use in the succeeding year in order to get rid of the yellowing of leaves?

A Urea
B Potash
C Suphala
D Super phosphate

Answer: *A* *Urea*

Question 2. **[Understanding]**

The sacks of inorganic fertilizer contain varying ratios of Nitrogen, Phosphorus and Potassium.

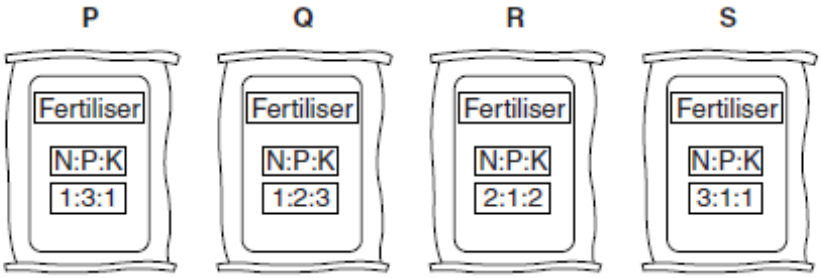


Figure 3.5

Which sack has the highest proportion of potassium?

A P
B Q
C R
D S

Answer: *B* *Q*

Question 3. **[Remembering]**
From the following, which has the highest source of nitrogen?
A ammonium nitrate
B ammonium sulphate
C ammonium polyphosphate
D urea
Answer: *D urea*

Question 4.
Ap Kuenzang has a piece of land and he wants to use it for the cultivation of cereal crops. He takes only one sample of soil from the middle of his field and carries out a test to find the pH of the soil. Figure 3.6 shows the result of the test.

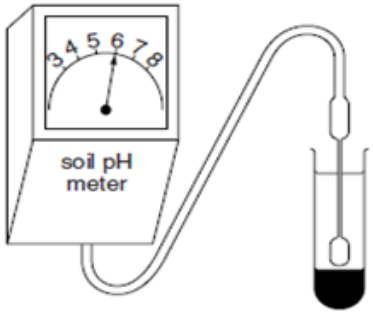


Figure 3.6

i. What is the nature of the soil sample? **[Remembering]**
Answer: *It is slightly acidic.*

ii. Explain why the farmer should take multiple soil samples from his field. **[Analyzing]**
Answer: *To have more knowledge on the type of soil so that ideal plants can be grown in each soil type.*

iii. Suggest one way to increase the pH of the soil in the field before planting his crops. **[Applying]**
Answer: *By adding lime.*

Question 5. **[Analyzing]**
Ap Kinley constructed a pond where he cultured fish. The fishes mostly ate algae (microscopic green plant floating on the surface of pond).
i. He adds a small quantity of animal manure to the pond. Why?
Answer: *Adding a small amount of manure will promote the growth of algae so that fishes can eat algae as food.*

ii. If too much manure is added to the pond what will happen to the fish? Why?
Answer: *The fish will die due to eutrophication which arises from the over-supply of manure. This induces explosive growth of plants and algae. When such plants and algae die bacteria decay them using oxygen from the water thereby creating shortage of oxygen for the fishes leading to suffocation and death.*

Question 6.
Figure 3.7 shows a type of pest control method in organic farming.
i. Identify the type of pest control. **[Understanding]**
Answer: *Biological pest control.*

Figure 3.7

ii. Which type of farming do you prefer, organic or inorganic? Justify with one point. **[Evaluating]**
Answer: *I prefer organic farming because it is free of chemicals.*
I prefer inorganic farming because it gives more yields on less land.

Question 7.

Figure 3.8 shows the root of a plant which is often used for crop rotation.

i. Name the part labelled **X**. **[Remembering]**

Answer: *Root nodules*

ii. Explain how this type of root increases the fertility of soil? **[Understanding]**

Answer: *Root nodules contain Rhizobium bacteria capable of fixing atmospheric nitrogen into soluble nitrates in the soil.*

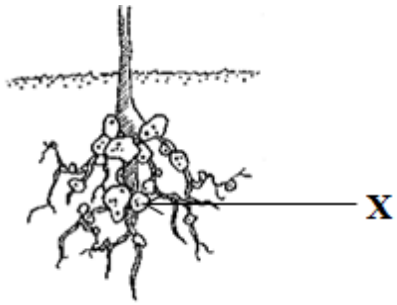


Figure 3.8

Question 8 **[Applying]**

Figure 3.9 shows some common vegetables grown by our farmers. Each vegetable require an ideal soil pH for its proper growth. Identify the following vegetables that grow in acidic and basic soil.

Figure 3.9

Answer:

Acidic soil	***Base soil***
	

Question 9. **[Evaluating]**

Modern fertilizer consists of varying amounts of nitrogen, phosphorus and potassium. These three are believed to be essential for plants to grow. This is why farmers spread fertilizer on their field, to replace the nutrients lost. It is certainly not the ideal and sustainable way to farm but it is thought to be the most efficient for large scale farms whereas strategies like crop rotation and allowing large field to rest would cut too deep into profit that are based on quantity, opposed to quality.

(www.OrganicConsumer.org)

After reading the above article do you think Bhutanese farmers should use chemical fertilizer? Justify with one point.

Answer: (Sample)

Yes, in order to increase the crop yield and for our country to be self sufficient in food, crop cultivation requires large quantities of nutrients which can be fortified to the soil only through the use of chemical fertilizers. Moreover chemical fertilizers are easily available and can be directly used for immediate result. Farmers can benefit financially from exporting their produce. No, use of chemical fertilizer depletes the nutrients in the soil as they change the texture and soil pH. It also pollutes the environment.

Question 10. **[Applying]**

Pesticides and fertilizers can help farmers to produce more crops. However, over use of these chemicals result in

I fluctuation in the pH of the soil
II ecological succession
III selective breeding
IV eutrophication
A I and II.
B I and III.
C II and IV.
D I and IV.

Answer: *D I and IV*

Question 11. **[Evaluating]**

Conduct a debate in the class on the topic 'Organic farming is better than inorganic farming'.

Answer: (Opened ended - sample answer)

- ✓ **For the motion**—Organic farming is better because it is environment friendly and sustainable. The product is free of toxic chemicals and have more nutritional value as well as superior taste. In addition, the products do not contain any artificial preservatives, colouring and genetically modified ingredients.
- ✓ **Against the motion**—Inorganic farming is better because we can increase the production and minimize food shortage in the world. It is very time efficient and the inorganic products are by far cheaper than the organic products.

Question 12. **[Analyzing]**

In a lake near a farm the growth of algae suddenly increased. This increase was most likely due to

A a decrease in the water level.
B a decrease in the air temperature.
C exhaust gases from the industries.
D chemical fertilizer runoff from the farm.

Answer: *D chemical fertilizer runoff from the farm*

Question 13. **[Analyzing]**

The practice of crop rotation is one component of polyculture. The advantage of including leguminous plant in such practice is to

A reduce insect attack.
B increase soil fertility.
C decrease competition.
D increase the growth of plant.

Answer: *B increase soil fertility*

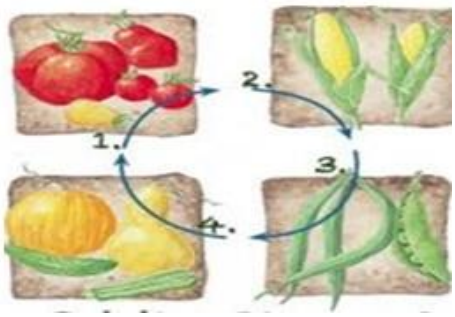


Figure 3.10

Question 14. **[Understanding}**

State whether the following statements are **TRUE** or **FALSE**. Re-write the false statements correctly.

1. Growing different crops in different season in the same field will deplete the nutrients from the soil.
2. Cells of root nodules of leguminous plant fix nitrogen.
3. Using good quality seed is the only criterion to get high yield.
4. Freshly harvested grains must be dried before storing.
5. All crops are propagated only by using seeds.

Answer: *1. False – Growing different crops in different season will add nutrients to the soil.*
2. True
3. False – Using good quality seeds is one of the criteria to get high yield.
4. True
5. False – Crops are propagated by using different vegetative parts.

3. REPRODUCTION IN PLANTS

Learning Outcomes

At the end of the lesson, a student should be able to:

3.3.1 Explain sexual and asexual reproduction in plants,
3.3.2 Distinguish between natural and artificial vegetative propagation and
3.3.3 List advantages and disadvantages of vegetative propagation.

Assessment Items

Question 1. **[Understanding]**

When a butterfly drinks nectar from a flower, it brushes against the anthers and gets covered with pollen. The pollen is transferred to another flower. This transfer of pollen is important for

A agamogenesis.
B sexual reproduction.
C asexual reproduction.
D vegetative reproduction.

Answer: *B* *sexual reproduction*

Question 2. **[Remembering]**

The organism that is **NOT** endowed with asexual reproduction is

A yeast.
B hydra.
C amoeba.
D rainbow trout.

Answer: *D* *rainbow trout*

Question 3. **[Analyzing]**

Figure 3.11 shows a bryophyllum leaf that reproduces through leaves.

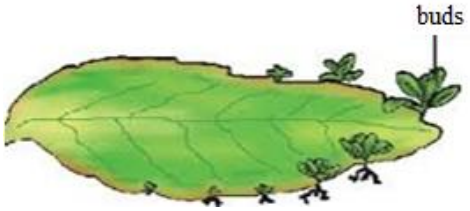


Figure 3.11

The disadvantages of this reproduction is

A the plantlets would have to compete for food.
B if the parent plant dies the plantlets would also die.
C the plantlets would cause overcrowding around the parent plant.
D growing in groups would make it difficult for the plantlets to avoid pests.

Answer: *C* *the plantlets would cause overcrowding around the parent plant*

Question 4. **[Applying]**

Figure 3.12 shows the method of artificial vegetative propagation.

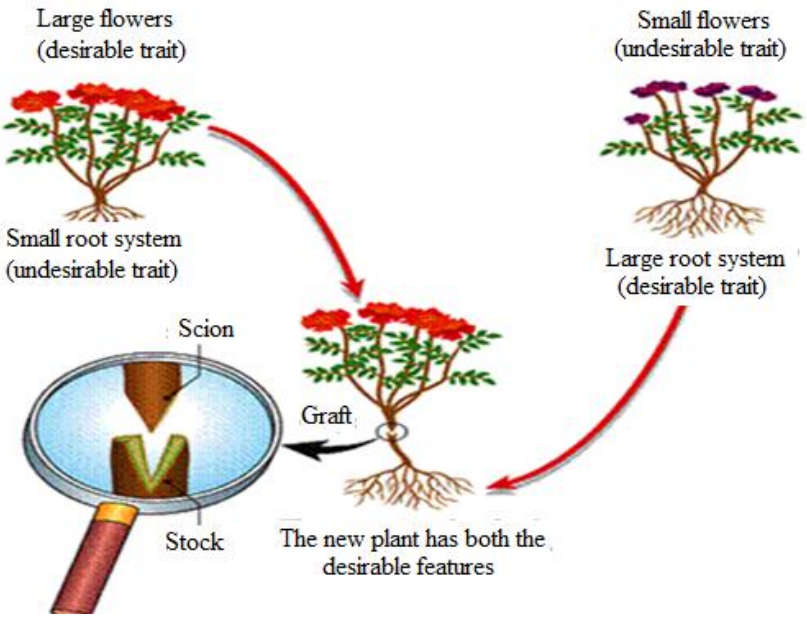


Figure 3.12

Identify the above method of artificial propagation.

A Mound layering
B Aerial layering
C Wedge grafting
D Stem cutting

Answer: *C Wedge grafting*

Question 5. **[Analyzing]**

Put a tick (✓) under 'Yes' or 'No' to indicate the plant whose stem is used for vegetative propagation. (The first one is done for you).

Table 3.6

Plant	**Yes**	**No**
Potato	✓	
Onion		
Sweet potato		
Ginger		
Turmeric		

Answer: *potato – yes, onion – yes, sweet potato – no, ginger – yes, turmeric – yes*

Question 6. **[Understanding]**

Figure 3.13 shows the method for propagating banana plants. Answer the questions (i) and (ii).

i) Bananas do not produce viable seeds, so a new plant is produced by cutting and planting a section of a mature plant called ……..

ii) What type of reproduction is this?

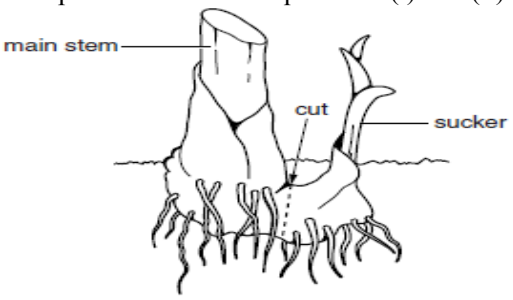


Figure 3.13

Answer: *i) Sucker*

ii) Asexual/vegetative reproduction

Question 7.

Use the Venn diagram to answer the questions below.

i. State one advantage of set A over set C. **[Understanding]**

Answer: *It is quicker and more certain.*

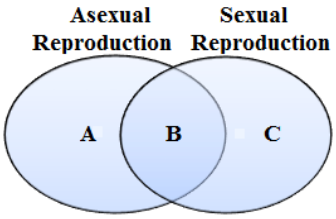


Figure 3.14

ii. Which characteristic identifies B? **[Analyzing]**

A requires sexual gametes

B cannot produce new varieties

C retains parental characteristics

D can produce both identical and new varieties

Answer: *D can produce both identical and new varieties*

Question 8. **[Analyzing]**

Padam has an orange orchard. He prefers propagating orange in his orchard by fixing a scion to the stock. Why does he prefer such type of propagation?

A He wants to produce healthy orange seeds.

B It is quicker and more certain for orange plantation.

C He doesn't want to produce new varieties of oranges.

D He doesn't want new orange plants that do not have the parental characteristics.

Answer: *B It is quicker and more certain for orange plantation.*

Question 9. **[Applying]**

Complete the following statements by selecting the correct word(s) from the box.

hybridization	root cutting	rubber	hormone
jasmine	stem cutting	salt solution	cloning

i) The technique of plant breeding to bring improvement in crop is ……

ii) Hibiscus is artificially propagated by …….

iii) Aerial layering is employed to propagate…….. plant.

iv) Stem cuttings are dipped in …… to stimulate rooting.

Answer: *i- hybridization ii-stem cutting iii-rubber iv-hormone*

CHAPTER 4
LIVING THINGS AND THEIR ENVIRONMENT

1. ADAPTATION AND SURVIVAL

Learning Outcomes

At the end of the lesson, a student should be able to:

4.1.1 Explain how plants and animals adapt to their habitats,
4.1.2 Illustrate the role of natural selection in the struggle of existence and
4.1.3 Explain bio-magnification and its effects.

Assessment Items

Question 1. **[Understanding]**

Which phrase best explains the meaning of the arrow labeled A in Figure 4.1?

A X does not determine Y
B X favours Y
C Y does not depend on X
D X reduces the possibility of Y

Answer: *B* *X favours Y*

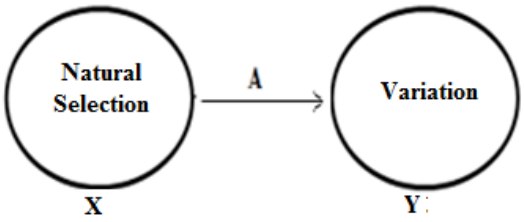


Figure 4.1

Question 2. **[Understanding]**

Figure 4.2 shows a desert habitat, which important factor do desert plants and animals generally compete for?

A air
B soil
C water
D shelter

Answer: *C* *water*

Figure 4.2

Question 3. **[Understanding]**

Climbers have a special characteristic that help them to climb tall trees. Which of the following explains why such plants need to climb tall trees?

A To occupy more space.
B To receive more sunlight.
C To take in more carbon dioxide.
D To escape from attacks of herbivore.

Answers: *B* *To receive more sunlight.*

Question 4. **[Analyzing]**

What would happen to animals that lose the competition for food?

I It will become weak and eventually die of hunger.
II It will remain in the territory and fight to death.
III It will be forced to leave the territory.
IV It will make its own food.
A I and II
B II and III
C I and III
D III and IV

Answer: *C* *I and III*

Question 5. **[Analyzing]**

The competition among the carnivores in a natural habitat become more intense when

I the numbers of off springs increase rapidly
II the number of herbivores increase
III more hunting licenses are issued
IV the number of herbivores decline
A I and III.
B I and IV.
C II and III.
D III and IV.

Answer: *B* *I and IV*

Question 6. **[Analyzing]**

Figure 4.3 shows a herd of elephants.
The animals in a group normally compete for
A food.
B mate.
C water.
D space.

Answer: *B* *mate*

Figure 4.3

Question 7. **[Understanding]**

In a lake polluted with pesticides, which organism in the food chain will contain maximum amount of pesticides.

A big fish
B small fish
C water bird
D microscopic organism

Answer: *C* *water bird*

Question 8. **[Applying]**

Figure 4.4 shows a food pyramid.

Which trophic level will have the highest toxin?

A primary
B secondary
C tertiary
D quaternary

Answer: *D* *quaternary*

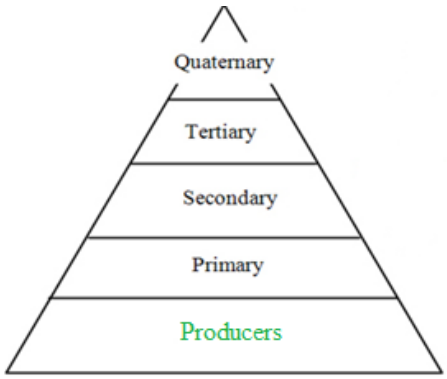


Figure 4.4

Question 9. **[Analyzing]**

The graph shows the quantity of pesticides accumulated in four populations each at different trophic levels in a food chain.

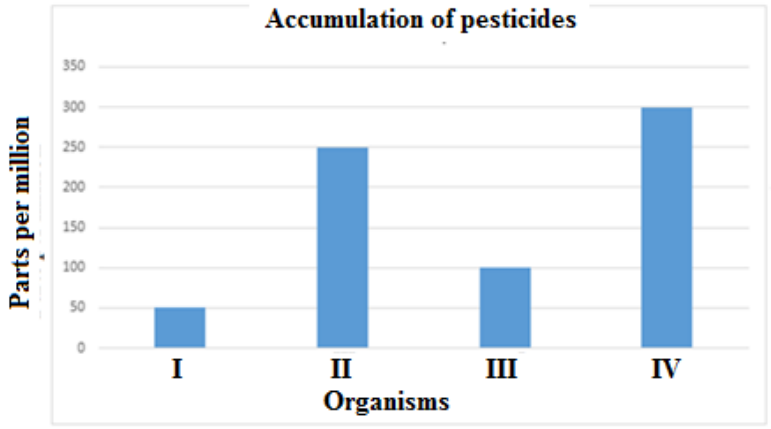


Figure 4.5

Which population is most likely to be herbivore?

A I
B II
C III
D IV

Answer: *A* *I*

Question 10.
With reference to Figure 4.6 which shows the flow of energy level, answer the following questions.

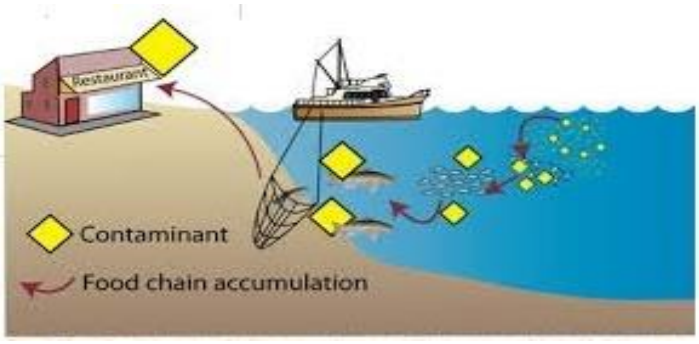
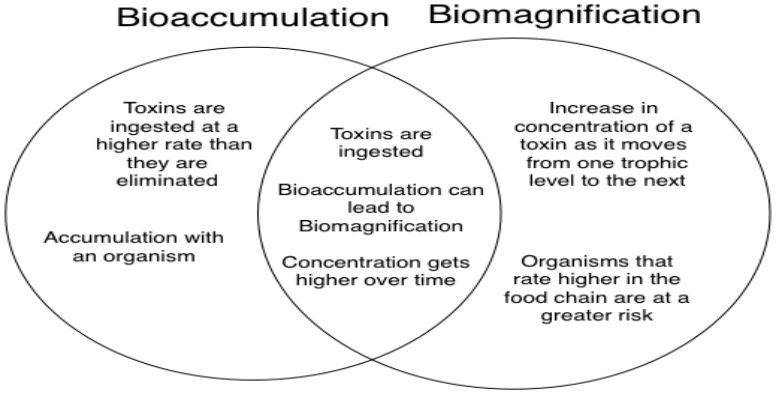


Figure 4.6

i. What process is being demonstrated by the above figure? **[Understanding]**
Answer: *It explains the process of bio-magnification.*

ii. Which level of consumer will be affected most? **[Remembering]**
Answer: *Tertiary consumer*

iii. Make a Venn diagram to compare and contrast bioaccumulation and bio magnification.
Answer: **[Analyzing]**



2. BIODIVERSITY

Learning Outcomes

At the end of the lesson, a student should be able to:

4.2.1 Explain biodiversity and its significance and
4.2.2 Explain the importance of practicing sustainable development in relation to conservation of environment within a community and a country.

Assessment Items

Question 1. **[Understanding]**

Biodiversity ensures natural sustainability for all forms of life. Which importance of biodiversity is the least significant?

A It provides ecological balance.
B It provides food security and health.
C It provides home to all living things.
D It has social and cultural importance to people.

Answer: *D It has social and cultural importance to people.*

Question 2. **[Analyzing]**

Sustainable development involves

A practices of careful planning and management of natural resources.
B constructing large buildings using better design and materials.
C searching for more deposit of fossil fuel.
D using all resources at maximum rate.

Answer: *A practices of careful planning and management of natural resources*

Question 3. **[Analyzing]**

Bhutan is known as a 'biological hotspot' and a destination for eco-tourism in the world. Tourism is the major contributor of Bhutan's socio-economic development. Which of these pose a threat to the sustainability of eco-tourism?

I rising human population
II increased sewerage and waste production
III restricting grazing in the watershed areas
IV banning the sale of products from endangered wildlife

A I and II
B I and III
C II and IV
D III and IV

Answer: *A I and II*

Question 4. **[Analyzing]**

Figure 4.7 represents biodiversity in three ecosystems.

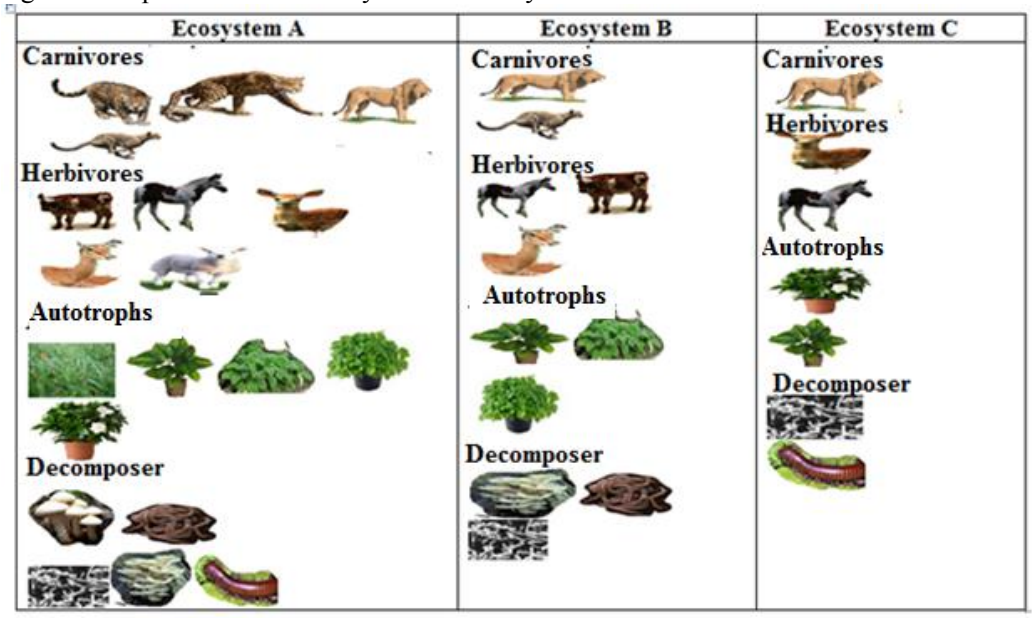


Figure 4.7

The level of biodiversity in ecosystem **A** is high because it has the

A least variety of energy levels.
B greatest numbers of decomposers.
C least number of ecological niches.
D greatest variety of genetic materials.

Answer: *D greatest variety of genetic materials*

Question 5.

"….The Bhutan Forest Act of 1969 declared all unclaimed land to be government forest reserves, banned felling and burning of trees by shifting cultivators, fishing and hunting. The National Forest policy declared that all logging was to be done by the Department of Forests in order to control the number of trees felled and prevent environment damage….."

(National Environment Commission, 1974)

i. What would have happened to our country if the above policy was not implemented?

[Creating]

Answer: (**Open ended)**

There would have been

- ✓ *frequent landslides*
- ✓ *drinking water shortage*
- ✓ *impacts of climate change*
- ✓ *global warming and*
- ✓ *flash floods.*

ii. Write two significances of maintaining rich biodiversity. **[Understanding]**

Answer: *The significances of maintaining rich biodiversity are:*

- ✓ *maintains stable ecosystem*
- ✓ *protects water resources*
- ✓ *contributes in controlling pollution*
- ✓ *maintains climate stability*
- ✓ *supports food and livelihood sustainably*
- ✓ *enhances social and cultural values through tourism*
- ✓ *promotes education and recreation*

Question 6. **[Applying]**

Wind is a renewable and sustainable source of energy. Druk Green Power Corporation Limited is planning to install a windmill in one of the Dzongkhags. Which Dzongkhag would be the most appropriate for establishing a wind mill according to the graphs shown in Figure 4.8?

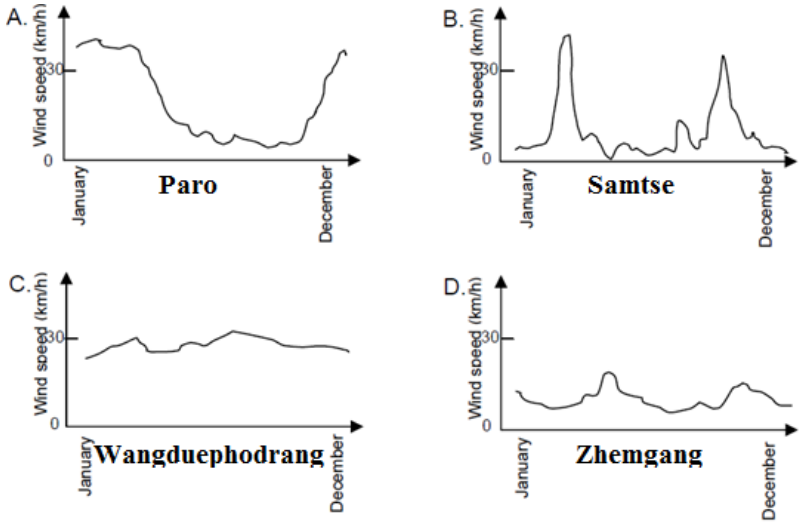


Figure 4.8

A Paro
B Samtse
C Wangdue phodrang
D Zhemgang

Answer: C *Wangdue phodrang*

Question 7. **[Analyzing]**

Use the table to match the cause and effect of human activities on environment and write down the matching pairs.

Table 4.1

Human activity	Impact on environment
1. Extracting mineral for industries 2. Clearing of forest for settlement 3. Improper waste disposal	a) Depletion of oxygen b) Destruction of landscape c) Pollution of ground water d) Weathering of rocks

Answer: *1-b, 2-a, 3-c*

Question 8. **Case study**

Mr. Sangay went to a forest where he found a glittering solid substance. He took it home and showed it to his wife and found to his delight that it was gold. Every morning he went to forest to collect the gold. He soon became rich by selling gold. As he became rich he grew greedy. Thinking of getting more gold he mined the whole area by destroying and cutting all the trees but no more gold was found.

With reference to the above case study, answer the questions below.

i. What message is conveyed by the above story in terms of sustainable development?

[Analyzing]

Answer: *We should use the natural resources judiciously without compromising the needs of future generation and not to destroy the environment.*

ii. If you were Sangay, what would you do with the resources you have found?

[Creating]

Answer: (Opened ended)

- ✓ *I would use it wisely.*
- ✓ *I would be more mindful about the needs of future generation.*

3. BREEDING

Learning Outcomes

At the end of the lesson, a student should be able to:

4.3.1 Explain selective breeding and hybridization,
4.3.2 Give some examples of plant and animal hybrids,
4.3.3 Describe the advantages and disadvantages of hybridization and
4.3.4 Explain the economic importance of livestock and crops.

Assessment Items

Question 1. **[Understanding]**

To obtain maximum yield, farmers practice 'selective breeding'. This technique is used to

A produce offspring with certain desirable traits.
B give all organisms a chance to reproduce.
C produce organisms from extinct species.
D breed organism in a specific season.

Answer: *A produce offspring with certain desirable traits*

Question 2.

Wheat is a type of grass that has been grown by human since the beginning of civilization. The earliest variety is called emmer. Figure 4.9 below shows emmer wheat and a modern type of wheat.

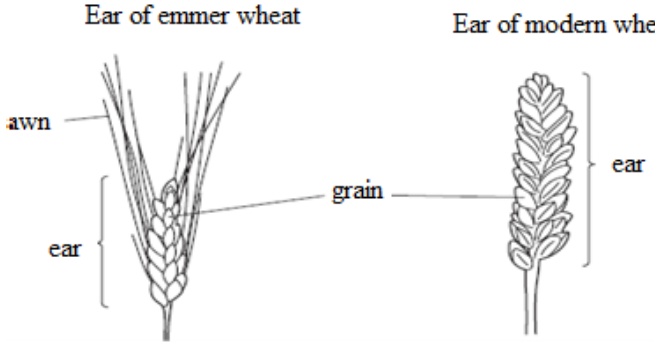


Figure 4.9

i. Describe two ways in which emmer wheat is different from modern wheat. **[Analyzing]**

Answer: *i. The ears of modern wheat are longer than the ears of emmer wheat.*
ii. Modern wheat is awnless but emmer is awned.

ii. Over hundreds of years, farmers improved wheat yields. They saved grains from the highest yielding wheat plant for growing them the following year. Explain the type of farming practised. **[Understanding]**

Answer: *Selective cultivation is practiced in order to obtain maximum yield.*

Question 3. **[Analyzing]**

Selective breeding is a process used by some farmers. Complete the chart below by ticking the appropriate box to indicate the process as an example of selective breeding.

Table 4.2

Description	Selective breeding	
	Yes	No
A farmer developed seeds that are resistant to fungal diseases by crossing two disease resistant plants.		
A farmer found that if the temperature of the barn was kept 5 degrees Celsius warmer, the cows in the barn produced more milk.		
A farmer planted maize seeds in the field two weeks earlier than usual. The maize planted early yielded more.		
A farmer mated his smaller cow breed with a large cow breed. The crossbred cow weighed more than the parents.		

Answer:

Description	*Selective breeding*	
	Yes	*No*
A farmer developed seeds that are resistant to fungal diseases by crossing two disease resistant plants.	✓	
A farmer found that if the temperature of the barn was kept 5 degrees Celsius warmer, the cows in the barn produced more milk.		✓
A farmer planted maize seeds in the field two weeks earlier than usual. The maize planted early yielded more.		✓
A farmer mated his smaller cow breed with a large cow breed. The crossbred cow weighed more than the parents.	✓	

Question 4. **[Understanding]**

Crossbreed usually refers to an organism with purebred parents of two different breeds or varieties.

The crossbreed shown in Figure 4.10 is a

A liger.
B tigon.
B tiger-lion.
C bolivian big cat.

Answer: *A liger*

Figure 4.10

Question 5. **[Applying]**

The table below represents the amount of milk produced per day by cows when selectively bred by hybridization.

Table 4.3

Breed	Siri	Jatsam	Australian Zebu
Jersey bull	7litres	6 litres	8 litres
Brown Swiss bull	5 litres	2litres	6 litres
Mithun	3 litres	3 litres	4 litres

Which statement best interprets the above information?

A Jersey + Siri hybrid produces more milk than Mithun + Jatsam hybrid.

B Mithun + Australian Zebu hybrid produces more milk than Brown Swiss + Jatsam hybrid.

C Brown Swiss + Australian Zebu hybrid produces same amount of milk as Jersey +Jatsam hybrid.

D Brown Swiss + Australian Zebu hybrid produces equal amount of milk as Jersey + Jatsam hybrid.

Answer: *D Brown Swiss + Australian Zebu hybrid produces equal amount of milk as Jersey + Jatsam hybrid.*

Question 6. **[Applying]**

The correct match for the animal hybrid given in the table 4.4 is

Table 4.4

Column I	Column II
1. yak x cow	a. andalusian
2. horse x donkey	b. hebra
3. white rooster x black hen	c. jersey
4. zebra x horse	d. dzo
	e. mule

Answer: *1 – d 2 – e 3 – a 4 - b*

Question 7. **[Understanding]**

Dawa wants to breed his local cow with Holstein Friesian to get

A better quality of leather.

B better quality of meat.

C better taste of milk.

D high yield of milk.

Answer: *D high yield of milk*

Question 8. **[Analyzing]**

Study the concept map to answer questions (i) and (ii).

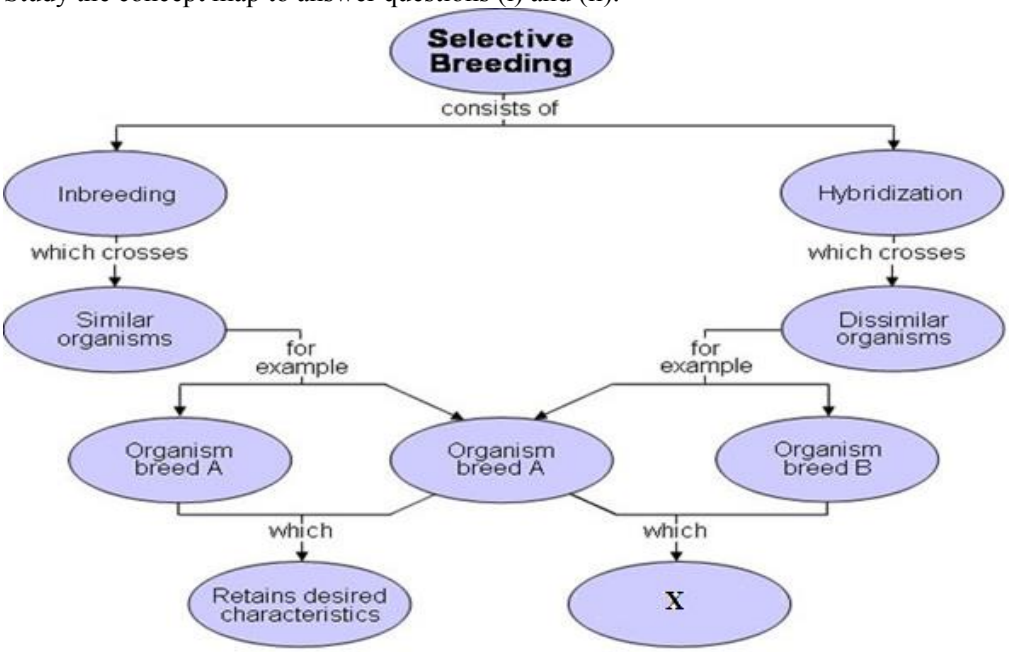


Figure 4.11

i. The most suitable characteristic of X in selective breeding is

A less varieties are produced.

B many varieties are produced.

C same characters are retained.

D desired characteristics are combined.

Answer: *D desired characteristics are combined*

ii. Use the information from the above concept map to compare inbreeding and selective breeding.

Inbreeding	Selective breeding
Desired characteristics are retained.	Desired characteristics are combined.

Question 9. **[Analyzing]**

i. Name the hybrid shown in Figure 4.12.

Answer: *Pomato*

Figure 4.12

ii. What will be the characteristics of this hybrid? **[Analyzing]**

Answer:

- ✓ *The hybrid plant can produce both tomatoes and potatoes.*
- ✓ *The outer cover of tomato will be thick.*

iii. Would you suggest the above practice to the farmers of Bhutan? Justify?**[Evaluating]**

Answer: *Yes, it can be economical as farmers can get two types of yield from a small piece of land. The ripe tomato has thick cover, so it does not perish fast.*

Question 10.

Read the conversation between two farmers Sonam and Dawa and answer the following questions.

Dawa : Brother Sonam, your maize plants have grown rapidly and they look healthy too.
Sonam: Yes, because I sprayed urea this time. What about yours?
Dawa: Well, I am still relying on good old cow dung. I am saving money for buying a power tiller.
Sonam: That's good. Power tiller saves a lot of time and labour.
Dawa: Yes, it has been labour intensive so far. Weeds are another big problem.
Sonam: Try weedicides. They are very effective…….(conversation continues).

i. List down the practices discussed above which are not environment friendly.**[Remembering]**

Answer: *Using of urea and weedicides.*

ii. What is the advantage of modern agricultural practices over traditional one?**[Understanding]**

Answer*: Modern agricultural practices increase the crop yield. It saves time and labour.*

iii. If you were Dawa would you agree to use weedicides as suggested by Sonam? Justify. **[Evaluating]**

Answer: **(Open ended)**

- ✓ *Yes, because the yield will increase.*
- ✓ *No, because weedicides will cause water and soil pollution.*

Question 11. **[Creating]**

Poultry farmers are facing trouble in protecting hens from feral animals. Design a coop that can save the hens from predation.

Answer: (Open ended)

- ✓ *Provide a sturdy and secure coop with a door that shuts securely at night.*
- ✓ *Erect proper wire mesh fences around the coop and the wire mesh should be underground at least 1.6 meters to prevent animals from digging and coming up through the soil.*
- ✓ *Put lights around the coop at night.*
- ✓ *Elevate the coop off the ground to help prevent mice and rats from getting into the coop.*
- ✓ *Inspect the bottom of the coop and patch any holes where predators could gain entry.*
- ✓ *Train a dog to ward off the predators at night.*

UNIT II: MATERIALS AND THEIR PROPERTIES

CHAPTER 5
CLASSIFYING MATERIALS

1. ATOMIC STRUCTURE

Learning Outcomes

At the end of the lesson, a student should be able to:

5.1.1 Name and describe the particles of atom with respect to proton, electron and neutron including their charges,
5.1.2 Define atomic number and mass number,
5.1.3 Draw the atomic structures of some elements,
5.1.4 Explain the term isotope with some common examples and
5.1.5 Relate the uses of isotope to our daily life.

Assessment Items

Question 1. **[Understanding]**

Which phrase below describes an atomic structure?

A the positively charged electrons revolve around the positively charged nucleus
B the positively charged electrons revolve around the negatively charged nucleus
C the negatively charged electrons revolve around the positively charged nucleus
D the negatively charged electrons revolve around the negatively charged nucleus

Answer: *C the negatively charged electrons revolve around the positively charged nucleus*

Question 2. **[Understanding]**

Table 5.1 shows the location of sub-atomic particles in various atomic models developed by students during a science project.

Table 5.1

Model	Location of Protons	Location of Electrons
P	within the nucleus	distributed in the shells
Q	distributed in the shells	inside the nucleus
R	dispersed throughout the atom	concentrated throughout the atom
S	outside the nucleus	outside the nucleus

Which model correctly indicates the location of protons and electrons of an atom?

A P
B Q
C R
D S

Answer: *A P*

Question 3. [**Analyzing**]

An atom is electrically neutral because the number of

A protons equal the number of neutrons.
B protons equal the number of electrons.
C neutrons equal the number of electrons.
D neutrons equal the sum total of electrons and protons.

Answer: *B protons equal the number of electrons*

Question 4.

With reference to Figure 5.1 which shows an atomic structure, answer the questions that follow.

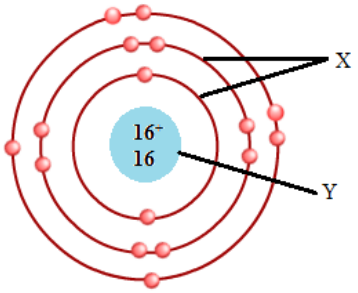


Figure 5.1

i) Label X and Y. [**Remembering]**

Answer: *X-shells, Y-nucleus*

ii) Name the particle that does not carry any charge. [**Remembering**]

Answer: *neutron*

iii) Calculate its atomic mass and atomic number. [**Applying**]

Answer: *Atomic mass is 32 and atomic number is 16.*

Question 5.

Given the atomic notation of bromine, how many neutrons are there in it? [**Applying**]

$_{35}Br^{79}$

Figure 5.2

A 35
B 44
C 79
D 114

Answer: *B 44*

Question 6. [**Analyzing**]

From Figure 5.3, identify the nucleus of an atom $_{13}Al^{27}$.

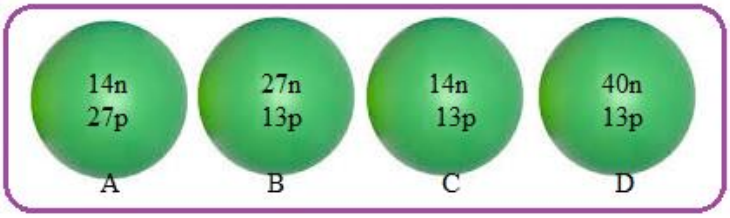


Figure 5.3

Answer: *C*

Question 7. [**Applying**]

Figure 5.4 represents sub atomic particles of an atom.

What will be the atomic number and mass number of this atom?

A atomic number is 6 and mass number is 14
B atomic number is 7 and mass number is 16
C atomic number is 8 and mass number is 18
D atomic number is 9 and mass number is 20

Answer: *D* *atomic number is 9 and mass number is 20*

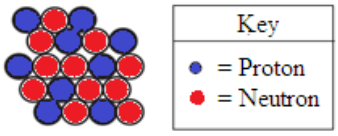


Figure 5.4

Question 8. [**Analyzing**]

By what percent will the atomic mass of an atom increase whose actual atomic mass is 52 and mass number is 24 if the numbers of protons are halved and the numbers of neutrons are doubled.

A increases approximately by 50%
B decreases approximately by 40%
C increases approximately by 30%
D decreases approximately by 30%

Answer: *C* *increases approximately by 30%*

Question 9. [**Analyzing**]

Which particles make-up most of the mass of Hydrogen 2 atom?

I electron
II proton
III neutron
A I and II
B II and III
C I and III
D I, II and III

Answer: *B* *II and III*

Question 10.
Refer Figure 5.5 to answer questions i and ii.

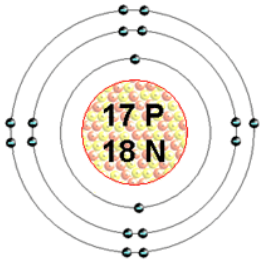


Figure 5.5

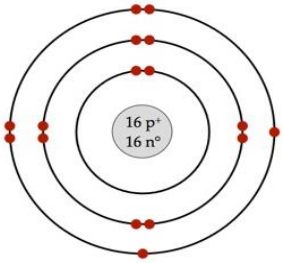
i) Valency of the atom is [**Applying**]
A 1.
B 7.
C 17.
D 18.
Answer: *A* *1*

ii) The above atomic structure represents a [**Analyzing**]
A metal.
B noble gas.
C metalloid.
D non-metal.
Answer: *D* *non-metal*

Question 11. [**Applying**]
The formula $2n^2$ is used for calculating the distribution of electrons in different shells of an atom. The number of electrons in the third shell of an atom will be
A 2.
B 8.
C 18.
D 32.
Answer: *C* *18*

Question 12.
The electronic configuration of an atom is 2, 8 and 6. Apply this information while answering the questions i to iv.

i) Draw the atomic structure using the above electronic configuration. [**Applying**]
Answer:



ii) Predict the valency of the atom. [**Understanding**]
Answer: *2*

iii) What is the valence electron of the atom? [**Remembering**]
Answer: *6*

iv) Is it a metal or a non-metal? Justify your answer. [**Analyzing**]

Answer: *The given atom is a non-metal. Since the valance shell has 6 electrons, the atom tries to gain two electrons to attain octet configuration. Metals lose electrons whereas non-metals gain electrons.*

Question 13. [**Analyzing**]

Table 5.2 shows the number of particles in four different atoms.

Table 5.2

Atom	Number of Protons	Number of Neutrons	Atomic Mass
A1	7	8	15
A2	8	8	16
A3	8	9	17
A4	9	10	19

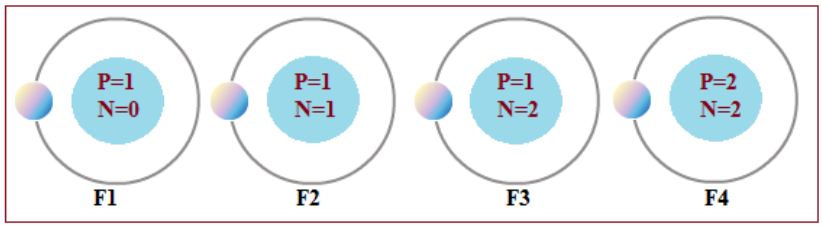
Identify the isotopes.

A A1 and A2
B A2 and A3
C A3 and A4
D A4 and A1

Answer: *B A2 and A3*

Question 14. [**Analyzing**]

Study Figure 5.6 and answer the question given below.



Figures 5.6

Which diagram does **NOT** represent the isotope of hydrogen?

A F1
B F2
C F3
D F4

Answer: *D F4*

Question 15.
Figure 5.7 below shows the structure of an atom.

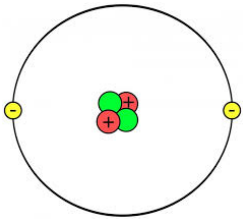
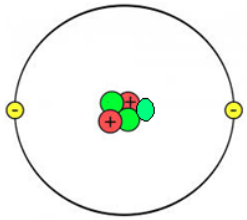


Figure 5.7

Draw a diagram of an isotope of the given atom. [**Creating**]
Answer: **(Suggestive)**



Question 16. [**Creating**]
Isotopes have a variety of applications in our everyday life; Cobalt-60 is used in radiotherapy for the treatment of cancer, Iodine 131 for treatment of thyroid gland and so on.
Use your library or any other sources of information to explore more about the uses of isotopes in our daily lives and make a Power Point presentation of about 10 slides.
Answer: (Suggestive)

Uses of Isotopes are

- ✓ *diagnosing and treating cancer*
- ✓ *carbon dating*
- ✓ *detecting smoke*
- ✓ *batteries to power the satellites*
- ✓ *enabling new sources of energy*
- ✓ *nuclear weapon*

Question 17. [**Understanding**]
Study Figure 5.8 and complete the passage by filling in the blanks with appropriate terms.

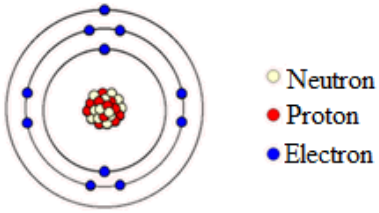


Figure 5.8

Matters are made up of atoms. All atoms have __(1)__ in the center. The nucleus contains protons and__ (2)__. All atoms have shells around its nucleus. The electrons are located in the __ (3)___. For any atom, the number of __ (4)__ is same as the number of __(5)__. If the atom loses or gains an electron, it becomes an__(6)___, which may be positively or negatively

charged. The total number of protons in the nucleus of an atom is called the __(7)___. The sum of the number of protons and the number of neutrons is called the___(8)__. Atoms of the same element may have different numbers of neutrons which are called __(9)___. Isotopes have numerous uses in our day to day life. For instance, __ (10)__, an isotope of carbon, is used in determining the age of fossils.

Answer: *1) nucleus 2) neutrons 3) shells 4) electrons 5) protons 6) ion 7) atomic number 8) atomic mass 9) isotopes 10)* $_6C^{14}$

Question 18. [**Understanding**]

Write **True** or **False** against each statement and re-write the false statements by replacing the underlined words.

i) If an atom loses an electron, the charge borne by this atom will be negative.

ii) Chlorine has two isotopes with atomic masses 35 and 37. Their isotopes differ due to the difference in the number of protons.

iii) Isobars are the atoms of different elements having same mass number, but different atomic numbers.

iv) If the atomic number of potassium is 19, the number of protons in its nucleus will be 39.

v) Isotopes are atoms of the same element having same atomic mass but different atomic number.

Answers: *i) False; If an atom loses an electron, the charge borne by this atom will be positive.*
ii) False; Chlorine has two isotopes with atomic masses 35 and 37. Their isotopes differ due to the difference in the number of neutrons.
iii) True
iv) False; If the atomic number of potassium is 19, the number of protons in its nucleus will be 19
v) False: Isotopes are atoms of the same element having different atomic mass but same atomic number.

Question 19. **[Analyzing]**

Match each item in **column A** with a correct item in **column B**. Rewrite the correct matching pairs.

Table 5.3

Column A		**Column B**	
1	Determines the mass of an atom	a	protons
2	Electrically neutral	b	ions
3	Excess or deficit of electrons	c	isobars
4	Balances the negative charge of electrons	d	nucleon
5	Negatively charged particles	e	atoms
6	Have same chemical properties but different physical properties	f	isotones
7	Same number of neutrons but different number of protons	g	electrons
8	Same mass number but different atomic number	h	isotopes
		i	cations

Answer: *(1,d) (2,e) (3,b) (4,a) (5,g) (6,h) (7,f) (8,c)*

2. ELEMENTS AND THEIR SYMBOLS

Learning Outcomes

At the end of the lesson, a student should be able to:

5.2.1 Define compound, radical and valency,
5.2.2 Investigate the characteristics of compounds and
5.2.3 Name the chemical compounds and their chemical formula.

Assessment Items

Question 1. **[Understanding]**

Compound is a substance

A made of only one type of atom.
B formed by a chemical combination of different types of atoms.
C that cannot be split up into simpler substances by any chemical means.
D formed by a physical combination of different types of atoms.

Answer: *B formed by a chemical combination of different types of atoms*

Question 2. **[Analyzing]**

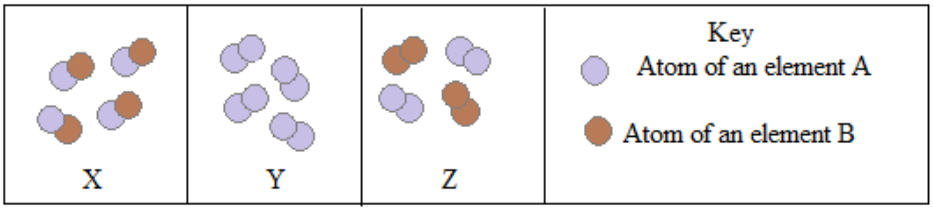


Figure 5.9

Which diagram represents a compound of elements A and B in Figure 5.9?

A X and Z
B Z and Y
C only Z
D only X

Answer: *D only X*

Question 3. **[Applying]**

Derive a chemical formula of Magnesium Oxide if Magnesium having valency 2 and Oxygen having 6 valence electrons combine to form a compound.

A Mg_2O
B MgO_2
C MgO
D Mg_2O_3

Answer: *C MgO*

Question 4. [**Understanding**]

Write **TRUE** or **FALSE** based on the attributes of element, compound and mixture.

Table 5.4

Attributes	Element	Compound	Mixture
Has a definite chemical formula	True / False	True / False	True / False
Is a pure substance	True / False	True / False	True / False

A true, false, true
B true, true, false
C false, false, true
D false, true, false

Answer: *B true, true, false*

Question 5. [**Applying**]

Identify the following substances as element, compound and mixture.

(silver ice-cream table salt)

	silver	ice-cream	table salt
A	element	mixture	compound
B	compound	element	mixture
C	compound	mixture	element
D	compound	mixture	compound

Answer: *A element, mixture, compound*

Question 6. [**Understanding**]

Valency is numerically equal to the total number of

Table 5.5

A	electrons of an atom.
B	electrons lost or gained.
C	electrons in the valence shell.
D	neutrons in the nucleus.

Answer: *B electrons lost or gained*

Question 7. [**Creating**]

Develop simple rules to write a chemical formula of a compound, with an example.

Answer: *1. Identify the symbols of elements present in a compound, metal precedes non-metal.*

2. Write the valency above each symbol.

3. Simplify the valencies if possible, to arrive at the simplest whole number.

4. Cross valency over (swap).

5. Place the whole number valencies just below the symbol.

6. Finally, write the correct chemical formula.

Eg: $Cu^{(2)}$ $O^{(2)}$

CuO

Question 8.

Figure 5.10 shows four substances, A, B, C and D. A and C are pure substances but they cannot be broken down into anything simpler. B consists of A and D, which are not chemically bonded together. D is a pure substance which can be chemically decomposed into A and C.

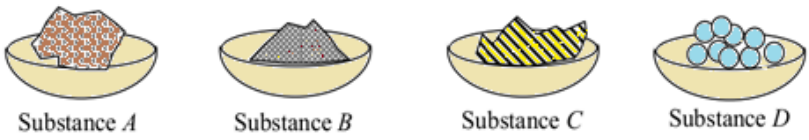


Figure 5.10

i) Identify the compound from the given substances. [**Analyzing**]

Answer: *Substance D*

ii) Is substance B a mixture or an element? Explain. [**Analyzing**]

Answer: *Mixture because it is formed by a physical combination.*

iii) Pema states that all pure substances should be elements. Do you agree with her? Support your answer. [**Evaluating**]

Answer: *No. I would not agree because, compounds are also pure substances. Substance D is a pure substance though it is not an element.*

Question 9. [**Creating**]

Draw Lewis dot structures of three compounds using the representations of two elements P and Q as shown in Figure 5.11.

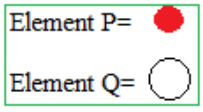
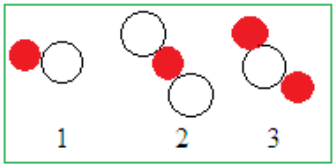


Figure 5.11

Answer: **(Suggestive)**



Question 10.

Use this formula $2Na_2CO_3$ and answer the following questions.

i) Name the compound. [**Understanding**]

Answer: *Sodium Carbonate*

ii) How many oxygen atoms are there in the compound? [**Applying**]

Answer: *6*

iii) Identify the cations and anions present in the molecule. [**Analyzing**]

Answer: *Cation* Na^+, *Anion* CO_3^{2-}

iv) Write the formula of a compound, if the positive ion is replaced by magnesium.

[**Applying**]

Answer: *$MgCO_3$*

Question 11. [**Understanding**]

Match the chemical names of the compounds in Column I with their correct formula in Column II. Re-write the correct pairs in Column III.

Table 5.6

Column I		Column II		Column III
1	Cuprous chloride	A	AgBr	
2	Ammonium dichromate	B	PbO	
3	Silver bromide	C	$CuCl_2$	
4	Sulphuric acid	D	$(NH_4)_2Cr_2O_7$	
5	Lead monoxide	E	H_2SO_4	
		F	PbO_2	
		G	CuCl	

Answer:

Column I		*Column II*		*Column III*
1	*Cuprous chloride*	*A*	*AgBr*	*1. Cuprous chloride - G. CuCl*
2	*Ammonium dichromate*	*B*	*PbO*	*2. Ammonium dichromate - D. $(NH_4)_2Cr_2O_7$*
3	*Silver bromide*	*C*	*$CuCl_2$*	*3. Silver bromide - A. AgBr*
4	*Sulphuric acid*	*D*	*$(NH_4)_2Cr_2O_7$*	*4. Sulphuric acid - E. H_2SO_4*
5	*Lead monoxide*	*E*	*H_2SO_4*	*5. Lead monoxide - B. PbO*
		F	*PbO_2*	
		G	*CuCl*	

Question 12. [**Understanding**]

Fill in the blanks with the appropriate chemical names or chemical formula.

Table 5.7

Compound	Formula
Magnesium___(1)_____	$Mg(OH)_2$
____(2)_____	Na_2S
Ammonium bicarbonate	NH_4_____(3)_____
Calcium_____(4)_____	$CaSO_4$
_____(5)_____sulphate	Al_2_____(6)_____

Answer: *1) Magnesium hydroxide 2) Sodium sulphide 3) NH_4HCO_3*
4) Calcium sulphate 5) Aluminium sulphate 6) $Al_2(SO_4)_3$

3. CHEMICAL EQUATIONS

Learning Outcomes

At the end of the lesson, a student should be able to:

5.3.1 Write the word equations and chemical equations,
5.3.2 Identify the reactants and products of a chemical reaction and
5.3.3 Explain the importance of writing balanced chemical equations.

Assessment Items

Question 1. **[Understanding]**

Sodium, a highly reactive metal, reacts with chlorine to produce sodium chloride (table salt). Which is the correct word equation for the chemical reaction?

A sodium + chlorite ⟶ sodium chloride
B sodium + chlorate ⟶ sodium chloride
C sodium + chloride ⟶ sodium chloride
D sodium + chlorine ⟶ sodium chloride

Answer: *D* *sodium + chlorine ⟶ sodium chloride*

Question 2. **[Understanding]**

Which among the following chemical compound's formula is incorrect?

Table 5.8

Index	Chemical names	Chemical formula
A	Phosphoric acid	H_3PO_4
B	Nitrogen dioxide	NO
C	Acetic acid	CH_3COOH
D	Sodium chromate	Na_2CrO_4

Answer: *B* *Nitrogen dioxide* *NO*

Question 3. **[Understanding]**

Sulphur is burned in the presence of oxygen to produce sulphur dioxide. Which one of the following best represents the reaction?

A sulphur + oxygen ⟶ sulphur dioxide
B sulphur dioxide + oxygen ⟶ sulphur
C sulphur dioxide ⟶ sulphur + oxygen
D sulphur ⟶ sulphur dioxide + oxygen

Answer: *A* *sulphur + oxygen ⟶ sulphur dioxide*

Question 4. **[Applying]**

Complete the word equation:
calcium + hydrochloric acid ⟶ ? + ?

A calcium chlorate + oxygen
B calcium chloride + hydrogen
C calcium chlorate + carbon dioxide
D calcium chloride + water

Answer: *B* *calcium chloride + hydrogen*

Question 5. **[Understanding]**

Sonam carried out the following experiments in the school laboratory as shown in Table 5.9. Interpret each experiment in the form of word equation.

Table 5.9

Experiment 1	Experiment 2	Experiment 3
Dissolved calcium hydroxide in phosphoric acid and obtained calcium phosphate and water.	Dissolved copper in sulphuric acid and obtained copper sulphate, water and sulphur dioxide.	Heated zinc granules with lead nitrate to get zinc nitrate and lead

Answer:

Experiment 1	*Experiment 2*	*Experiment 3*
Calcium hydroxide + Phosphoric acid → Calcium phosphate and Water	*Copper + Sulphuric acid → Copper sulphate + Water + Sulphur dioxide*	*Zinc + Lead nitrate → Zinc nitrate + Lead*

Question 6. **[Analyzing]**

Which observation indicates that the chemical reaction has occurred?

A is a reversible reaction
B liberates heat and light
C does not form precipitate
D change in the total mass of substance

Answer: *B liberates heat and light*

Question 7. **[Analyzing]**

In a chemical reaction, what is the relationship between the total mass of reactants and the total mass of products?

A The mass of the reactants must be greater.
B The mass of the products must be greater.
C There is no relationship between the reactants and the products.
D The total mass of the reactants must be equal to the total mass of products.

Answer: *D The total mass of the reactants must be equal to the total mass of products.*

Question 8.

The whole numbers required in a, b, and c to balance the equation are **[Applying]**

$$(a)Al + (b)O_2 \longrightarrow (c)Al_2O_3$$

A	3	4	2
B	2	4	3
C	4	3	2
D	2	3	4

Answer: *C 4, 3, 2*

Question 9. **[Applying]**

Study the flow chart of chemical reactions in Figure 5.12 and identify the missing links.

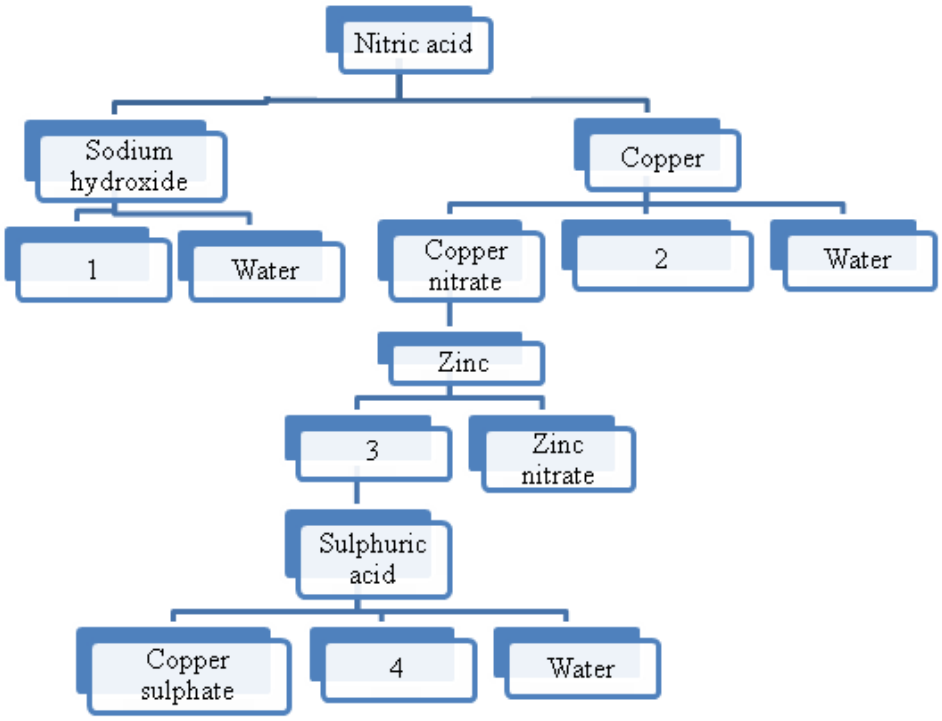


Figure 5.12

Answer: *1) Sodium nitrate* *2) Nitrogen dioxide* *3) Copper* *4) Sulphur dioxide*

Question 10. **[Understanding]**

According to the Law of Conservation of Mass, when a substance is decomposed, the total mass of reactants and products

A increase.
B decrease.
C remain same.
D both increase and decrease.

Answer: *C* *remain same*

Question 11. **[Analyzing]**

Which of the following statements is **TRUE** about a balanced chemical equation?

I) The mass of reactant and product are not equal.
II) Same types of atoms in reactant and product.
III) Unequal number of atoms of each element in reactant and product.
IV) Same number of atoms of each element in reactant and product.

A I and II
B II and III
C III and IV
D II and IV

Answer: *D* *II and IV*

Question 12.
Develop an argument with example to confirm that the Law of Conservation of Mass is universally valid for chemical reaction. [**Creating**]
Answer: (Suggestive)
According to the Law of Conservation of Mass, the total mass of the product is equal to the total mass of the reactants. For example, carbon reacts with sulphur to form carbon-disulphide. The mass of reactants, C and S is 56g which is equal to the mass of product, C_2S.

$$2C + S \longrightarrow C_2S$$
$$(2x12g) + 32g \longrightarrow (2x12g) + 32g$$
$$=56g \qquad =56g$$

Question 13. [**Applying**]
Choose appropriate terms from Table 5.10 to complete the passage.
Table 5.10

balanced	equation	products	reactants	equal
formula	co-efficient	mass	atom	weight

An ___1__ is the symbolic representation of a chemical reaction. The substances on the left side of the equation are called ___2__. The substances produced on the right side of the equation are called ___3____. Law of Conservation of ___4__ is illustrated in a ___5__ chemical equation. In such equations, the number of __6___ of each kind is equal on both the sides of the equation. While balancing a chemical equation, only the ___7__ of the molecule can be changed.
Answer: *1. equation 2. reactants 3. products 4. mass 5. balanced 6. atoms 7. co-efficient*

Question 14. [**Analyzing**]
Match the positive radicals with negative radicals in Table 5.11 in order to derive a correct chemical formula of the following compounds. Write the correct matching pairs.
Table 5.11

Compounds	**Column A**		**Column B**	
	Positive Radicals		**Negative Radicals**	
Hydrochloric acid	1	H^+	a	CO_3^{2-}
Calcium carbonate	2	Ca^{++}	b	NO_3^-
Potassium nitrate	3	K^+	c	Cl^-
Sodium hydroxide	4	Na^+	d	SO_4^{2-}
Magnesium sulphate	5	Mg^{++}	e	OH^-
			f	SO_3^{2-}
			g	NO_2^-

Answer: *(1,c) (2,a) (3,b) (4,e) (5,d)*

Question 15.

A whitish metallic ribbon X when ignited, burns in the air with a dazzling white flame to form a white powder Y. Upon adding water to the powder Y, it dissolves partially to form another substance Z.

i. Name the metal X. [**Remembering**]

Answer: *Magnesium*

ii. Identify powder Y. [**Remembering**]

Answer: *Magnesium oxide*

iii. Which element combines with metal X to form powder Y? [**Understanding**]

Answer: *Oxygen*

iv. What is substance Z? [**Applying**]

Answer: *Magnesium hydroxide*

v. Write a balanced equation which takes place between Y and water. [**Applying**]

Answer: $MgO + H_2O \longrightarrow Mg(OH)_2$

CHAPTER 6
MATERIALS AND CHANGE

1. SOLUBILITY

Learning Outcomes

At the end of the lesson, a student should be able to:

6.1.1 Explain solubility and factors affecting it,
6.1.2 Investigate the solubility of a solute in different solvents,
6.1.3 Tell the significance of solubility in life processes and the environment and
6.1.4 Interpret solubility curves and state their importance.

Assessment Items

Question 1. **[Remembering]**

A solution that contains all the solute it can hold at a given temperature is

A saturated.
B dissociated.
C unsaturated. .
D supersaturated

Answer: *A saturated*

Question 2. **[Understanding]**

Which factors influence the dissolution of salt in water?

A particle size, temperature and stirring
B particle size and stirring only
C particle size only
D stirring only

Answer: *A particle size, temperature and stirring*

Question 3. **[Analyzing]**

The step you would normally **avoid** to speed up the dissolution of sugar in water is

A heating water and sugar.
B stirring water and sugar.
C grinding sugar to make it finer.
D exerting pressure on the surface of water.

Answer: *D exerting pressure on the surface of water*

Question 4. **[Applying]**

Use the terms given below to generate a suitable definition of solubility.

[particular temperature, mass of solute, saturate, 100g of water]

Answer: S*olubility is measured as the mass of solute that will saturate 100g of water at a particular temperature.*

Question 5. **[Understanding]**

Which statement about the process of dissolution is **TRUE**?

I Once a solute, such as a salt crystal is dissolved in a solvent like water, it can never return to its original crystal state.

II The solute spreads out in all directions in a solvent because the solvent and solute particles attract one another.

III The process of dissolution releases or absorbs energy in the form of heat.

IV Applying heat often decelerates the process of dissolving.

A I and II

B II and III

C III and IV

D I and IV

Answer: *B II and III*

Question 6. **[Analyzing]**

Dawa did an experiment to investigate the effect of temperature on the solubility of sugar in water by measuring the quantity of sugar that would dissolve in 1 liter of water at different temperatures. He then plotted his results. From Figure 6.1, which graph is likely to be Dawa's result?

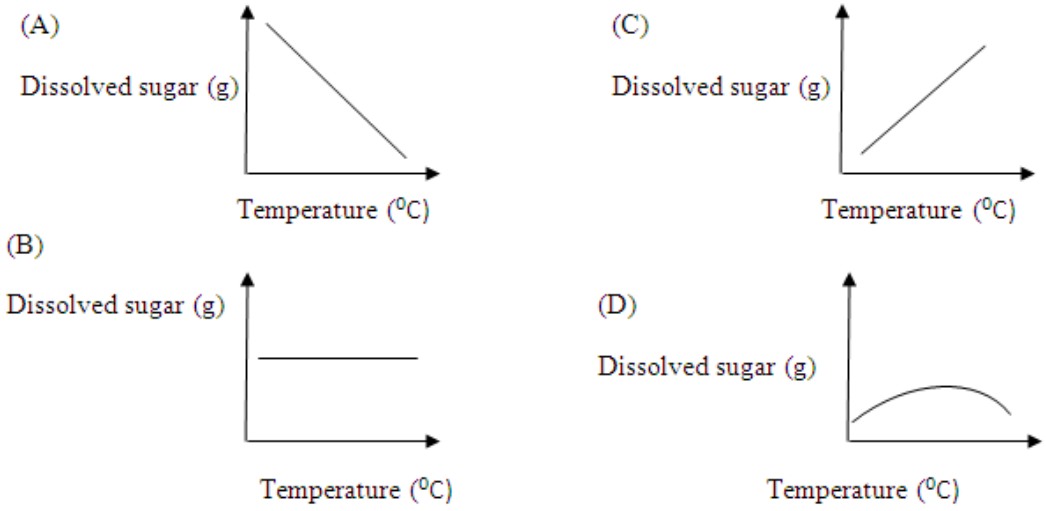
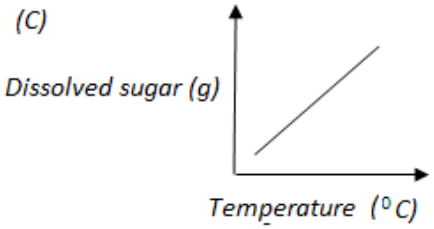


Figure 6.1

Answer: *C*



Question 7. **[Analyzing]**

Observe Figure 6.2 below to answer the question.

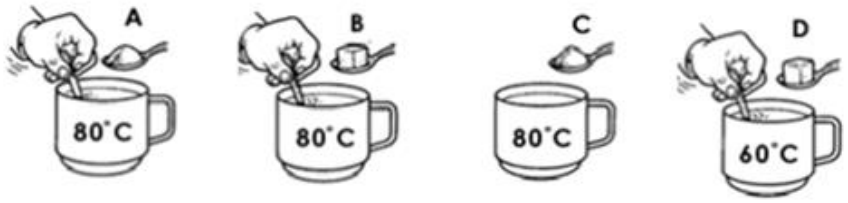


Figure 6.2

In which case, sugar would take least time to dissolve? Justify your answer?

Answer: *A, because factors like particle size, temperature and agitation (stirring) are involved actively.*

Question 8. **[Analyzing]**

Imagine that you have performed an experiment in which you dissolved two samples of copper sulphate (crystals and fine powder) into water to compare how long they took to dissolve.

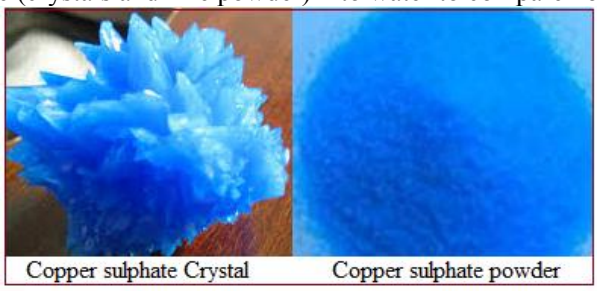


Figure 6.3

Which factor would be the **least** important to design such an experiment?

A the water samples must all be at the same temperature
B both the samples must be stirred for equal length of time
C same amount of samples must be used in each case
D all the samples must be tested at exactly the same time of the day

Answer: *D all the samples must be tested at exactly the same time of the day*

Question 9. **[Applying]**

If you crush salt crystals before putting it in your suja, how have you affected its solubility?

A Crushing it has really no effect on solubility because we have not heated it.
B Crushing it has really no effect on solubility because we have not stirred it.
C Crushing it has made the salt particles finer, which increases the surface area so it increases the rate of solubility.
D Crushing it has increased the surface area so it speeds up the dissolving process but does not change the rate of solubility.

Answer: *C Crushing it has made the salt particles finer, which increases the surface area so it increases the rate of solubility.*

Question 10.
Tshering adds sugar to a cup of iced tea and a cup of hot tea. She notices that the time required for the sugar to dissolve in each cup is different. She thinks this has something to do with the temperature of the tea. She wants to design an experiment to see if she is correct.

i) Construct a hypothesis based on Tshering's observations. **[Creating]**
Answer: Acceptable responses (but are not limited to)

- ✓ *If you increase the temperature of the liquid, then dissolving time decreases.*
- ✓ *Sugar will dissolve faster in hot water.*
- ✓ *If you decrease the temperature of the liquid, then dissolving time increases.*
- ✓ *Sugar will take more time to dissolve in the iced tea.*

ii) Identify any **two** variables that should be held constant in an experiment to test this hypothesis. **[Analyzing]**
Answer: (Suggestive)

- ✓ *amount of sugar*
- ✓ *sugar's particle size*
- ✓ *type of sugar*
- ✓ *amount of tea/water/liquid*
- ✓ *size of container*
- ✓ *speed of stirring*
- ✓ *length of time of stirring*

Question 11. **[Analyzing]**
Fish needs oxygen to survive. Goldfish in a crowded aquarium have better chance of survival in cold water than in warm water because
A in warm water, solubility of salt increases.
B in cold water, solubility of oxygen gas decreases.
C in cold water, solubility of oxygen gas increases.
D in warm water, solubility of oxygen gas increases.
Answer: *C in cold water, solubility of oxygen gas increases*

Question 12. **[Analyzing]**
Mina collected some algae in a beaker containing water and placed it in sunlight. She observed bubbles of a gas being released. The gas is
A Carbon monoxide.
B Carbon dioxide.
C Oxygen.
D Ozone.
Answer: *C Oxygen*

Question 13. [**Evaluating**]
Dissolution of various gases in water supports aquatic organisms in their life processes. Justify the statement with relevant examples.
Answer: *Dissolved carbon dioxide helps plants to prepare their food during photosynthesis; dissolved oxygen is used by plants and animals for respiration.*

Question 14.
Base your answers to questions i and ii on Figure 6.4, which shows the solubility (amount of solute that will dissolve in 100 grams of water) of three substances at various water temperatures.

i) The graph shows that as water temperature increases solubility **[Analyzing]**
A decreases.
B increases.
C increases and then decreases.
D decreases and then increases.
Answer: *B increases*

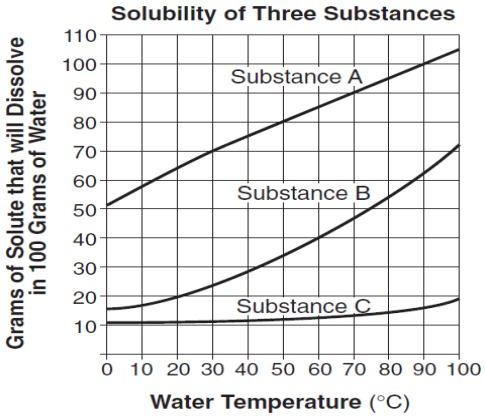


Figure 6.4

ii) As the water temperature is increased from 30°C to 70°C, how many more grams of substance **A** will dissolve in 100 grams of water? **[Applying]**
A 20 g
B 40 g
C 50 g
D 90 g
Answer: *A 20 g (for run 30, rise is 70; for run 70, rise is 90. Therefore, 90 - 70 = 20)*

Question 15.
Figure 6.5 shows the solubility curves for a solid solute and a gaseous solute.

i) How many grams of the solid solute will dissolve in 100 grams of water at 25°C? **[Applying]**
Answer: *The value can range from 36 g to 38 g.*

ii) Describe the relationship between water temperature and the solubility of the gaseous solute from 0°C to 15°C. **[Analyzing]**
Answer: *As the temperature increases, the solubility of the gas decreases.*

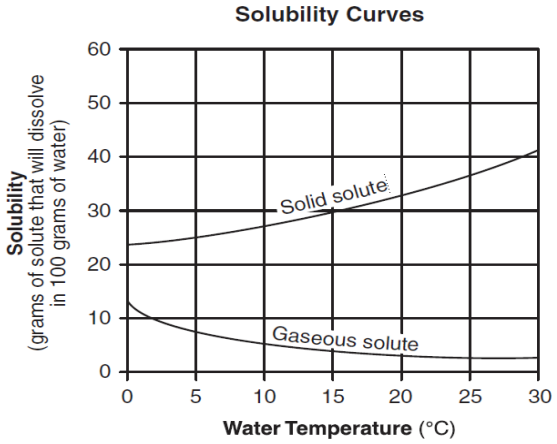


Figure 6.5

Question 16. **[Remembering]**

Fill in the blanks choosing the most appropriate terms from the box given below.

pressure, exothermic, unsaturated, saturated, temperature, solubility, endothermic

1. In fizzy drinks, there is evolution of a gas as it is ---------- with carbon dioxide.
2. If the temperature of water increases, the ---------- of dissolved oxygen decreases.
3. Making an ice cube is an example of ---------- reaction whereas melting of it is an example of ---------- reaction.
4. The determining factor for solubility of carbon dioxide in fizzy drinks when ice cube is added to it will be --------

Answer: *1 saturated 2 solubility 3 exothermic 4 endothermic 5 temperature*

Question 17. **[Applying]**

The data given in Table 6.1 below shows the maximum mass of ammonium chloride that can be dissolved in 100 grams of water at various temperatures.

Table 6.1

Water temperature ($^{\circ}$C)	**Solubility of Ammonium chloride (g)**
0	30
20	37
40	46
60	55
80	65
100	76

i) What is the maximum mass of ammonium chloride that can be dissolved in 100 grams of water at a temperature of 70°C? **[Applying]**

Answer: *60 grams of ammonium chloride*

ii) State the relationship between water temperature and the maximum mass of ammonium chloride that can be dissolved in 100 grams of water. **[Analyzing]**

Answer:

✓ *Higher the temperature, more the solubility of ammonium chloride.*

iii) Construct a line graph on the grid below. Use an **X** to plot the maximum mass of ammonium chloride that can be dissolved in 100 grams of water at each water temperature shown in the data table. Connect the **X**s with a line.

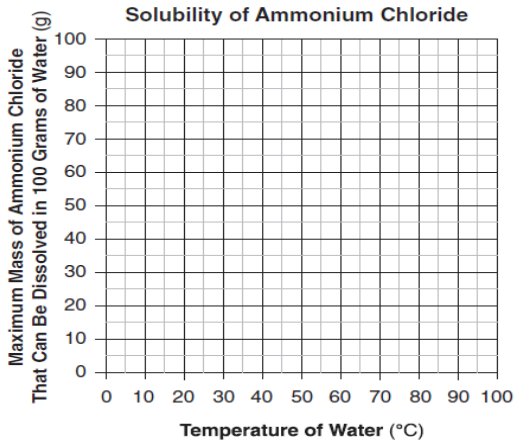
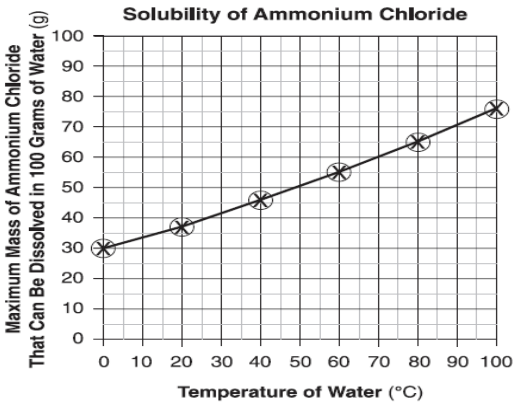


Figure 6.6

Answer:



2. CHEMICAL REACTION

Learning Outcomes

At the end of the lesson, a student should be able to:

6.2.1 Explain chemical reaction with an example,
6.2.2 List the chemical indicators for chemical reactions and
6.2.3 Classify the types of chemical reactions through investigation.

Assessment Items

Question 1. **[Understanding]**

Which information is conveyed by a chemical reaction?

A the mass of products
B the structure of reactants and products
C liberation of energy by the reactants
D the mass of reactants and products involved in the reaction

Answer: *D the mass of reactants and products involved in the reaction*

Question 2. **[Analyzing]**

Study the chemical equation given below and answer the question that follows.

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Which of the following is true about the chemical equation?

A It is a physical change, as a result of breaking of bonds.
B It is a chemical change, as a result to making of bonds.
C It is a physical change, as a result of making of bonds
D It is a chemical change, as a result of breaking and making of bonds.

Answer: *D It is a chemical change, as a result of breaking and making of bonds.*

Question 3. **[Understanding]**

A garden tool made up of iron gets rusted in summer. The general equation for the chemical reaction is

$$4Fe + 3O_2 \xrightarrow{XH_2O} 2Fe_2O_3.\ xH_2O$$

Choose the most appropriate statement that describes the above equation.

A only water is needed for rusting
B only oxygen is needed for rusting
C oxygen and water is needed for rusting
D water and oxygen do not influence rusting

Answer: *C oxygen and water is needed for rusting*

Question 4. **[Analyzing]**

A large sample of solid calcium sulphate is crushed into smaller pieces for testing. Identify two physical properties that are same for both the large and smaller pieces?

A mass and density
B mass and volume
C solubility and density
D solubility and volume

Answer: *A mass and density*

Question 5.
Figure 6.7 is a flow chart showing different types of chemical reactions.

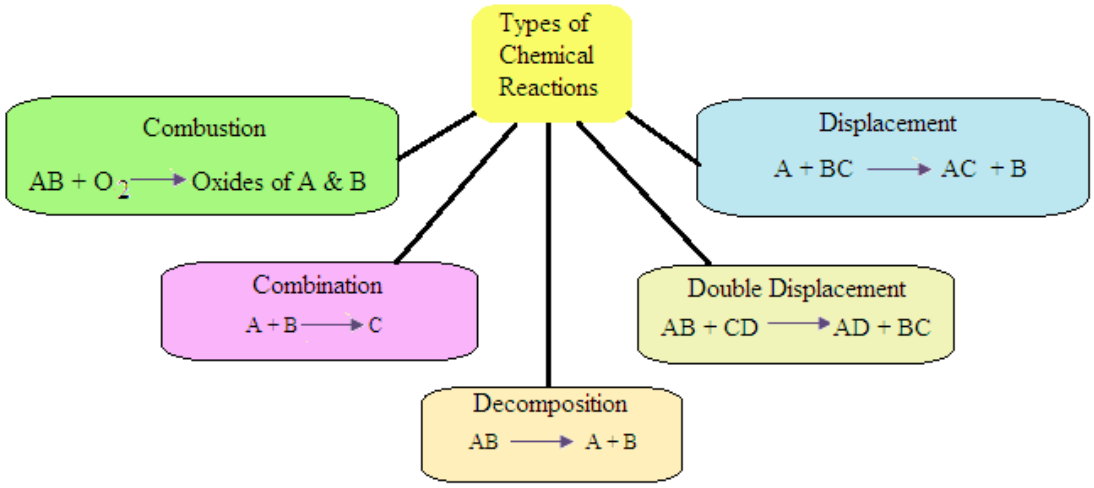


Figure 6.7

Based on the above general equations, identify the type of reaction involved in the following reactions **[Applying]**

i) Thermite welding in which Al and Fe_2O_3 react to produce molten iron.
ii) Heating $NaHCO_3$
iii) Burning natural gas for heat

Answer: *i) displacement ii) decomposition iii) Combustion*

Question 6. **[Applying]**
One characteristic property of a chemical compound is the way it reacts chemically with another substance. Another way of interpreting this statement is a substance will

A react in the same way when tested with two different substances.
B always react the same way when tested with the same chemical.
C always react differently when tested with the same chemical.
D change its property constantly.

Answer: *B always react the same way when tested with the same chemical*

Question 7. **[Remembering]**
During the formation of a chemical bond, heat

A is absorbed.
B is released.
C remains constant.
D is not at all involved.

Answer: *B is released*

Question 8. [**Understanding**]

Study the given equation and answer the question that follow:

$$Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$$

Which one of the following options best describes the reaction?

A substitution
B combination
C neutralization
D decomposition

Answer: *A substitution*

Question 9. [**Applying**]

Dawa reacted substance A with substance B and noticed a rise in temperature of the substance. Such reaction where heat is spontaneously given out is known as

A catalytic reaction.
B nuclear reaction.
C exothermic reaction.
D endothermic reaction.

Answer: *C exothermic reaction*

Question 10. [**Analyzing**]

In a chemical reaction, substance A reacts with substance B and forms a new substance AB. The chemical equation for this reaction is A + B ⟶ AB, where A and B are reactants and AB is a product. If you add more and more of only substance A, there will be

A less and less of product AB.
B no change in the amount of AB produced.
C more and more of product AB but limited by the amount of B.
D more and more of product AB with no limit to the amount of AB produce.

Answer: *C more and more of product AB but limited by the amount of B*

Question 11. **[Understanding]**

Fill in the blanks with appropriate word(s).

i. The chemical substances that take part in a chemical reaction are called _____.
ii. Burning of wood is an _____ reaction.
iii. A homogeneous mixture which has water as one of the components is known as _____ solution.
iv. Breaking down of $Ca(OH)_2$ by heating is an example of _____ reaction.

Answer: *i. reactants ii. exothermic iii. aqueous iv. decomposition*

Question 12. [**Analysis**]

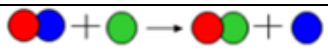
You are asked to balance a chemical equation. Which parameter would you chose out of co-efficient or the subscript in the chemical formula. Justify.

Answer: *Only coefficient can be changed while balancing the chemical equation because this number is simply used to balance the atomic species in the equation. Coefficient is not the intrinsic part of the chemical formula. However, if subscript is changed, the chemical nature and identity of that substance is changed.*

Question 13. **[Analyzing]**

Match the items of Column A with Column B in Table 6.2.

Table 6.2

Index	Column A	Index	Column B
1	Two or more substances chemically combine	a	
2	Compounds break down into smaller units	b	
3	One element replaces another element of a compound	c	
4	Atoms of two different compounds swap or trade places	d	

Answer: *(1,d) (2,c) (3,b) (4,a)*

Question 14. **[Understanding]**

Write **True** and **False** for each statement given below. Rewrite the **False** statements.

i) Dissolving salt is an example of chemical reaction.

ii) Products in a chemical reaction are usually formed more quickly at a higher temperature.

iii) Substances react chemically in characteristic ways. This indicator can be used to identify unknown substances.

iv) It is an endothermic reaction if more heat energy is released than it is produced.

v) Two different molecules are more likely to react and form products if the frequency of collision is decreased.

Answer: *i) False, Dissolving salt is an example of physical reaction.*

ii) True

iii) True

iv) False, It is an exothermic reaction if more heat energy is released than it is produced.

v) False, Two different molecules are more likely to react and form products if the frequency of collision is increased.

Question 15. **[Understanding]**

Law of Conservation of Mass states that mass cannot be created nor can it be destroyed. Explain the above statement by referring to a chemical equation.

Answer: *This clearly relates to a balanced equation in which the mass of reactants and products are equal. If the chemical reaction is not balanced, the law of conservation of mass fails which is not true*.

Question 16. **[Understanding]**

Frame a chemical equation to represent a reaction between gastric juice (HCl) and baking soda ($NaHCO_3$) and balance it.

Answer: $HCl + NaHCO_3 \longrightarrow NaCl + H_2O + CO_2$

(The chemical equation is already balanced)

CHAPTER 7
SEPARATING MIXTURES

1. MIXTURE AND THEIR SEPARATION

Learning Outcomes

At the end of the lesson, a student should be able to:

7.1.1 Differentiate between mixture and compound with examples,
7.1.2 Explain various separating techniques applied in local and industrial context and
7.1.3 Apply different techniques to separate mixtures.

Assessment Items

Question 1. **[Understanding]**

Ethanol is a compound made up of elements carbon, oxygen and hydrogen. Which of the following statements is **TRUE**?

A The properties of carbon are similar to that of ethanol.
B Ethanol has different properties from carbon, hydrogen and oxygen.
C Carbon, oxygen and hydrogen can combine in any proportion to form ethanol.
D Ethanol can be formed by mixing carbon, hydrogen and oxygen without involving energy.

Answer: *B* *Ethanol has different properties from carbon, hydrogen and oxygen.*

Question 2. **[Remembering]**

A specific type of homogeneous mixture is

A an atom.
B a solution.
C an element.
D a compound.

Answer: *B* *a solution*

Question 3. **[Applying]**

Karma bought a brass plate which is an alloy of copper and zinc. Brass is a mixture since it

A consists of metals and it is a solid.
B is a good conductor of heat and electricity.
C need not be made from its constituents in a fixed ratio.
D is made from its constituents through a chemical reaction.

Answer: *C* *need not be made from its constituents in a fixed ratio*

Question 4. **[Analyzing]**

How is a compound different from a mixture?

A compounds have two or more components
B compounds are commonly found in nature
C solids, liquids and gases can form compounds
D each substance in a compound loses its characteristic properties

Answer: *D* *each substance in a compound loses its characteristic properties*

Question 5. **[Applying]**

A compound can be formed when

I an element and a compound react
II elements combine physically
III two compounds react together
IV elements combine chemically
A I and II.
B II and III.
C I, II and IV.
D I, III and IV.

Answer: *D* *I, III and IV*

Question 6. **[Analyzing]**

Figure 7.1 below shows a chromatogram produced by three dyes and a food pigment. What colour would you expect in the food?

A Red
B Blue
C Green
D Yellow

Answer: *C* *Green*

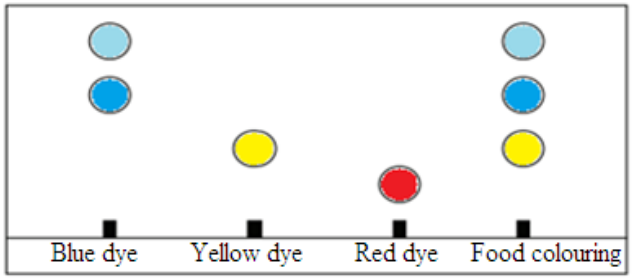


Figure 7.1

Question 7. **[Understanding]**

Which of the following separating methods for the mixtures is **INCORRECT**?

Table 7.1

	MIXTURES	SEPARATING METHOD
A	Oil and water	using a separating funnel
B	Ink colours	chromatography
C	Sodium chloride and water	filtration
D	Propanol and water	fractional distillation

Answer: *C* *Sodium chloride and water* - *filtration*

Question 8. **[Remembering]**

Which of the following is an industrial application of fractional distillation?

A Identifying and detecting traces of banned additives in foodstuffs.
B Filtering air in mechanical engines to prevent from damage.
C Treating sewage to combat water pollution.
D Manufacturing alcoholic beverages.

Answer: *D* *Manufacturing alcoholic beverages.*

Question 9. **[Applying]**

Match each diagram in Figure 7.2 with its correct description in Table 7.2. Justify your answer. Use each diagram only once.

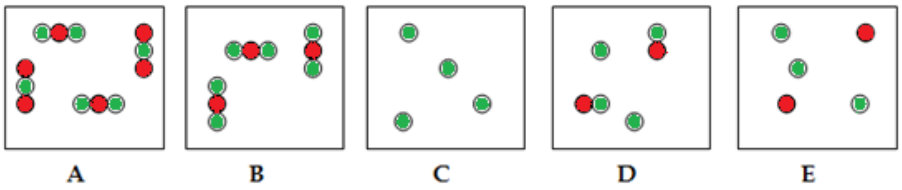


Figure 7.2

Table 7.2

Description	Diagram	Justification
Pure Element		
Mixture of two elements		
Pure compound		
Mixture of two compounds		
Mixture of a compound and an element		

Answer:

Description	*Diagram*	*Justification*
Pure Element	***C***	*Only one type of atoms present*
Mixture of two elements	***E***	*Two types of uncombined atoms present*
Pure compound	***B***	*Only one type of compounds present*
Mixture of two compounds	***A***	*Two types of compounds present*
Mixture of a compound and an element	***D***	*Two types of compounds with an atom of an element*

Question 10. **[Analyzing]**

A colourless crystal Z melts at 801°C and boils at 1413°C. It dissolves in water. Which apparatus can be used to obtain Z from a mixture of liquid Z and water?

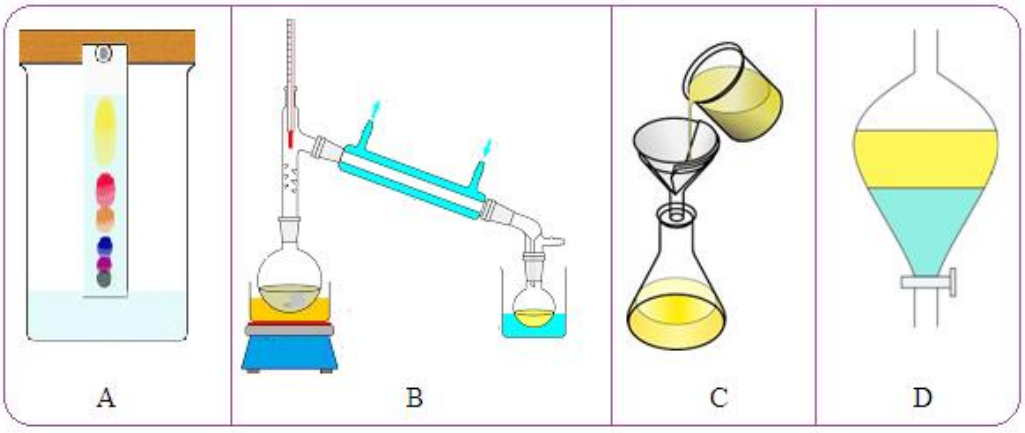


Figure 7.3

Answer: *Apparatus B*

Question 11. **[Analyzing]**

Dechen spills ink on her nylon dress. Choose the most appropriate liquid from the list in Table 7.3 to remove the stain from her dress.

Table 7.3

Liquid	Nylon	Ink
I	soluble	soluble
II	insoluble	insoluble
III	insoluble	soluble
IV	soluble	insoluble

A Liquid I
B Liquid II
C Liquid III
D Liquid IV

Answer: *C* *Liquid III*

Question 12. **[Applying]**

Sangay added following solids to water as given in Table 7.4 and stirred the mixture. Identify the solid that Sangay could not separate by filtration.

Table 7.4

Mixture	Solids
A	chalk
B	flour
C	salt
D	sand

Answer: *C* *salt*

Question 13. **[Applying]**

Figure 7.4 represents a flow diagram that shows how Dawa extracted pure, dry salt from rock salt. Choose the final process and complete the flow diagram.

Figure 7.4

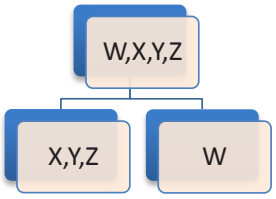
A condensation
B distillation
C evaporation
D freezing

Answer: *C* *evaporation*

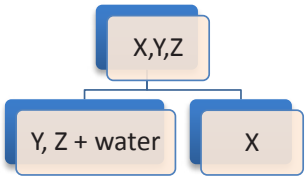
Question 14. **[Applying]**

Ngawang is given a mixture of salt, sand, iron filings and saw dust. She separates the mixture using a four step/procedure as shown in the diagram. The letters W,X,Y and Z stand for the four components but donot indicate which letter stands for which component.

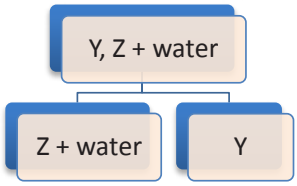
Step 1. Uses a magnet



Step 2. Adds water and removes the component that floats



Step 3. Filters



Step 4. Evaporates water

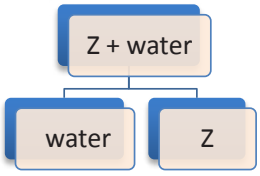


Figure 7.5

Identify each component separated by Ngawang by writing salt, iron, sand and saw dust in the correct spaces below.

Table 7.5

Component W: ……
Component X: ……
Component Y: ……
Component Z: ……

Answer:

Component W: iron filings
Component X: saw dust
Component Y: sand
Component Z: salt

Question 15. **[Applying]**

Figure 7.6 shows results of a paper chromatography experiment.

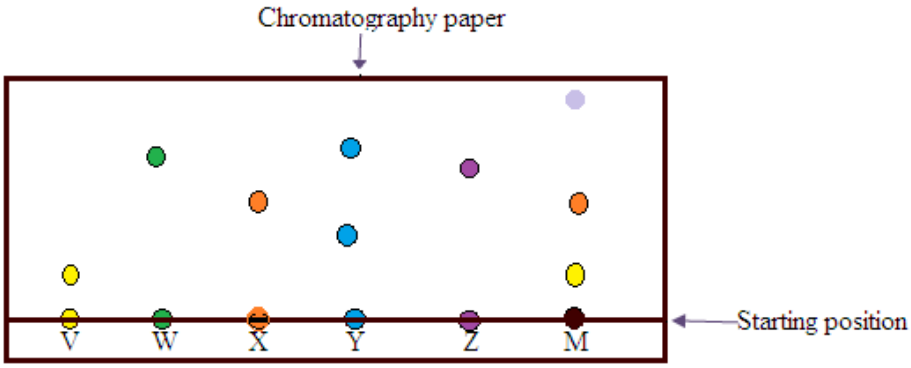


Figure 7.6

The substances present in the mixture M are

A V and X.

B V, Y and Z.

C V and Z unknown substance.

D V, X and unknown substance.

Answer: *D V, X and unknown substance*

Question 16.

Figure 7.7 shows an apparatus used by Yeshey to obtain ethanol from a mixture of ethanol and water.

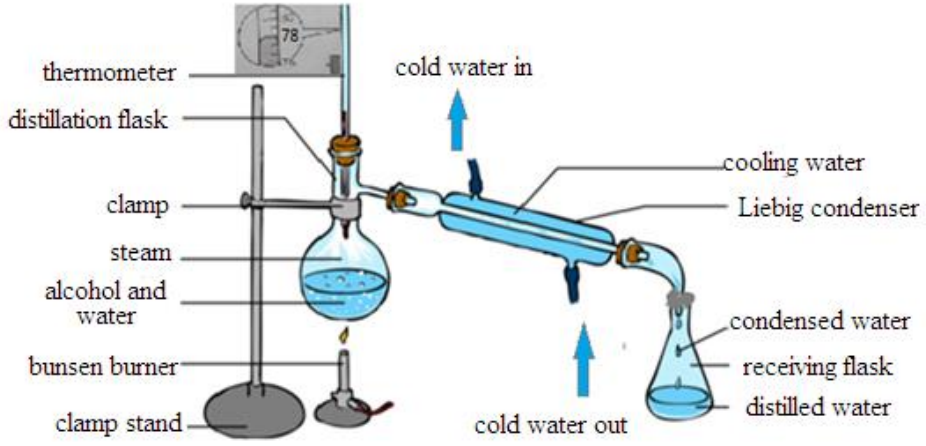


Figure 7.7

i) Identify the errors made by Yeshey in his experimental setup. **[Analyzing]**

Answer: *Arrowheads showing the direction of cold water in and cold water out is incorrect.*

ii) At what temperature is ethanol collected? [**Understanding**]

Answer: 78^{o}C

iii) Name the process. [**Remembering**]

Answer: *distillation*

iv) What is the purpose of boiling porcelain chips along with mixture of ethanol and water? **[Understanding]**

Answer: *The chips prevent the mixture from boiling too vigorously and exploding thus, making the process safe.*

v) Is the ethanol obtained 100% pure? Explain your answer. [**Understanding**]

Answer: *Normally, ethanol can be purified only upto 95% by distillation because surface evaporation of water takes place at 78^{0}C. In order to obtain 100% ethanol, a drying agent (CaO) needs to be used to absorb moisture.*

Question 17. **[Analyzing]**

Match each mixture in Column A with the separating technique in Column B. Rewrite the correct matching pairs.

Table 7.6

Column A		Column B	
1	Chlorophyll pigments from leaves	A	filtration
2	Petrol from crude oil	B	evaporation and crystallization
3	Debris from swimming pool	C	sublimation
4	Pure sugar from a solution	D	distillation
5	Mixture of iodine and sodium chloride	E	chromatography
		F	steam distillation

Answer: *(1, E), (2, D), (3, A), (4, B), (5, C)*

Question 18. **[Applying]**

How can paper chromatography be used to analyze different samples of food?

Answer: (Suggestive)

Paper chromatography can be used to separate dyes in food. Each dye can be identified by comparing its position in the chromatogram with that of the known dye. Chemists can then check whether or not these dyes are permitted for use in food.

Question 19. **[Creating]**

A simple distillation plant used to prepare local alcohol (ara) in villages is shown in Figure 7.8. Modify the diagram to make the process less labour intensive and more productive.

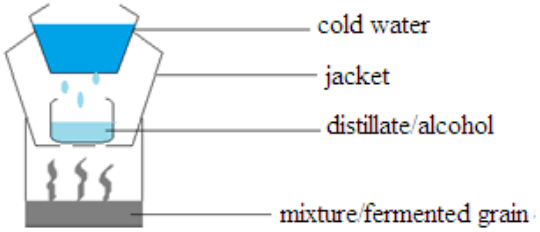
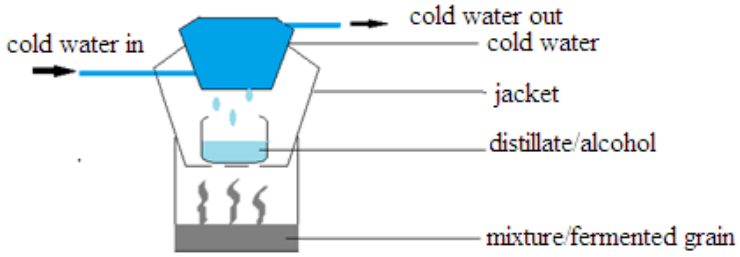


Figure 7.8

Answer: (Suggestive)



CHAPTER 8
PATTERNS IN CHEMISTRY

1. ACID AND BASE

Learning Outcomes

At the end of the lesson, a student should be able to:

8.1.1 Classify acid with examples,
8.1.2 Investigate the chemical properties and basic reactions of acid
8.1.3 Classify base with examples,
8.1.4 Investigate the chemical properties and basic reactions of bases and
8.1.5 Explain neutralization and apply the knowledge of neutralization reaction in everyday life.

Assessment Items

Question 1. [**Remembering**]

The most commonly used indicator in a laboratory is

A thymol blue.
B litmus paper.
C methyl orange.
D phenolphthalein.

Answer: *B litmus paper*

Question 2. [**Analyzing**]

A substance ionizes in water and produces a high concentration of H^+ ions. In this case, the solution is

A neutral.
B weak acid.
C weak base.
D strong acid.

Answer: *D* strong acid

Question 3. **[Applying]**

Deki drinks cola during recess as well as during meals. Do you think it is a good habit? What would you advise her?

Answer: (Suggestive)

Carbonic acid (weak acid) is added to cola to make the drink fizzy. However, the acid being corrosive in nature erodes the enamel of teeth making the teeth sensitive and weak. Additionally, cola irritates the delicate lining of stomach which might cause stomach ulcer. Therefore, I would advise her to stop drinking cola and replace it with natural fruit juices.

Question 4. [**Understanding**]

Kailash conducted a series of tests on unknown samples of 1 and 2 and found the results as given in Table 8.1.

Table 8.1

Sample	Indicator	Result
Sample 1	phenolpthalein	colourless
	Methyl orange	orange
Sample 2	phenolpthalein	pink
	Methyl orange	yellow

Sample 1 and Sample 2 are

A base and acid.
B acid and base.
C base and neutral.
D acid and neutral.

Answer: *B acid and base*

Question 5. [**Analyzing**]

Parsuram accidentally splashed concentrated sulphuric acid on his cotton laboratory coat. Gradually the coat charred and got stained black. This shows sulphuric acid is a

I strong acid
II strong dehydrating agent
III powerful oxidizing agent
IV weak acid
A I only.
B II only.
C I and III only.
D II and III only.

Answer: *B II only*

Question 6. **[Analyzing]**

Which of these acids is most likely to be dangerous?

A. citric acid
B formic acid
C carbonic acid
D hydrochloric acid

Answer: *D hydrochloric acid*

Question 7. [**Analyzing**]

Tshering did a litmus test on a fruit juice and the litmus paper turned red. She inferred that the fruit was

A sour.
B bitter.
C sweet.
D umami.

Answer: *A sour*

Question 8. **[Analyzing]**

An experiment was conducted as shown below in Figure 8.1. Three different liquids were connected to a wire and a light source. Predict the brightness of the bulbs with proper logical reasoning.

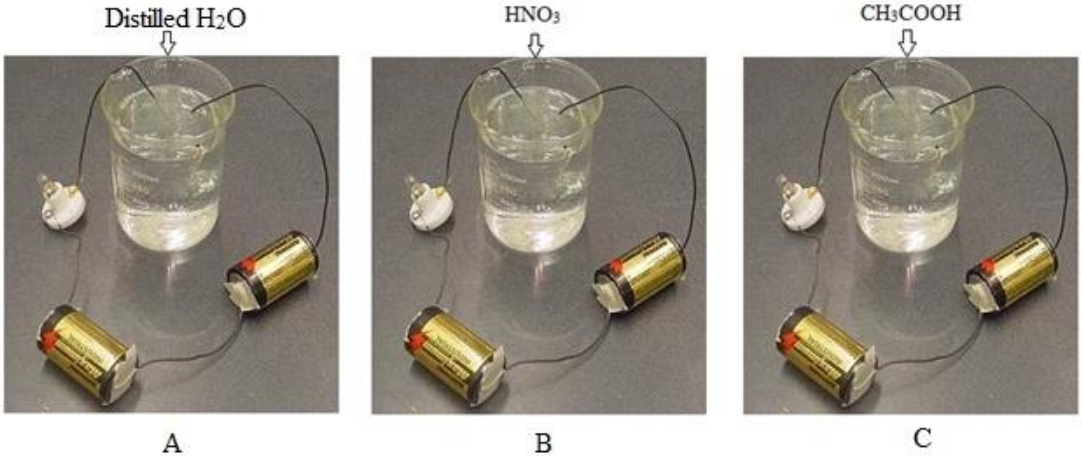


Figure 8.1

Answer: *Bulb in setup A will not glow because the distilled water does not contain ion (non-electrolyte/neutral).*
Bulb in setup B will glow very bright because it contains more ions (strong acid).
Bulb in set up C will glow dim because it contains fewer ions (weak acid).

Question 9. **[Understanding]**

Figure 8.2 represents a flow chart of chemical reactions. Study the chart and fill in the substances that react with water.

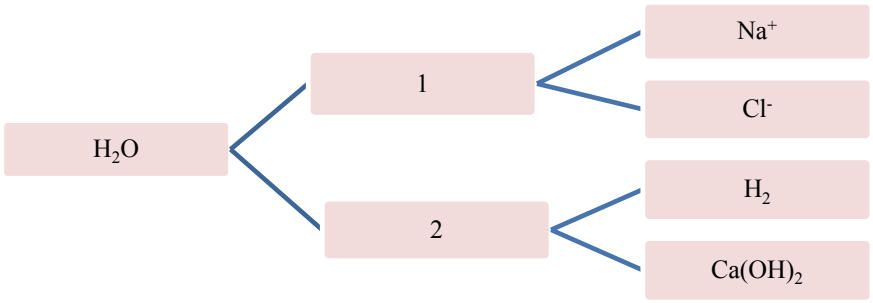


Figure 8.2

	1	2
A	NaCl	$CaCO_3$
B	NaCl	HNO_3
C	NaCl	Ca
D	NaCl	$Ca(NO_3)_2$

Answer: *C* *1. NaCl and 2. Ca*

Question 10. [**Understanding**]

The reaction of acid with metal carbonates produce

I) salt
II) water
III) carbonate
IV) carbon dioxide

A I and II.
B I and III.
C II and IV.
D I, II and IV.

Answer: *D I, II and IV*

Question 11. [**Understanding**]

Which of the following is **TRUE** about acids?

A They dissolve in water.
B They react with metals to give oxygen gas.
C They react with base to give salt and water.
D They contain OH^- ions as negative ion in water.

Answer: *C They react with base to give salt and water.*

Question 12. **[Applying]**

We regularly brush our teeth using toothpastes. Which reaction occurs during the process?

A substitution reaction
B displacement reaction
C decomposition reaction
D neutralization reaction

Answer: *D neutralization reaction*

Question 13. **[Applying]**

If you have lunch in one of the Indian restaurants, you would be given a lemon slice in a bowl after eating. How do you think it will help you?

A lemon slice can ease peristaltic movement of food
B lemon slice can improve the quality of finger nails
C lemon slice can remove turmeric stains from fingers
D lemon slice is to be eaten for better bowel movement

Answer: *C lemon slice can remove turmeric stains from fingers*

Question 14. **[Remembering]**

Which of the following is a base that changes milky while bubbling carbon dioxide through it?

A calcium hydroxide
B magnesium oxide
C sodium hydroxide
D calcium oxide

Answer: *A calcium hydroxide*

Question 15. [**Applying**]
Department of Agriculture found Seday's land very acidic and recommended a chemical to be applied on the soil. What could be the chemical?
A Urea
B NPK
C Humic acid
D Calcium carbonate
Answer: *D Calcium carbonate*

Question 16. [**Analyzing**]
Bases have very significant applications in our day to day life. For instance, sodium hydroxide is found in soap and ammonium hydroxide is used as a sanitizer. What is Sodium bicarbonate used for?
A bleaching
B colouring
C detergent
D raising bread
Answer: *D raising bread*

Question 17. [**Understanding**]
A chemist found that the pH of stock solution increased when he added a few pints of a particular chemical. In this case, the number of H_3O^+ ion
A doubled.
B increased.
C decreased.
D remained same.
Answer: *C decreased*

Question 18. [**Understanding**]
Double decomposition reaction is a
A physical change and reversible.
B physical change and irreversible.
C chemical change and reversible.
D chemical change and irreversible.
Answer: *D chemical change and irreversible*

Question 19. [**Analyzing**]
Tashi reacted hydrochloric acid and sodium hydroxide to produce salt and water. The salt formed is
A sodium oxide.
B sodium chlorate.
C sodium chloride.
D sodium hydroxide.
Answer: *C sodium chloride*

Question 20. [**Applying**]

Kezang is stung by a wasp. As a chemistry student, what first aid would you give to help her?

A apply oil
B apply lemon
C apply vinegar
D apply soap water

Answer: *B apply lemon*

Figure 8.3

Question 21. [**Analyzing**]

One of your friends complained of chest burn after staying empty stomach and was taken to hospital. The doctor advised and gave antacids tablets. Deduce the nature of the tablet.

A acidic
B neutral
C alkaline
D corrosive

Answer: *C alkaline*

Question 22. [**Understanding**]

Write **TRUE** or **FALSE** against each statement and correct the false statements.

i. All substances are either acidic or basic.
ii. Organic acids are obtained from minerals.
iii. pH of a substance can vary from 0 to 14.
iv. Applying baking soda can treat ant sting.
v. Common salt dissolves in water and turns blue litmus red.

Answer:

i. False, Some substances are neutral in nature.
ii. False, Organic acids are obtained from plants and animals.
iii. True
iv. True
v. False, The solution is neutral in nature.

Question 23. [**Remembering**]

Match each item in Column A against the correct item in Column B. Rewrite the correct matching pairs.

Table 8.2

Column A		**Column B**	
1	Tartaric Acid	a	soap
2	Calcium hydroxide	b	curd
3	Formic acid	c	tamarind
4	Sodium hydroxide	d	ant sting
5	Lactic acid	e	lime water
		f	baking soda
		g	detergent

Answer: *(1,c) (2,e) (3,d) (4,a) (5,b)*

Question 24. **[Understanding]**

Fill in the blanks with appropriate words from the word bank given below.

water, acid, H^+, neutralization, alkali, OH^-, metal, salt

i The substance which has the tendency to give protons in water is an _____.
ii Acid reacts with base and gives salt and water. This reaction is referred to as _____.
iii The pH scale measures the amount of _____ and _____ions in solution.
iv Acid reacts with _____and releases salt and hydrogen.
v Soluble bases are known as _____.

Answer: *i. acid ii. neutralization iii. H^+ and OH^- iii. metal iv. alkali*

Question 25. **[Applying]**

Yutha tested some kitchen items with various indicators. Refer Table 8.3 and mention the colour changes.

Table 8.3

Index	Samples	Indicators				
		Phenolphthalein	Litmus		Methyl Orange	Remarks
			Red	Blue		
1	Raw spinach					
2	Rain water					
3	Baking soda					
4	Vinegar					
5	Lime water					
6	Fizzy drinks					
8	Distilled water					

Answer:

Index	*Samples*	*Indicators*				
		Phenolphthalein	*Litmus*		*Methyl Orange*	*Remarks*
			Red	*Blue*		
1	*Raw spinach*	*pink*	*Blue*	*Blue*	*Yellow*	
2	*Rain water*	*colourless*	*Red*	*Light red*		
3	*Baking soda*	*Pink*	*Blue*	*Blue*	*Yellow*	
4	*Vinegar*	*Colourless*	*Red*	*Red*	*Red*	
5	*Lime water*	*Pink*	*Blue*	*Blue*	*Yellow*	
6	*Fizzy drinks*	*Colourless*	*Red*	*Red*	*Light red*	
8	*Distilled water*	*No change*				

i. Design your own indicator to test common house hold items. **[Creating]**

Answer: **(Suggestive)**

Turmeric solution remains yellow both in acid and neutral substances but turns bright red in bases.

ii. Construct a hypothesis to explain why indicators react differently to rain water and distilled water. [**Evaluating**]

Answer: *Rain water has acidic pollutants dissolved in it giving a slight acidic property, hence it gives an acid positive test while distilled water does not contain any chemical compound dissolved in it, hence it gives acidic and basic negative test.*

iii. Your chemistry teacher advised you not to store curd and sour food items in brass and copper vessels. Justify your answer with valid reasons. [**Evaluating**]

Answer*: I agree with her as curds and sour substances contain acids that may react with metallic containers which would release hydrogen and metallic salt. This may tarnish the vessel and sometime be very poisonous. OR*
I do not agree with her as this reaction may release metallic ions which may have positive benefits on health.

iv. While diluting acids, it is always recommended to add acid to water and not water to acid. Justify your answer. [**Analyzing**]

Answer: *This is because, acid reacts with water and liberate huge amount of heat (exothermic reaction). Therefore, instant heat generated may splash water out of the container which may cause severe burns and injury.*

2. ACID RAIN

Learning Outcomes

At the end of the lesson, a student should be able to:

8.2.1 Define acid rain,
8.2.2 Explain the causes of acid rain,
8.2.3 Explain the effects of acid rain on environment and
8.2.4 Describe the ways to reduce acid rain.

Assessment Items

Question 1. **[Applying]**

An experiment was conducted as shown in Figure 8.4.
The gas that is released during the reaction is

A water vapour.
B sulphur dioxide.
C carbon dioxide.
D nitrogen dioxide.

Answer: *C* *carbon dioxide*

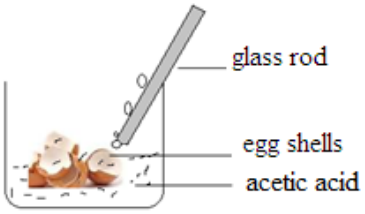


Figure 8.4

Question 2. **[Analyzing]**

Penjor conducted a soil test and found it to be highly acidic. Which step taken by Penjor is the best way to neutralize acidity of soil in his field?

A using lime in the field
B removal of acidified soil
C addition of organic fertilizers
D addition of more chemical fertilizers

Answer: *A* *using lime in the field*

Question 3. **[Remembering]**

Which of the following acids is not present in acid rain?

A nitric acid
B acetic acid
C sulphuric acid
D sulphurous acid

Answer *B* *acetic acid*

Question 4. [**Remembering**]

One of the impacts of acid rain on soil is it

A increases pH.
B decreases pH.
C improves the soil texture.
D increases the ability to retain moisture.

Answer: *B* *decreases pH*

Question 5.

Observe Figure 8.5 given below and answer the questions i to iv that follow.

i) Identify the phenomenon occurring in Figure 8.5. **[Remembering]**

Answer: *Acid rain*

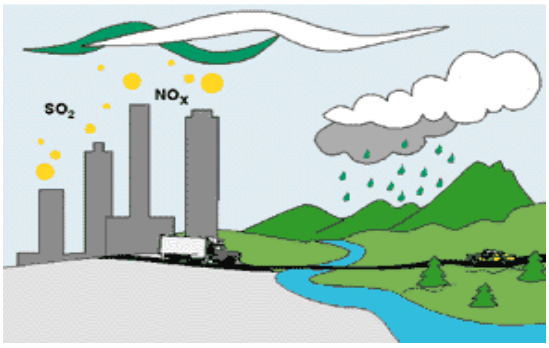


Figure 8.5

ii) Generate a suitable definition for the identified phenomenon. [**Applying**]

Answer: *Rain containing acids that is formed in the atmosphere when industrial and vehicular gases like oxides of sulphur and nitrogen dissolve in the rain water.*

iii) Mention any two impacts of the above phenomenon on nature. [**Applying**]

Answer: (Suggestive)

- ✓ *damages plants*
- ✓ *damages monuments*
- ✓ *kills aquatic animals and plants*
- ✓ *causes skin cancer*

iv) Suggest ways to control such undesirable occurrences. [**Creating**]

Answer: (Suggestive)

- *Use clean energy (hydro or solar energy) to minimize emission of carbon dioxide and other harmful pollutants*
- *Use air filters in chimneys of factories*
- *Plant trees to absorb carbon dioxide*
- *Minimize the use of fossil fuel*

Question 6.

Read the passage and answer the questions that follow.

"Acid rain lowers the pH in ponds and lakes and over time can cause the death of some aquatic life. Acid rain is caused in large part by the burning of fossil fuels in power plants and by gasoline-powered vehicles. The acids commonly associated with acid rain are sulphuric acid and nitric acid. In general, fish can tolerate a pH range between 5 and 9. However, even small changes in pH can significantly affect the solubility and toxicity of common pollutants. Increased concentration of these pollutants can adversely affect the behavior and normal life processes of fish and cause deformity, lower egg production, and less egg hatching".

i) Acid rain causes the pH of water bodies to decrease. Explain this effect in terms of hydronium ion concentration. **[Understanding]**

Answer: *Acid rain contains dilute acids that dissociate in water furnishing H^+ions or $H3O^+$. These ions decrease the pH of the water bodies.*

ii) Write the chemical formula of a negative poly-atomic ion present in an aqueous nitric acid solution. **[Understanding]**

Answer: *NO_3^- OR OH^-*

iii) Using information from the passage, describe one effect of acid rain on the future of fishes in ponds and rivers. **[Analyzing]**

Answer: *There will be decrease in the number of fish eggs hatched. The eggs hatched would be with deformities. Finally, this would cause decrease in the fish population resulting in severe ecological imbalance.*

iv) Sulphur dioxide, is one of the gases that react with water to produce acid rain. Describe how the solubility of sulphur dioxide in water is affected by an increase in water temperature.
[Applying]

Answer: *As the water temperature increases, the solubility of sulphur dioxide decreases. Therefore, decreasing the chances of acidifying water bodies by sulphuric acid.*

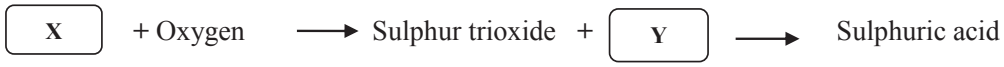
Question 7. **[Understanding]**
Fill in the blanks with appropriate word. You need to choose the right word from the pool of words provided below.

acid rain, oxygen, hydrocarbons, alkaline, greenhouse gas, filters, neutralization, water vapour, acidic, carbon dioxide, nitrogen, chlorofluorocarbons

i. When the pH of a solution is greater than 7, the solution is _____.
ii. Oxides of sulphur and nitrogen are released from power plants due to burning of _____.
iii. _____refers to a mixture of wet and dry deposition.
iv. One of the ways of treating exhaust from factories is to use air _____.
v. _____ released out of respiration process is acidic.
vi. The primary pollutants of the air are hydrocarbons, sulphur dioxide and oxides of _____.
vii. _____ are added to the air when there is increased use of refrigerator and air conditioners.
viii. Prevention of forest fires can contribute to the minimization of _____.

Answer: *i. alkaline* *ii. hydrocarbons*
iii. acid rain *iv. filters*
v. carbon dioxide *vi. nitrogen*
vii. chlorofluorocarbons *viii. green house gas*

Question 8. **[Applying]**
Given below is a sequence of events to illustrate formation of sulphuric acid in the atmosphere.



The letters X and Y correspond to
A water and sulphur.
B sulphur and hydrogen.
C sulphur dioxide and water.
D hydrogen and sulphur dioxide.
Answer: *C* *sulphur dioxide and water*

Question 9. [**Applying**]

Which of the following are the remedial measures to prevent acid rain?

I) reducing the release of oxides of nitrogen and sulphur into the atmosphere
II) use of hydroelectricity instead of firewood
III) recycling wastes rather than burning them up
IV) use of petrol cars

A I and II
B II, III and IV
C III and IV
D I, II and III

Answer: *D I, II and III*

Question 10. **[Creating]**

Taj Mahal in India, one of the Seven Wonders of the World once celebrated for its white marble façade has gradually corroded and turned yellow. Discuss the cause of such effect and draw a chemical equation to represent the reaction.

Answer: *Marble (limestone) is used in Taj Mahal as a building material. The pollutants such as SO_2, NO_2, SO_3, CO_2 from factories and vehicles dissolve in the rain water making it acidic. Such acidic rain react with the surface of Taj Mahal composed of limestone as represented below:*

$$\underset{\text{(lime stone)}}{CaCO_3} + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$$

$CaSO_4$ formed in the process flakes off the surface of the monument thereby corroding and turning the surface yellow.

Question 11.

Study Figure 8.6 an industrial area in our country and answer the questions that follow.

Figure 8.6

i) State your observations based on the Figure 8.6. **[Understanding]**

Answer: S*moke released into the air from the chimneys of the factories.*

ii) What inferences can you make from the observation? **[Applying]**

Answer: *Gaseous pollutants are released into the atmosphere which contributes to various sorts of environmental problems like- acid rain, rise in global temperature, degradation of flora and fauna etc.*

iii) Predict the effects of the above observations on **[Analyzing]**

a. Human health
b. Environment

Answer: (Suggestive)

i. Health - Strokes, respiratory diseases, skin problems, eye diseases
ii. Environment- Contamination of water, damage to vegetation, loss of animal habitats, threatens aquatic life, reduces soil fertility

Question 12.
Study the chemical equations given below and answer the questions that follow.

CO_2 + [1] ⟶ H_2CO_3

H_2CO_3 + [2] ⟶ $Ca(HCO_3)_2$

i) Complete the above equations. **[Understanding]**
Answer: *1.* *H_2O*
2. *$CaCO_3$*

ii) Identify the natural phenomenon in nature represented by the reactions given above. **[Analyzing]**

Answer: *Carbonation*

Question 13. **[Understanding]**
Some peculiar land forms are created due to the process mentioned as shown in Figure 8.7. Explain their formation.
Answer: *When acid rain falls on the limestone, it corrodes the weaker joints of the limestone rock, resulting in the collapse of lime stone beds forming limestone caves and pavements.*

Figure 8.7

Question 14. **[Understanding]**
Chortens constructed out of lime stones need periodic renovations since they get damaged due to various kinds of weathering. This kind of weathering can be due to

A hydration.
B oxidation.
C corrosion.
D wind abrasion.
Answer: *C corrosion*

Figure 8.8

Question 15. **[Analyzing]**

To solve environmental problems, we can adopt the following strategies **EXCEPT**

A educate the public.
B assess the situation.
C predict the consequences.
D encourage to maximize carbon footprint.

Answer: *D encourage to maximize carbon footprint*

Question 16.

The 'Greener Way' is Bhutan's first waste management and recycling firm established on March 8, 2010 aimed at managing waste in an efficient and environmentally friendly manner with a vision _ 'working towards a clean and environmentally rich Bhutan addressing global change issues'.

Suppose you are the CEO of this firm, develop a plan to reduce acid rain and its impact in Bhutan. **[Creating]**

Answer: (Suggestive)

- ✓ *segregation of wastes there by reducing the volume of wastes*
- ✓ *reuse and recycle wastes*
- ✓ *collection and proper disposal of wastes*
- ✓ *educate community on the advantages of proper waste management*

These activities prevent people from accumulating and burning their wastes which would otherwise produce gases contributing to acid rain.

Question 17. [**Analyzing**]

Imagine you are representing Bhutan on 'Global Summit on Climate Change'. Which of the following agendas would you present as your commitment?

P use of clean fuels
Q planting of trees in mass scale
R increase the number of animals
S decrease of vehicular emissions
A Q, R and S
B P, Q and R
C P, Q and S
D Q, R and S

Answer: *C P, Q and S*

Question 18. [**Understanding**]

Study Table 8.4 that contains information on clean fuels and their advantages and disadvantages. Fill in the blank spaces with appropriate answer.

Table 8.4

Clean fuels	Advantages	Disadvantages
Hydro Electricity	Minimum GHG emission	1
Biogas	2	Difficult to enhance the efficiency
Solar electricity	Renewable and readily available	3

Answer: (Suggestive)

Clean fuels	***Advantages***	***Disadvantages***
Hydro Electricity	*Minimum GHG emission*	*Affects ecosystem and habitat*
Biogas	*Renewable source of energy*	*Difficult to enhance the efficiency*
Solar electricity	*Renewable and readily available*	*Cannot be generated during nights and cloudy weathers*

Question 19. [**Understanding**]

Which one of the following is **NOT** an issue of Carbon Crisis?

A earthquake
B climate change
C global warming
D water acidification

Answer: *A earthquake*

Question 20. [**Remembering**]

The greenhouse gas that is released as a result of human activities is

A petroleum.
B natural gas.
C carbon dioxide.
D sulphur dioxide.

Answer: *C carbon dioxide*

Question 21. [**Evaluating**]

Constitution of Bhutan mandates keeping 70% of our nation under forest cover. Relate this vision with Global Warming.

Answer: *Forest helps absorbing carbon dioxide while supplying us with fresh natural oxygen. Large part of our land covered with forest means we also become "Carbon Sink", for neighboring countries.*

UNIT III: PHYSICAL PROCESSES

CHAPTER 9
FORCES AND MOTION

1. LINEAR MOTION

Learning Outcomes

At the end of the lesson, a student should be able to:

9.1.1 Compare speed and velocity,
9.1.2 Interpret displacement- time graph and
9.1.3 Explain the effects of gravity on mass and weight.

Assessment Items

Question 1. **[Understanding]**

Speed is the measurement of how

A far an object moves.
B fast an object moves.
C long an object moves.
D often an object moves.

Answer: *B* *fast an object moves*

Question 2. **[Analyzing]**

Which of the following statement describes both speed and velocity?

A both speed and velocity cannot be zero
B speed and velocity are vector quantities
C the magnitudes of speed and velocity are represented by using the same units
D both refer to the rate at which an object changes position in a specific direction

Answer: *C* *the magnitudes of speed and velocity are represented by using the same units*

Question 3. **[Understanding]**

Figure 9.1 shows a woman pulling a luggage bag. The force applied by the lady has

A direction only.
B magnitude only.
C both direction and magnitude.
D neither magnitude nor direction.

Answer: *C* *both direction and magnitude*

Figure 9.1

Question 4. **[Applying]**

Figure 9.2 shows the distance travelled by four cars **A, B, C** and **D** over a period of time.

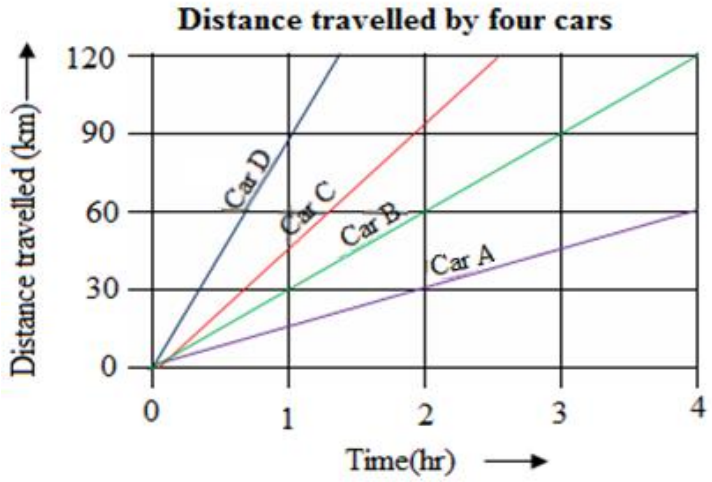


Figure 9.2

Which car traveled with speed of 30km/hr?

A Car A
B Car B
C Car C
D Car D

Answer: *B Car B*

Question 5. **[Analyzing]**

A student observes that the velocity of a falling object increases with time. In scientific investigation, which of the following statement is made after the observation?

A velocity of object increases with time
B velocity of an object can be measured
C how the velocity of object changes with time
D determine the velocity of the object at various time interval

Answer: *C how the velocity of object changes with time*

Question 6. **[Applying]**

A bus travels from Thimphu to Paro, Paro to Wangdue and finally back to Thimphu as shown in the Figure 9.3.

Calculate:

a. The velocity of the bus from Thimphu to Wangdi and back.
b. The average speed of the bus from Thimphu to Wangdi via Paro.

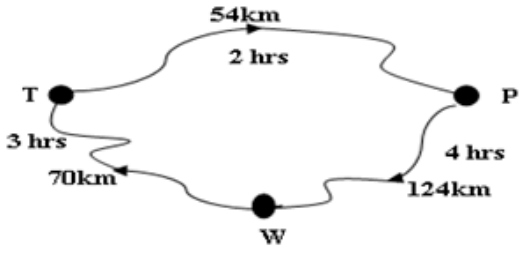


Figure 9.3

Answer:

a. $Velocity = \frac{TotalDisplacement}{TotalTimeTaken} = \frac{0}{6hr} = 0km/h$

b. $Average\ Speed = \frac{Totaldistance}{TotaltimeTaken} = \frac{54+124\ km}{6\ hr} = 29.67km/h$

Question 7. **[Applying]**

To commemorate the 4th King's Birthday, Lhuentse HSS organized 25 km open marathon. How long will a participant travelling with the speed of 12.5 km/hr take to complete the race?

Answer: *Given: distance = 25km, speed = 12.5km/hr*

$$Time = \frac{distance}{speed} = \frac{25\ km}{12.5km/hr} = 2hours$$

$\therefore$ *Time = 2 hours*

Question 8. **[Understanding]**

Which of the following displacement- time graphs best describes a vehicle moving with uniform velocity?

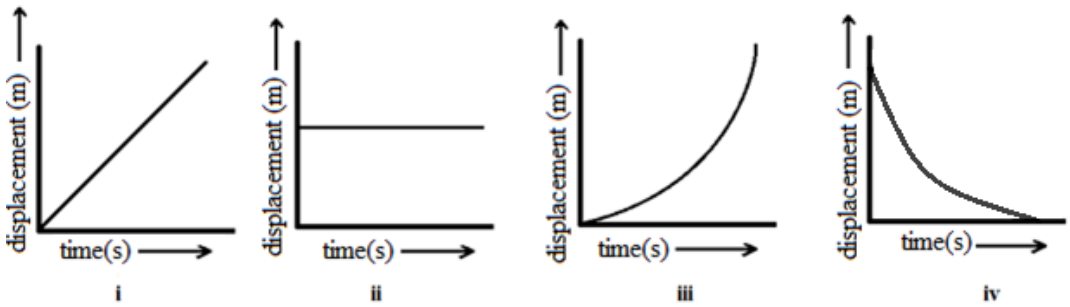


Figure 9.4

A i only.
B i and ii.
C ii and iii.
D ii and iv.

Answer: *A i only*

Question 9. **[Understanding]**

Which one of the following is a scalar quantity?

A 10 Newton
B 2 km due north
C 15 m/s due south
D 37 degree Celsius

Answer: *D 37 degree Celsius*

Question 10. **[Understanding]**

Which one of the following correctly describes 'acceleration due to gravity'?

A It is the force that defines mass of an object.

B It is the force that pulls an object towards the centre of the Earth.

C The acceleration due to gravity increases with decrease in latitude.

D The acceleration due to gravity increases with depth towards the centre of the Earth.

Answer: *B It is the force that pulls an object towards the centre of the Earth.*

Question 11.

Figure 9.5 below shows the displacement of a car at different times. Study the graph carefully and answer the questions (i) to (v).

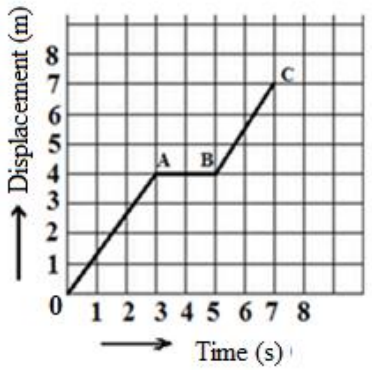


Figure 9.5

i) What is the state of the car at point O? [**Understanding**]

Answer: *The car is at rest.*

ii) Which part of the graph shows the car moving with a maximum velocity? **[Applying]**

Answer: *The car moves with the following velocities*

a. *O to A*

Velocity=4/3=1.33m/s

b. A to B

Velocity=0/2=0m/s

c. B to C

Velocity=3/2=1.5m/s

Therefore, the car moves with maximum velocity from point B to C.

iii) Which part of the graph shows that the car stopped moving? Why? **[Analyzing]**

Answer: *A to B because the displacement is zero.*

iv) What is the displacement between point O and C? **[Applying]**

Answer: *Displacement between point O and C = 4+0+3=7m.*

v) Find the average velocity during the time interval 3s to 7s. **[Applying]**

Answer: *Average velocity* $= \frac{Total\ diplacement}{Total\ time\ taken}$

Total displacement between A and C = 0+3= 3m

Total time taken =4s

Therefore, Average velocity $= \frac{3}{4} = 0.75 ms^{-1}$

Question 12. **[Understanding]**

Figure 9.6 shows different people at different locations. Who will experience the maximum acceleration due to gravity?

Figure 9.6

A Pema
B Dorji
C Sonam
D Karma

Answer: *D Karma*

Question 13. **[Analyzing]**

The gravitational force on the moon is lesser than Earth because the Moon

A is far away from the Earth.
B has less mass than the Earth.
C is closer to the Sun than to Earth.
D has more mass than the Earth.

Answer: *B has less mass than the Earth*

Question 14. **[Applying]**

When Sangay was in Gasa, he weighed 60N. On the same day, when he reached Phuentsholing, he weighed 100N. Do you think he has put on weight? Explain.

Answer: *No. Gasa is at a higher altitude than Phuentsholing. The acceleration due to gravity increases with decrease in altitude. Therefore, at Phuntsholing, Sangay is acted upon by higher acceleration due to gravity, increasing his weight.*

Question 15. **[Applying]**

Figure 9.7 shows a bee moving from flower to flower. Draw a displacement-time graph for the given diagram.

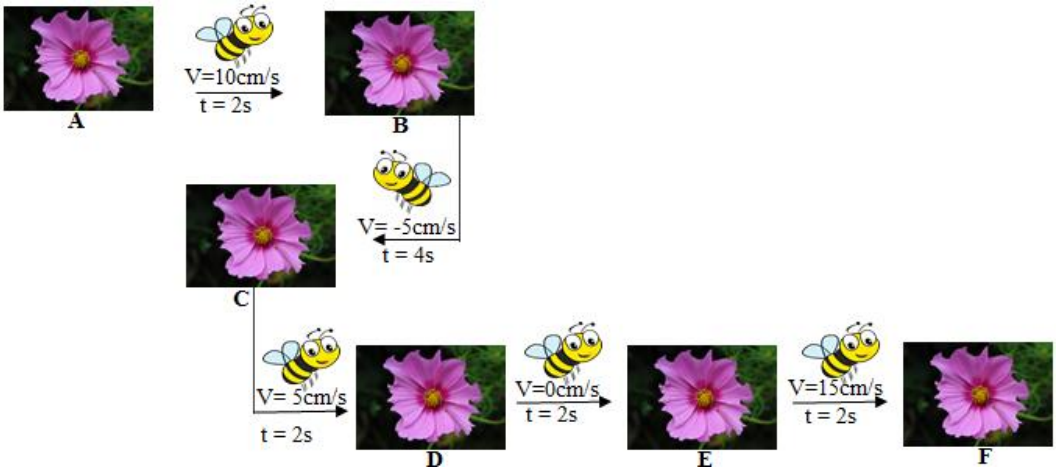
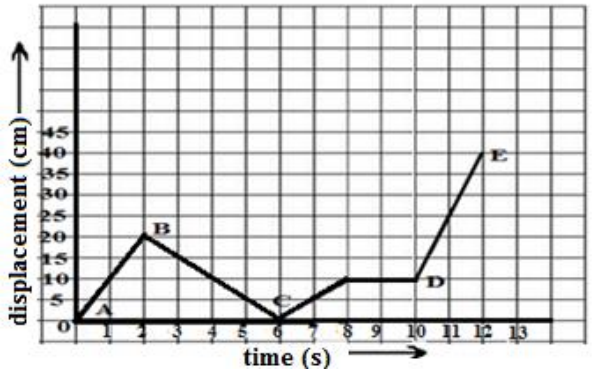


Figure 9.7

Answer:



Question 16. **[Evaluating]**

Assume that the acceleration due to gravity is two times more than the existing gravity on the Earth. How would life be on earth?

Answer: **(Suggestive)**

Every object on the surface of the earth will be twice as heavy and every activity and movement may require double energy.

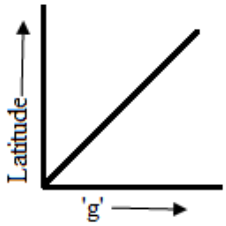
Question 17. **[Applying]**

Pema did a survey on relationship between latitude and acceleration due to gravity and got the information as shown in Table 9.1.

Table 9.1

Latitude	g (ms^{-2})
0	9.7804
15	9.7838
30	9.7933
45	9.8062
60	9.8191
75	9.8286

Draw a graph to represent the change in 'g' with the change in latitude. Interpret the graph.



Answer: *The change in 'g' is directly proportional to the change in latitude. Therefore, as the latitude increases, 'g' increases.*

Question 18. **[Analyzing]**

Sonam lives in Gelephu . During vacation he goes to Lunana to meet his parents. Sonam experiences a change in his body weight. Which graph below best represents this phenomenon?

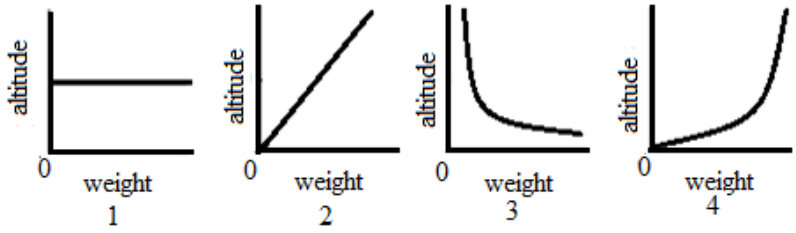


Figure 9.8

A 1
B 2
C 3
D 4

Answer: *C 3*

Question 19. **[Applying]**

An astronaut is able to lift a load of 392N on the Moon without much effort compared to the Earth. Give reasons.

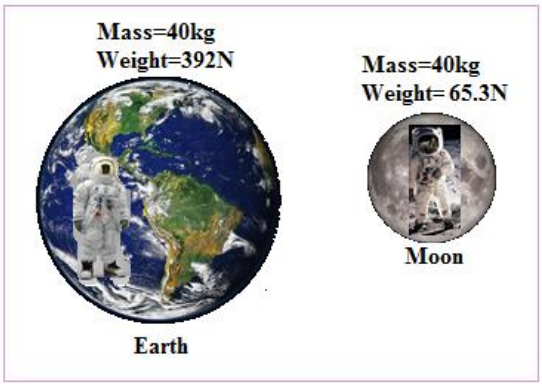


Figure 9.9

Answer: *The gravitational pull of the Earth is 9.8m/s^{2}and the gravitational pull of the Moon is 1/6th of the Earth's gravitational pull. Therefore, the load of 392 N would weigh 1/6th of 392N on the Moon, which is 65.3N that can be lifted without much effort on the Moon.*

Question 20. **[Applying]**

i) Fill-in the blanks in Table 9.2.with appropriate values.

Table 9.2

Location	**Value of g(ms^{-2})**	**Mass(kg)**	**Weight(N)**
Earth's surface	9.8	65	1.....
1000 km above surface	2.7.33	2……..	475
5000 km above surface	3.08	50	3……..
10000 km above surface	0.13	4…….	585

Answer: *1. 637 N* *2.64.80 kg* *3.154N* *4. 4500kg*

ii) What conclusion can you draw from the above table of values? **[Understanding]**

Answer: *Weight of a body is given by the product of mass and acceleration due to gravity.*

2. FLUID FRICTION

Learning Outcomes

At the end of the lesson, a student should be able to:

9.2.1 Define fluid friction and
9.2.2 Investigate the effects of fluid friction on objects moving through them.

Assessment Items

Question 1. **[Remembering]**

A fluid which is thick and sticky is a viscous fluid. Fluid friction increases with increase in viscosity of fluid. Choden dropped a marble in four different fluids as shown in Figure 9.10. In which fluid would the marble experience more friction?

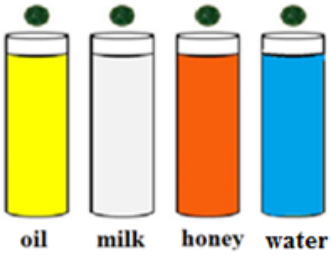


Figure 9.10

A oil
B milk
C honey
D kerosene

Answer: *C honey*

Question 2. **[Understanding]**

All the following objects have equal mass. The directions of the movement of the objects in water are indicated by arrows. Which object will take the shortest time?

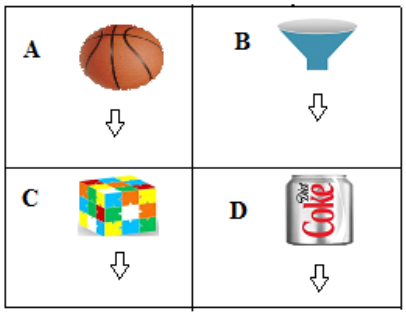


Figure 9.11

Answer: *B*

Question 3. **[Creating]**

Design a prototype of a toy which will reduce fluid friction.

Answer: (*Students could come up with the model of rocket, boat, etc.)*

Question 4. **[Remembering]**

Figure 9.12 represents a flow chart on fluid friction.

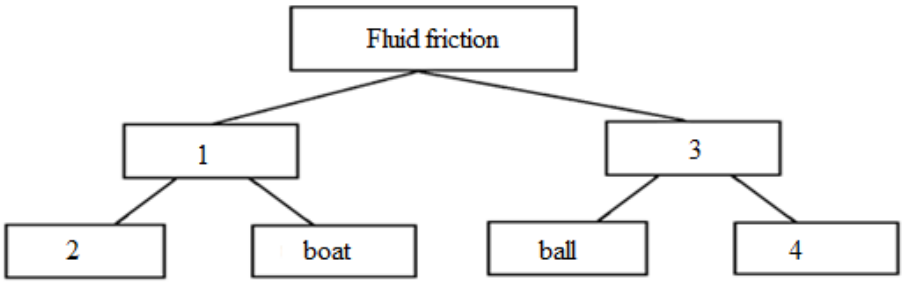


Figure 9.12

Which set of words will correctly fill the flowchart 9.12?

	1	2	3	4
A	*streamlined*	*truck*	*bluff*	*rocket*
B	*streamlined*	*rocket*	*bluff*	*juice can*
C	*bluff*	*boat*	*bluff*	*rocket*
D	*bluff*	*aeroplane*	*streamlined*	*arrow*

Answer:

B	*streamlined*	*rocket*	*bluff*	*juice can*

3. FORCE AND PRESSURE

Learning Outcomes

At the end of the lesson, a student should be able to:

9.3.1 Explain the term pressure,
9.3.2 Express the quantitative relationship between force, area and pressure and
9.3.3 Explain the application of pressure in our daily lives.

Assessment Items

Question 1. **[Remembering]**

Which one of the following uses the concept of pressure?

A rocking doll
B pointed shape of a rocket
C streamlined shape of a boat
D a wide foundation of a dam

Answer: *D a wide foundation of a dam*

Question 2. **[Applying]**

Rank the following shapes of boxes according to the pressure exerted by them in increasing order.

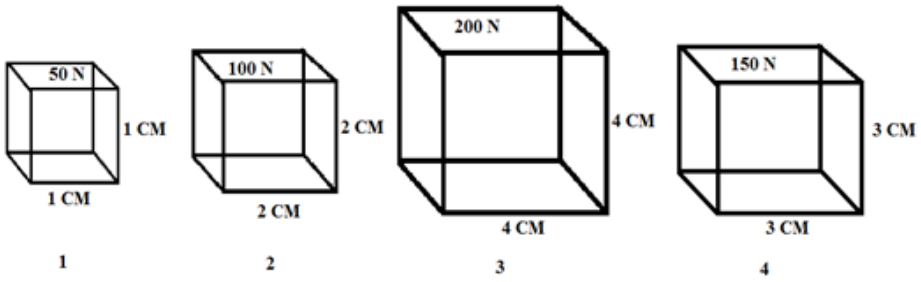


Figure 9.13

A 1, 2, 3, 4
B 3, 4, 2, 1
C 3, 4, 1, 2
D 2, 3, 4, 1

Answer: *B 3, 4, 2, 1*

Question 3. **[Applying]**

A woman walking in high heels can damage a wooden floor by making small dimples since her weight is concentrated on a small area. If the mass of the woman is 50kg and the tip of the high heel is $10cm^2$, what is the pressure exerted on the floor by the heel of the woman's shoes. (Take g =$10m/s^2$)

Answer: *Given: mass = 50kg, g = $10m/s^2$*

Area = $10cm^2 = 0.001m^2$

$$Pressure = \frac{force}{Area} = \frac{mass \times g}{Area} = \frac{50 \times 10}{0.001} = 500{,}000 Nm^{-2} (Pa)$$

Question 4. **[Understanding]**

Which one of the following posture A, B, C or D of a human exerts a minimum pressure on the floor.

Figure 9.14

Answer: *C*

Question 5. **[Understanding]**

Concrete blocks are stacked in three different ways (X, Y and Z) as shown in Figure 9.15.

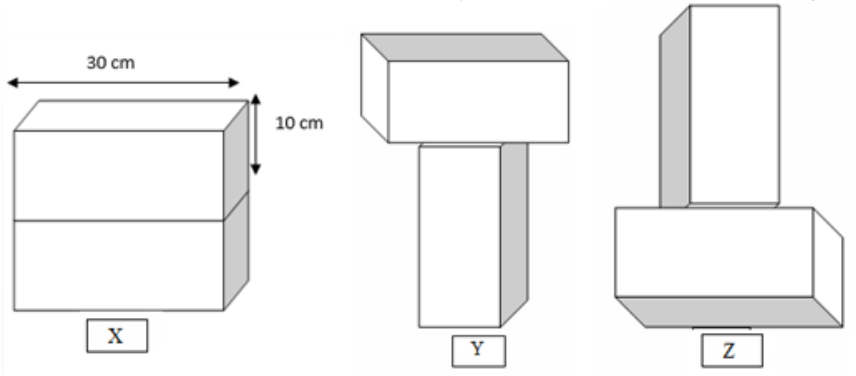


Figure 9.15

Complete the following sentences given below using a correct word(s)

i. The force of concrete blocks on surfaces X, Y and Z are…….
ii. The pressure on surface X is equal to the pressure from the concrete block on surface Z, because the ……..are equal.
iii. The pressure exerted on surface X is less than on surface …….
iv. The pressure exerted on surface Y is greater than X and Z as the surface area is of Y is …….. than X and Z
v. The fore exerted on surface Y is …… X and Z.

Answer: *i. equal ii. surface iii. Y iv. smaller v. equal to*

Question 6. **[Applying]**

A rectangular box of 2m x 1m x 0.5 m has a mass of 2500kg as shown in Figure 9.16. What is the pressure exerted by the box on the ground? (take: g =10ms^{-2})

A 2500 Pa
B 12500 Pa
C 25000 Pa
D 50000 Pa

Answer: *C 25000 Pa*

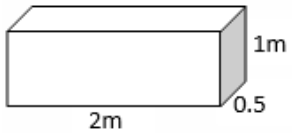


Figure 9.16

Question 7.
Figure 9.17 shows same book in different positions on a table. Answer the questions (i to v) based on the Figure 9.17.

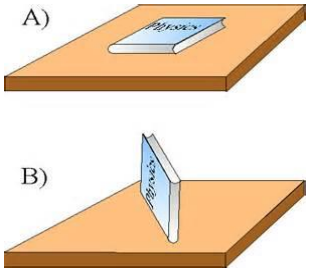


Figure 9.17

i. Write a hypothesis for the above experiment? **[Creating]**
Answer: *The book in both the positions will exert same force (weight) OR the book in position A will exert more pressure than in position B.*

ii. What is the controlled variable? **[Understanding]**
Answer: *Weight of the book.*

iii. Which book exerts more pressure? Why? **[Understanding]**
Answer: *Book in position B will exert more pressure due to small surface area in contact.*

iv**.** How will the pressure exerted by the book change if the book is placed on the ground? **[Applying]**
Answer: *The pressure exerted will remain same.*

v**.** Draw a conclusion from the above diagram. **[Evaluating]**
Answer: *The pressure on a surface is increased by reducing the surface area and the pressure on surface is reduced by increasing the surface area.*

Question 8. **[Applying]**
To pop a balloon, you poke it with a pin. If the area of the tip of the pin is $0.001cm^2$ and the pressure exerted by the pin on the balloon is $10dynecm^2$, how hard must you push on the pin to make the balloon pop?
Answer:
Given: $A = 0.001cm^2$, $P = 10dynecm^2$

$F = P \times A$

$F = 10 \times 0.001$

$\therefore F = 0.01dyne.$

Question 9. **[Applying]**

Figure 9.18 shows two wooden blocks kept on the ground. ($g = 10ms^{-2}$). Answer the questions i to iii based on Figure 9.18.

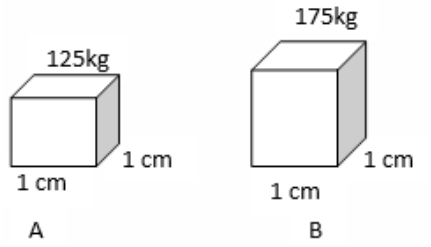


Figure 9.18

i. Predict which wooden block will exert more pressure on the ground.**[Understanding]**

Answer: *Block A or Block B*

ii. Calculate the pressure exerted on the ground by each wooden block. **[Applying]**

Answer: *Pressure exerted by wooden block A* $= \frac{force}{area}$

Force=mg=125×10= 1250N

Area= length × width= 1×1 = 1m²

Pressure $= \frac{1250}{1} = 1250\ Pa$

Pressure exerted by wooden block B $= \frac{force}{area}$

Force=mg=175×10= 1750N

Area= length × width= 1×1 = 1m²

Pressure $= \frac{1750}{1} = 1750\ Pa$

iii. Which block exerted more pressure? Why?

Answer: *Block B exerted more pressure because both the blocks have same surface area of contact but block B has more mass which applies more force downwards.*

iv. Draw a conclusion from the above findings. **[Evaluating]**

Answer: *Greater the force, greater is the pressure for the same contact surface area. Therefore, for controlled surface area, the pressure exerted by a body is directly proportional to the force exerted by the body.*

Question 10. **[Understanding]**

Write **TRUE** or **FALSE** against the following statements. Correct and rewrite the false statements.

i. Luggage bags have wide straps so that the force exerted on the shoulder is less.

ii. A sharp knife has less surface area of contact that increases pressure which cuts the vegetables even when less forces is applied.

iii. For a given thrust, pressure is directly proportional to the surface area.

Answer:

i. False; Luggage bags have wide straps so that the pressure exerted on the shoulder is less.

ii. True

iii. False; For a given thrust, pressure is inversely proportional to the surface area.

Question 11. **[Creating]**

Design an experiment to determine the relationship among pressure and surface area of contact. Write the following for your experiment.

i. Aim of the experiment
ii. Identification of variables (manipulated variable, responding variable and constant variable)
iii. List of apparatus and materials
iv. Procedure or method
v. Observations
vi. Conclusions

Answer:

- *To study the relationship between surface area and the pressure exerted by a force.*
- *Manipulated variable: area where the force is acting on*
- *Responding variable: pressure*
- *Controlled variable: Force*
- *Sample: ,100g weight, ruler, plasticine, three numbers of 200g wooden block: Block A- 2cm cuboid, Block B- 3cm cuboid, Block C- 4cm cuboid, of*
- *Procedure:*
  1. *Prepare a thick layer of plasticine*
  2. *Place Block A on the plasticine,*
  3. *Place the weight on top of Block A so that a dent is formed on the plasticine,*
  4. *Remove the weight and the block , and measure and record the depth of the dent*
  5. *Repeat step 1 to step 4with the Block B and Block C.*
- *Observation:*

Size of rectangular block of wood	*Small*	*Medium*	*Large*
Depth of the dent			

- *Conclusion:*

  The pressure exerted by a body decreases with the decrease in the surface area in contact.

Question 12. **[Applying]**

List **three** examples of roles of pressure in our daily life.

Answer: (Sample)

i. Rear wheels of buses or trucks are provided with double wheels to reduce pressure.
ii. Wide wooden sleepers are placed below the rail way track to reduce pressure exerted by the trains and avoid sinking of tracks into the ground.
iii. Cutting tools are either sharp or pointed so that a smaller thrust may cause greater pressure.
iv. The pressure under the studs on the soles of football shoes is high enough for the players to sink in the ground which gives extra grip.

CHAPTER 10
WORK, POWER AND ENERGY

1. POWER

Learning Outcomes

At the end of the lesson, a student should be able to:

10.1.1 Define power and its unit,
10.1.2 Calculate power and apply it in a variety of situations and
10.1.3 Calculate power in terms of the rate of doing work or of transferring energy.

Assessment Items

Question 1. **[Understanding]**

Which of the following statements are **valid** about power?

I. If 250 joule of work is done in 1 second by a device, then the power of the machine is 250 watt seconds.
II. A 60kg boy runs up a 2.0 meter staircase in 1.5 seconds. His power is approximately 1000 Watt.
III. Power is a measure of energy required to do the work.
IV. If person A and person B do the same work but person B does it faster than Person A then B has more power.

A I and III
B II and III
C III and IV
D II and IV

Answer: *C III and IV*

Question 2. **[Analyzing]**

Car A and car B of equal mass travel up a hill. Car A moves up the hill at a constant speed that is twice the constant speed of car B. Compared to the power developed by car B, the power developed by car A is

A equal to car B.
B half as much as car B.
C twice as much as car B.
D four times as much as car B.

Answer: *B half as much as car B*

Question 3. **[Analyzing]**

Ngawang and Rabgay ran up a staircase. Ngawang is twice as massive as Rabgay. Rabgay ascends the same distance in half the time.

i. Who did more work?

Answer: *Work done is directly proportional to the force applied. Ngawang must apply twice the force to lift his twice-as-massive body up the same flight of stair. Therefore, Ngawang does more work than Rabgay.*

ii. Who would have more power if Ngawang and Rabgay are of same mass? Explain your answers. **[Understanding]**

Answer: *Power is the rate of doing work. Rabgay is powerful as he could complete the same work in less time.*

Question 4. **[Understanding]**

During a Strong Man Competition, Phuntsho and Kinley took 7 minutes 45 seconds and 7 minutes 28 seconds respectively to complete all the tasks of pulling 110 kg log, cutting log, carrying 120 kg tyres and carrying 110 kg rice. Who is stronger? Explain your answers.

Answer: *Mr. Kinley is stronger than Phuntsho since he completed the same amount of work in less time.*

Question 5. **[Applying]**

A crane lifts a car of mass 300kg to a vertical height of 200m in 5 minutes. If acceleration due to gravity is 9.8m/s^2, then the power used to lift the car is

A 1906 W
B 9610 W
C 1690 W
D 1960 W

Answer: *D 1960 W*

Question 6. **[Applying]**

Figure 10.1 shows a man pulling a mini truck in 1 minute.

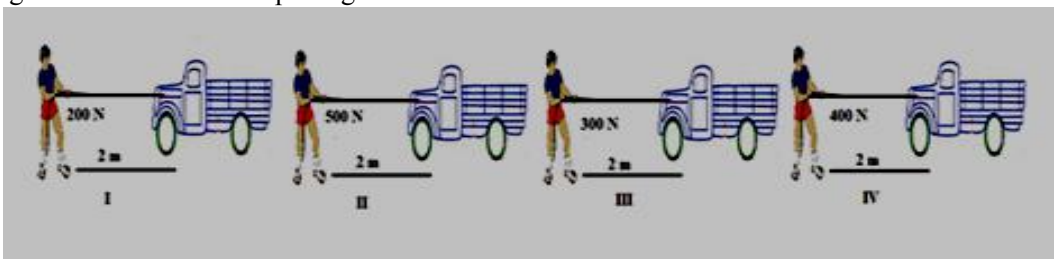


Figure 10.1

In which case the power involved is less than 11W?

A I only
B II only
C I and III
D I and IV

Answer: *C I and III*

Question 7. **[Applying]**

On a very cold day Wangmo switched on a 1000W radiator for 3hours. How much energy is consumed by the by radiator to produce heat?

A 333.3J
B 3000J
C 1.8×10^5 J
D 1.08×10^7 J

Answer: *D* $1.08\times10^7 J$

Question 8. **[Applying]**

The Figure 10.2 shows the amount of work done by five different people to fix a nail on the wall. Who do you think has applied the same amount of power to fix a nail on the wall?

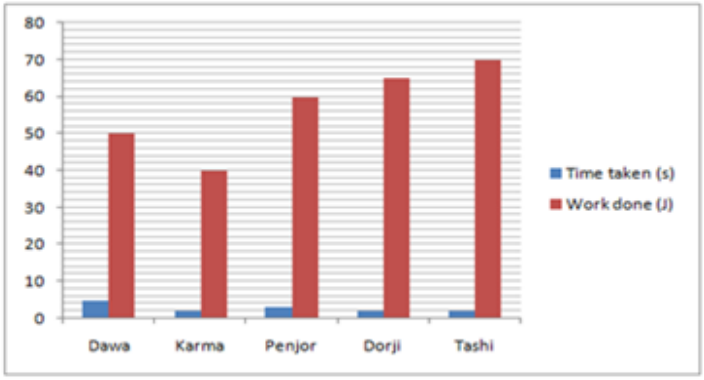


Figure 10.2

A Dawa and Karma
B Penjor and Tashi
C Karma and Penjor
D Dorji and Karma

Answer: *C Karma and Penjor*

Question 9. **[Applying]**

The amount of work done and time taken by four machines are listed in Table 10.1. Which machine is the most powerful?

Table 10.1

Machine	Work	Time
W	100 J	5 s
X	100 J	10 s
Y	200 J	5 s
Z	200 J	10

A Machine W
B Machine X
C Machine Y
D Machine Z

Answer: *C Machine Y*

Question 10. **[Applying]**

An electric motor of power 200 watt is used to drive the stirrer in a water bath. If 50% of the energy is supplied to the motor is spent in stirring the water. Calculate the work done on the water in one minute.

Answer: *Power on water= 50% of water supplied*

$$= \frac{50}{100} \times 200watt = 100watt$$

Work done= Power × Time

= 100× 60 = 6000J

Question 11. **[Applying]**

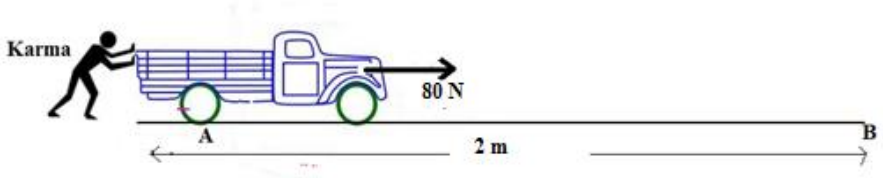


Figure10.3

Karma's rate of doing work is 16 W. Karma displaces his car from point A to B through 2m by applying a force of 80N as shown in Figure 10.3. The time taken by Karma to displace a car from point A to point B is

A 6 seconds.
B 8 seconds.
C 9 seconds.
D 10 seconds.

Answer: *D* *10 seconds*

Question 12. **[Applying]**

Dorji observed that his water tank placed on the top of a tower of 80 m as shown in Figure 10.4 was empty. He uses a motor to pump 10L of water every 20 seconds into the tank with a force of 5000 N. Calculate the power of the pump.

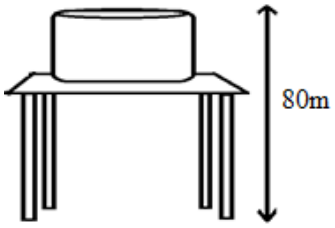


Figure 10.4

A 16,000W
B 20,000W
C 400,000 W
D 100,000W

Answer: *B* *20,000W*

Question 13. **[Applying]**

Figure 10.5 shows a man pulling a mini truck. How much force would the man use to displace the car in 60 s?

A 2000 N
B 2500 N
C 3000 N
D 3050 N

Answer: *C* *3000 N*

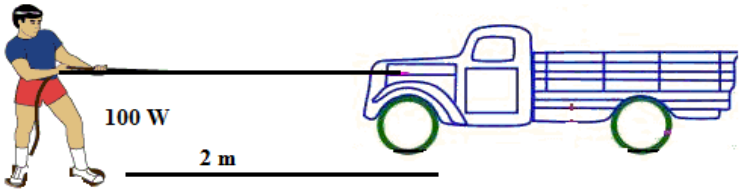


Figure10.5

Question 14. **[Analyzing]**

Different kind of lighting appliances are used to light our homes with equal brightness for 3 hours as shown in Figure 10.6.

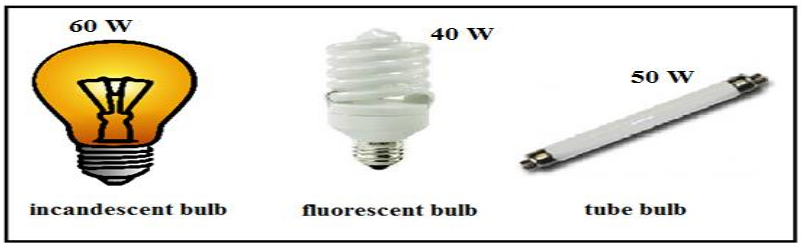


Figure10.6

i. Which of the above lighting appliances would you prefer to light your home to save energy?

Answer: *i) Energy consumed by incandescent bulb = power × time*

= 60 × 3

= 180Wh

Energy consumed by fluorescent bulb = 40× 3 = 120Wh

Energy consumed by tube = 50× 3 = 150Wh.

I would prefer fluorescent bulb as it consumes less energy and gives equal brightness as other lighting appliances.

Question 15. **[Applying]**

Sonam carries 50kg of rice and walked 15 steps each of 10cm height in 5 minutes. Find the power required by Sonam to carry the bag of rice. [Take g= 9.8ms^{-2}]

Answer: *Power* = $\frac{work}{Total}$

Work done = Force ×displacement

Force = mg = 50×9.8 = 490 N

Displacement = 15×10 = 150 cm = 1.5m

Work done = 490×1.5 = 735J

Power= $\frac{735}{300} = 2.45\ watt$

Question 16. **[Applying]**

A car weighing 400kg carries a load of mass 200kg and reaches the top of a gradient in 10 minutes. If power of the car is 4900W, calculate the height of the gradient the car climbed. (Take g =9.8m s^{-2})

Answer: *Given; total mass of the car is 400kg +200kg =600kg*

Weight = 600 × 9.8 = 5880 N

Time = 10 minutes =600 seconds

Power = 4900 W

Power = $\frac{Force \times displacement}{time}$

4900 = $\frac{5880 \times d}{600}$

d = $\frac{4900 \times 600}{5880}$

d = 500 m

The height of the gradient is 500m.

2. ENERGY

Learning Outcomes

At the end of the lesson, a student should be able to:

10.2.1 Define energy and its unit,
10.2.2 Differentiate between potential energy and kinetic energy and
10.2.3 Discuss the relevance of energy in our day to day life.

Assessment Items

Question 1. **[Remembering]**

Which one of the following event describes kinetic energy?

A loaded truck
B book lying on a table
C dart striking a target
D an exhausted dry cell

Answer: *C dart striking a target*

Question 2. **[Understanding]**

Which of the following statements correctly describe the requirement of energy?

I Energy is spent when a man bends an iron bar.
II Energy is spent when a chair supports a man sitting on it.
III Energy is spent when a boy swings his arms during exercise.
IV Energy is spent when a helicopter lifts a passenger off the ground.

A I, II and III
B I, III and IV
C II, III and IV
D I, II, III and IV

Answer: *B I, III and IV*

Question 3. **[Applying]**

The monthly household consumption of electricity is 250kWh. How much energy in joules is consumed by the house?

A 3.6×10^3J
B 3.6×10^6 J
C 9.0×10^8J
B 9.0×10^{10} J

Answer: *C* 9.0×10^8 *J*

Question 4. **[Remembering]**

Most of the electrical energy we use in Bhutan is generated from the

A air.
B sun.
C soil.
D water.

Answer: *D water*

Question 5. **[Understanding]**

Figure 10.7 below shows a crane moving construction materials.

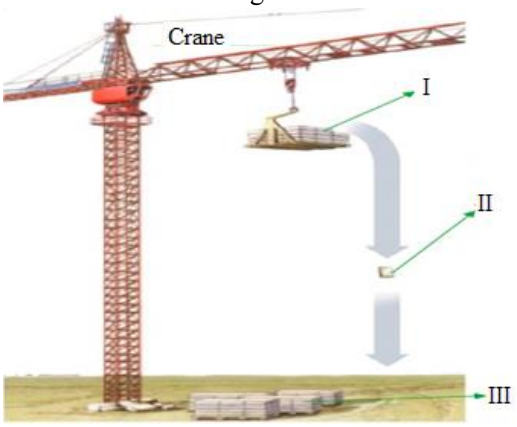


Figure10.7

Which of the following shows the correct sequence of energy transformation from stages I to III?

A I: the block has high potential energy
II: the block has kinetic energy
III: the block has low potential energy.

B I: the block has high kinetic energy
II: the block has neither potential energy nor kinetic energy.
III: the block has low potential energy

C I: the block has neither potential energy nor kinetic energy.
II: the block has high potential energy
III: the block has low kinetic energy

D I: the block has low potential energy
II: the block has neither potential energy nor kinetic energy.
III: the block has low kinetic energy

Answer: *A* *I: the block has high potential energy*
II: the block has kinetic energy
III: the block has low potential energy.

Question 6. **[Analyzing]**

In Figure 10.8, A, B, C, D and E show the positions of a rolling ball at different intervals of time.

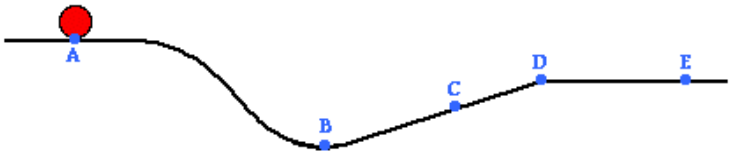


Figure10.8

The potential energy of the ball at point C is

A greater than D and E but equal to B.

B lower than B but greater than D.

C lower than A but greater than B.

D lower than B but greater than A.

Answer: *C* *lower than A but greater than B*

Question 7. **[Understanding]**

Pema threw a ball vertically up .Which one of the statements best describe the energy changes that occurs when ball is thrown vertically up?

A both potential energy and kinetic energy increases
B both potential energy and kinetic energy decreases
C kinetic energy decreases and potential energy increases
D kinetic energy increases and potential energy decreases

Answer: *C kinetic energy decreases and potential energy increases*

Question 8. **[Understanding]**

A person shoots an arrow at a target as shown in Figure 10.9. Which state of the bow and arrow has the greatest amount of potential energy?

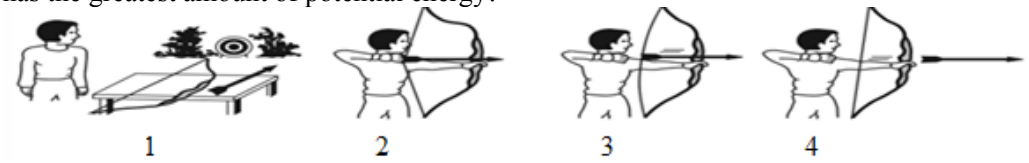


Figure 10.9

A 1
B 2
C 3
D 4

Answer: *B 2*

Question 9. **[Applying]**

Figure 10.10 shows a toy airplane. The propeller is turned twenty times, which twist the rubber band connected to it. When the propeller is released, the rubber band unwinds and the propeller turns at a high speed enabling the airplane to fly.

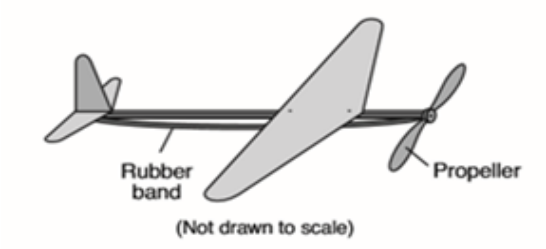


Figure 10.10

i) What type of energy results when the rubber band unwinds and the propeller turns enabling the airplane to fly?

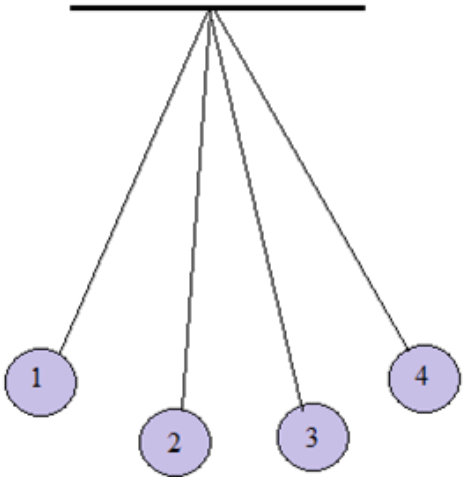
Answer: *i) Potential and kinetic energy*

ii) Identify one change that could be made to make the toy airplane fly at different speeds.

Answer: *Use thick or thinner rubber band or turn the propeller more times or change the mass of the air plane.*

Question 10. **[Applying]**

As the pendulum bob of 500g swings to and fro in a vacuum, its height and speed constantly changes. As the height decreases, potential energy decreases and simultaneously the kinetic energy increases. Yet at all times, the sum of the potential and kinetic energies of the bob remains constant. The total mechanical energy is 6 J. There is no loss or gain of mechanical energy, only a transformation from kinetic energy to potential energy and vice versa. This is depicted in Figure 10.11.



Position 1
PE = 2J
KE = 3J
h = A m
v = 3.8m/s

Position 2
PE = 1J
KE = 2J
h = B m
v = C m/s

Position 3
PE = 2J
KE = 2J
h = 4m
v = D m/s

Position 4
PE = 2J
KE = 1J
h = 3m
v = E m/s

Figure10.11

Calculate the values of A, B, C, D and E using the equations of energy at different positions.

Answer:

A: ***h = 0.4m*** *(2J/(0.5kg*9.8m/s)*

B: ***h = 0.2m*** *(1J/(0.5kg*9.8m/s)*

C: ***v = 4.47m/s*** $(\sqrt{2} * (2J/0.2m)$

D: ***h = 1m*** $(\sqrt{2} * (2J/4m)$

E: ***v = 0.81m/s*** *(*$\sqrt{2}$**1J/3m)*

3. HEAT ENERGY

Learning Outcomes

At the end of the lesson, a student should be able to:

10.3.1 Differentiate between heat and temperature,
10.3.2 Describe ways in which heat energy can be transferred and stored and
10.3.3 Relate the conceptual ideas of heat energy transfer to everyday life.

Assessment Items

Question 1. **[Understanding]**

Which of the following heat transfer is taking place in Figure 10.12?

I heat energy is transferred from the a mug of hot drink to the hand
II heat energy is transferred to a mug of hot drink from the hand
III heat energy is transferred from the ice to the hand
IV heat energy is transferred to the ice from the hand
A I and III
B I and IV
C II and III
D II and IV

Figure 10.12

Answer: *B I and IV*

Question 2. **[Applying]**

Wangmo wants to take a bath. She added 5 liters of water at 30^0 C to 5 liters of water at 50^0 C. The resulting temperature of mixture will be

A 30^0 C.
B 45ºC.
C 50^0C.
D 80^0 C.

Answer: *B* *45^0C*

Question 3. **[Remembering]**

Write **TRUE** or **FALSE** against the following statements. Correct and rewrite the false statements.

i. Heat is a form of energy.
ii. Thermal equilibrium is the measure of degree of hotness and coldness of the body.
iii. Kelvin, Celsius and Joule are all units of measurement of temperature.
iv. Heat energy transferred with the contact of bodies is called dissipation.

Answer*:*

i. True
ii. False; Temperature is the measure of degree of hotness and coldness of the body.
iii. False; Kelvin, Celsius and Fahrenheit are all units of measurements of temperature.
iv. False; Heat energy transferred with the contact of bodies is called conduction.

Question 4. **[Understanding]**

A 300ml of water in two identical beakers were heated for 2 minutes. The temperature of the water was recorded in each beaker after two minutes as shown in Figure 10.13

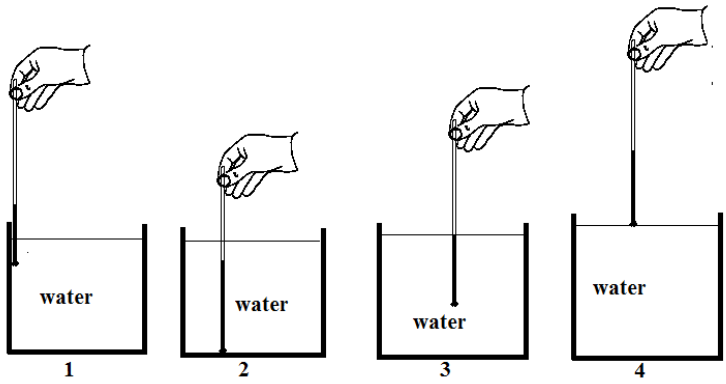


Figure10.13

Where should the thermometer be placed to accurately record the average temperature of water?

A 1
B 2
C 3
D 4

Answer: *C 3*

Question 5. **[Analyzing]**

Pema conducted an experiment to shows the changes in temperature of water when ice cubes are put into it as shown in Figure 10.14.

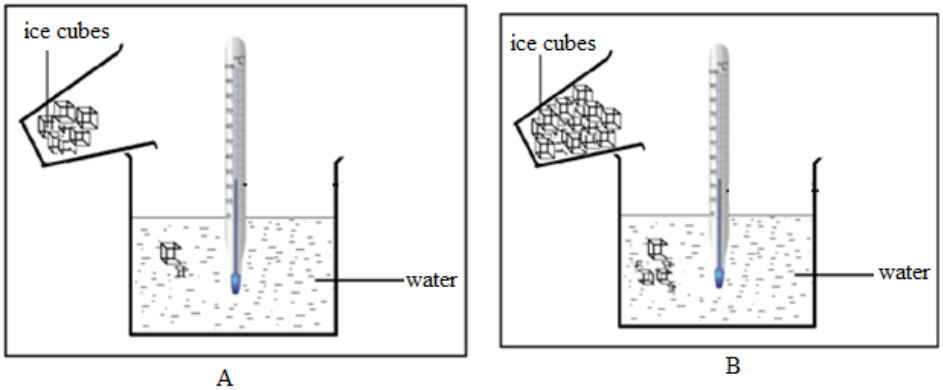


Figure 10.14

a) State the manipulated and controlled variable in this experiment.

Answer: *Manipulated variable-amount of ice and controlled variable-volume of water in beaker.*

b) State the hypothesis of this experiment.

Answer: *The more amount of ice added to the water, lower will be the final temperature of water.*

c) What will happen to the final reading of the thermometer if the volume of the water is increased?
Answer: *Final reading is higher.*

Question 6. **[Understanding]**
Which one of the following beakers, A and B, in figure 10.15 have more heat? Explain.

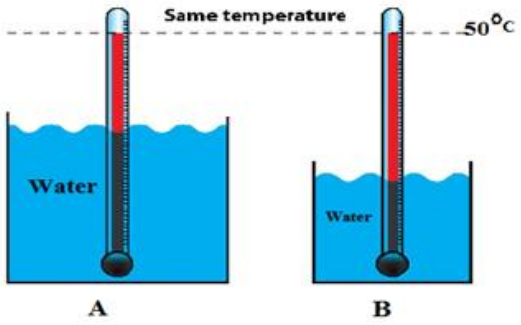


Figure10.15

Answer: *Beaker A would have more heat even if they are at same temperatures because the beaker with greater volume of water stores more heat energy.*

Question 7. **[Understanding]**
Which example best demonstrate the process of conduction?
A A piece of paper burning.
B Sunlight warming up a room.
C Warm air rising above a lit candle.
D A metal spoon warming up while stirring a hot soup.
Answer: *D A metal spoon warming up while stirring a hot soup.*

Question 8. **[Applying]**
The Figure 10.16 shows the modes of transmission of heat with incorrect labeling. Which of the following is the correct mode of transmission of heat?

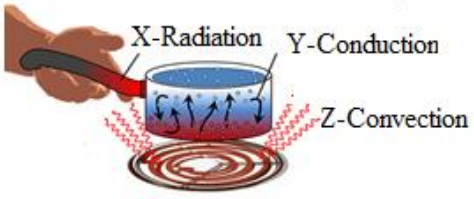


Figure10.16

	X	Y	Z
A	conduction	convection	radiation
B	Radiation	convection	conduction
C	conduction	radiation	convection
D	conduction	convection	radiation

Answer: *A*

Question 9. **[Understanding]**

Why does the end of a metal spoon kept in hot water also becomes hot?

A The heat is conducted from the hot water to the spoon.
B The hot water causes the spoon to produce heat.
C The heat is convected from water to the spoon.
D The heat is inducted from water to the spoon.

Answer: *A The heat is conducted from the hot water to the spoon.*

Question 10. **[Understanding]**

If you stand next to a fire, most of the heat energy is transferred to you as heat is conducted via

A diffusion.
B radiation.
C convection.
D conduction.

Answer: *B radiation*

Question 11. **[Applying]**

Identify the methods of heat transfer that takes place in each illustration as shown in Figure 10.17. Some illustrations may show more than one form of heat transfer.

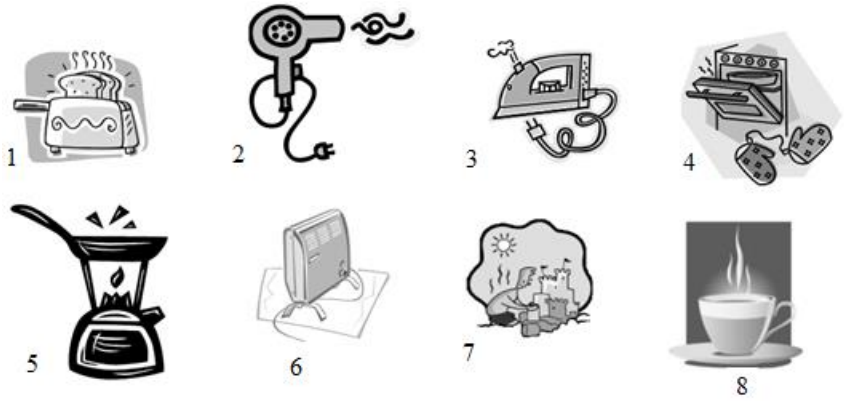


Figure 10.17

Answer: *1. conduction* *2. convection* *3. conduction*
4. Radiation *5. radiation and conduction* *6. radiation*
7. radiation *8. convection*

Question 12. **[Understanding]**

A handle of a pan are generally made from Bakelite to

A avoid conduction of heat to the handle.
B increase the grip on the pan.
C decorate the pan.
D prevent fire.

Answer: *A avoid conduction of heat to the handle*

Question 13. **[Understanding]**

Radiant energy from the Sun is transferred by radiation because

A air is a good conductor of heat.
B the Sun is too far from the Earth.
C heat does not always need a medium to transfer.
D the heat energy is unique to be transferred only by radiation.

Answer: *C* heat does not always need a medium to transfer.

Question 14. **[Analyzing]**

In places like Phuentsholing, it is advised to paint the outer walls of houses white. Give reasons.

Answer: *This is because Phuentsholing is a warm place. If our house is painted white, it absorbs less heat and reflects most of the heat from the sunlight that falls on it. Therefore, the temperature inside the house remains low.*

Question 15. **[Analyzing]**

This game is about the mode of transfer of heat to be played between two players.
From the table 10.2, find the words related to transfer of heat.

Table 10.2

c	d	e	g	r	e	e	a	r	d
o	r	t	r	a	n	s	f	e	r
n	c	o	n	d	u	c	t	o	r
d	r	g	o	i	n	c	e	e	e
u	e	e	r	a	a	t	t	e	w
c	e	e	n	t	a	w	a	v	e
t	n	d	n	i	d	w	c	a	i
i	r	o	d	o	i	e	i	e	t
o	c	a	a	n	r	a	u	e	r
n	r	a	t	c	t	n	v	t	t

Answer: *1. radiation* *2. radiate* *3. transfer*
4. conductor *5. degree* *6. conduction*
7. contact

4. DISSIPATION OF ENERGY

Learning Outcomes

At the end of the lesson, a student should be able to:

10.4.1 Define dissipation of energy with examples,
10.4.2 Explain how dissipation of energy reduces the efficiency and availability of energy resources and
10.4.3 Explain methods of reducing dissipation of energy.

Assessment Items

Question 1. **[Understanding]**

Whenever there is an energy transformation or transfer, the energy dissipated are treated as the waste of energy. In figure 10.18, name the dissipated energy 1 and 2.

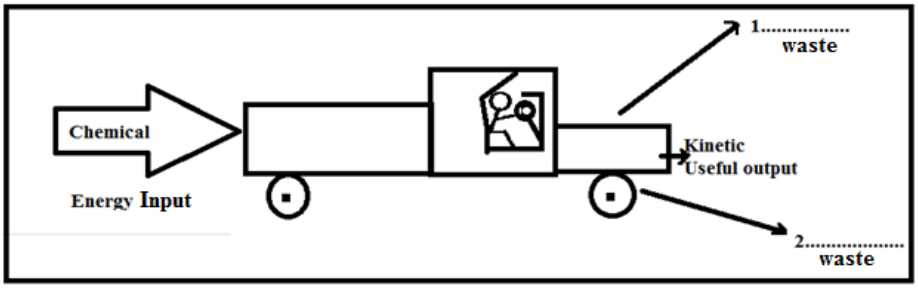


Figure 10.18

	1	2
A	chemical energy	sound energy
B	light energy	chemical energy
C	light energy	nuclear energy
D	sound energy	heat energy

Answer: *D sound energy and heat energy*

Question 2. **[Understanding]**

Which of the following activity dissipate light energy?

A lighting a bulb
B lighting a torch
C using a car battery
D cooking using LPG

Answer: *D cooking using LPG*

Question 3. **[Applying]**

As global warming and climate change is real and a growing issue. It is crucial that more effort is put into reducing energy consumption in homes. What steps can you take to save energy in your home?

Answer: *1)Put off the electrical appliance when not in use. 2) Purchase energy efficient electronics as they have low operating costs. 3) Use Energy star LED or compact fluorescent light bulbs. 4) Use high quality wiring in homes.*

Question 4. **[Applying]**

When energy is transferred from one form to another form some energy is converted into undesirable form. Fill in Table 10.3 with the form of dissipated energy from the different appliances. One example is done for you.

Table 10.3

Appliances	**Energy transformation**	**Useful output energy**	**Energy dissipated energy**
Television	*Electrical → light+ sound + heat energy*	*Light and sound*	*heat*
Light bulb	.....	.....	.....
Electric fan	.....	.....	.....
Hair dryer	.....	.....	.....
Power drill	.....	.....	.....

Answer:

Appliances	*Energy transformation*	*Useful output energy*	*Energy dissipated*
Television	*Electrical→ light+ sound + heat energy*	*Light and sound*	*heat*
Light bulb	*Electrical→ light + heat energy*	*light*	*heat*
Electric fan	*Electrical→ mechanical + heat energy +sound*	*mechanical*	*Heat+ sound*
Heater	*Electrical→ light + heat energy*	*heat*	*light*
Hair dryer	*Electrical→ sound + heat energy*	*heat*	*sound*
Power drill	*Electrical→ mechanical+ sound + heat energy*	*mechanical*	*Sound and heat*

Question 5. **[Understanding]**

The transformation of energy taking place from one form to another form is shown in Figure 10.19. Fill in the blanks numbered 1to 7 in the concept map given below.

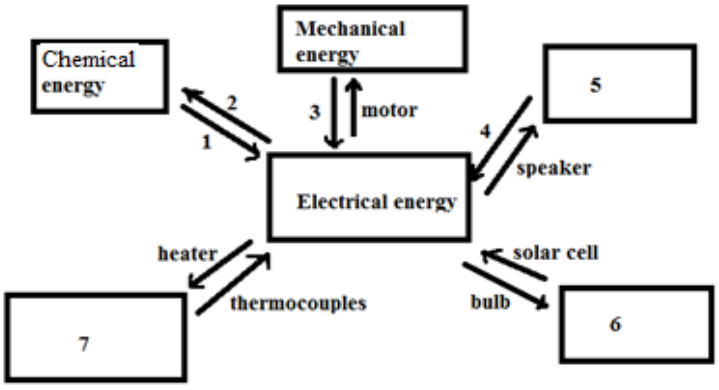


Figure 10.19

Answer:

1. Primary cell *2. Charging cell* *3. Dynamo* *4. Microphone*
5. Sound energy *6. Light energy* *7. Heat energy*

Question 6. **[Applying]**

Which conducting wire made up of the same material as shown in Figure 10.20 dissipates more energy?

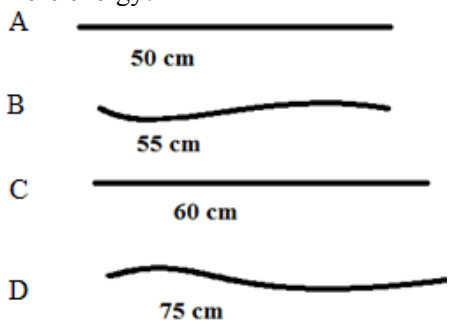


Figure10.20

Answer: *D*

Question 7. **[Analyzing]**

Which is more energy efficient, an incandescent light bulb or a compact fluorescent light bulb? Explain.

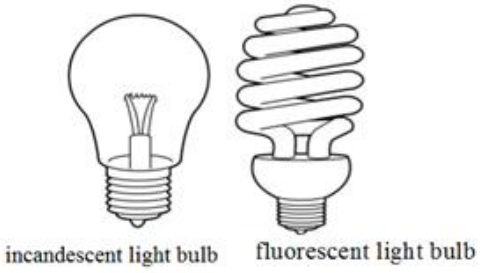


Figure 10.21

Answer:

A compact fluorescent light bulb is more energy efficient. In an incandescent light bulb, 100J of electrical energy is needed every second to make it work. Of this, 5J of light energy is produced per second. 95J of heat energy is also produced per second. We use a light bulb for light so, only 5J of the 100J of input energy is useful output energy (light) and 95J is dissipated (heat).In compact fluorescent light bulbs, the amount of useful output energy (light) is higher and the dissipation of energy (heat) is lower. This makes them more energy efficient than an incandescent light bulb.

Question 8. **[Understanding]**

World Energy Conservation Day is celebrated on 14th December globally to high light the importance of energy consumption and its use in our day to day life, its scarcity and its impact on sustainability of global eco systems. Being a responsible citizen of green Bhutan, list down the points on 'how to minimize use of energy'.

Answer: (Sample)

Timely maintenance of electronic equipment, greater use of public transport, bicycles instead of cars, better insulation in buildings, manufacturing goods that last longer, recycling more waste material to generate energy.

CHAPTER 11
ELECTRICITY AND MAGNETISM

1. CIRCUITS

Learning Outcomes

At the end of the lesson, a student should be able to:

11.1.1 Define current, resistance, voltage and state their units and symbols
11.1.2 State Ohm's Law and derive the relationship between current, voltage and resistance and
11.1.3 Describe the transfer of energy in a battery and its exhaustion.

Assessment Items

Question 1. **[Understanding]**

A current is said to exist whenever

A a wire is connected.
B a battery is connected.
C potential difference exists.
D electric charges flow in a circuit.

Answer: *D* *electric charges flow in a circuit*

Question 2. **[Understanding]**

We should not switch on the electrical appliances with wet hands because the water on wet hands

A offers resistance to the circuit.
B leads to the rusting of the appliances.
C conducts current and gives electric shocks.
D damages the appliances by increasing the voltage of the circuit.

Answer: *C* conducts current and gives electric shocks

Question 3. **[Analyzing]**

If the resistance of a circuit is tripled, then the current flowing through the circuit would be

A one-third as much.
B two-third as much.
C three times as much.
D four times as much.

Answer: *A* *one- third as much*

Question 4. **[Understanding]**

According to the Ohm's Law as

A *I* decreases, *V* increases proportionally.
B *I* increases, *V* increases proportionally.
C *I* increases, *R* increases proportionally.
D *I* decreases, *R* increases proportionally.

Answer: *B* *I increases, V increases proportionally*

Question 5. **[Applying]**

All the given wires in the Figure 11.1 are good conductors. The electrical resistance of the wires in the ascending order is

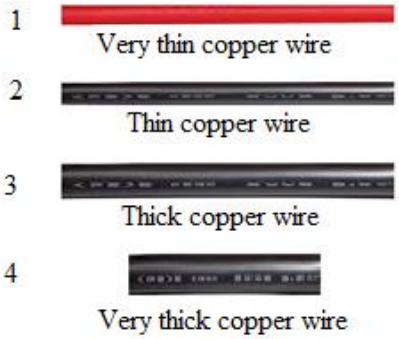


Figure 11.1

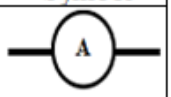
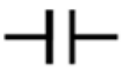
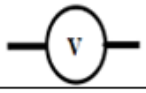
A 1<2<3<4
B 1<3<4<2
C 4<3<2<1
D 3<4<2<1

Answer: *C* *4<3<2<1*

Question 6. **[Remembering]**

The Table 11.1, shows the units and symbols of components of electrical circuits. Which one of the following unit correctly matches with its symbol?

Table 11.1

	Unit	Symbol
A	Volt	
B	Ampere	
C	Ohm	
D	Coulomb	

Answer: *C*

Question 7. **[Understanding]**

The two poles of the cell are known as

A North Pole and South Pole.
B cathode and anode.
C live and neutral.
D head and base.

Answer: *B* *cathode and anode*

Question 8. **[Analyzing]**

In the Figure 11.2, the nozzle of the water pipe represents resistance, while water pressure represents voltage and the flow of water represents current. This analogy refers to

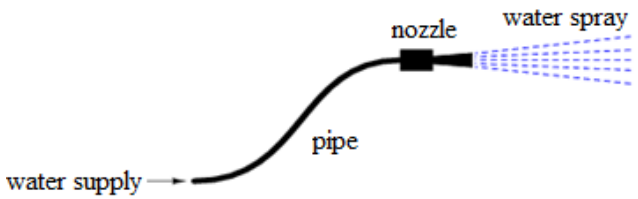


Figure 11.2

A Gas law.
B Ohm's law.
C Newton's law.
D Coulomb's law.

Answer: *B* *Ohm's law*

Question 9. **[Applying]**

Identify the correct relationship between resistance (R), current (I) and voltage (V) as stated by Ohm's Law.

A $R = \frac{V}{I}$

B $R = V \times I$

C $V = \frac{I}{R}$

D $I = V \times R$

Answer: *A* $R = \frac{V}{I}$

Question 10. **[Analyzing]**

Wangchuk conducted an experiment to study the relationship between voltage and electric current as shown in the table.11.3 below.

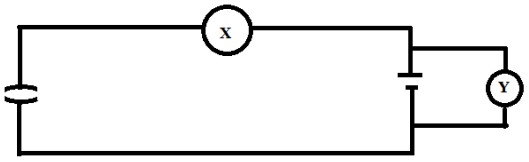


Figure 11.3

The result of his experiment is tabulated in the table given below:

Table 11.2

Current(A)	Voltage (V)
0.22	0.66
0.47	1.42
0.85	2.54
1.05	3.16
1.50	4.51

a) List down all the materials used in his experiment. **[Understanding]**
Answer: *Insulated wire, an ammeter, a voltmeter, dry cells and key*

b) Write the procedure of the experiment. **[Applying]**
Answer:
1. Set up the experiment as per the circuit diagram by connecting ammeter in position X and voltmeter in position Y.
2. Note down the least count of ammeter and voltmeter.
3. Note down the potential difference of the dry cell.
4. Plug in key to complete the circuit.
5. Record the reading in the voltmeter and ammeter with one dry cell.
6. Repeat the step 3, 4 and 5 with two battery, three battery, four battery and five battery.

c) Identify the controlled variable in the experiment. **[Understanding]**
Answer: *Resistance of the circuit remains the same throughout the experiment.*

d) State the relationship between current and voltage**.** **[Analyzing]**
Answer: *Flow of current is directly proportional to the voltage across the terminals of the electric circuit.*

e) What would be the voltammeter reading when no deflection is observed in the ammeter? [**Understanding]**
Answer: *Zero volt*

f) How much voltage will be required to produce a current of 1.25A? **[Applying]**
Answer: *4V (Approximately*

g) How much current will flow through the circuit if the battery is 2V? **[Applying]**
Answer: *0.6A (Approximately)*

Question 11. **[Understanding]**
Which of the following energy conversion takes place in torch lighted by a battery?
A mechanical→ electrical →light
B chemical→ electrical → light
C electrical→ chemical → light
D chemical→ mechanical → light
Answer: *B chemical → electrical → light*

Question 12. **[Understanding]**
Primary cells differ from secondary cells mainly because secondary cells
A have cathode or anode only.
B have very high voltage.
C are smaller in size.
D can be recharged.
Answer: *D can be recharged*

Question 13. **[Applying]**

Why should batteries be disposed properly?

Answer: *This is because the batteries cause the following hazards:*

- *Batteries contains toxic chemicals which may pollute lake and streams if thrown into them,*
- *Batteries produces harmful gases when burned polluting the air and*
- *Batteries contain non-degradable and corrosive chemicals which can pollute land.*

Question 14. **[Analyzing]**

Wangmo tests three types of cells A, B and C to check which one would last the longest in a flashlight. She switches on a flash light with cell A and records the time till the light goes off, which indicates the exhaustion of the cell. She repeats the experiment with cells B and C on the same flash light. Finally, she plots a bar graph based on her observations as shown in Figure 11.4.

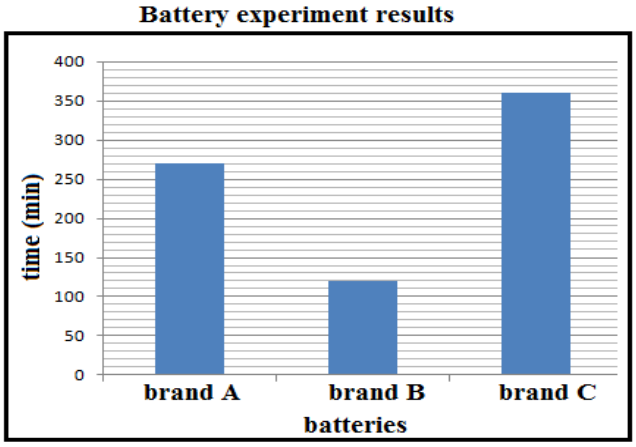


Figure 11.4

What conclusion can you draw from the experiment?

A C lasted twice as long as A
B A lasted twice as long as B
C C lasted two times longer than B
D C lasted three times longer than cell B

Answer: *D C lasted three times longer than B*

Question 15. **[Applying]**

Figure 11.5 shows four cells.

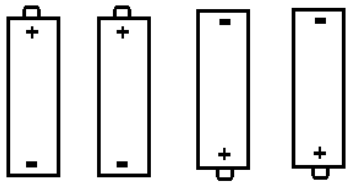
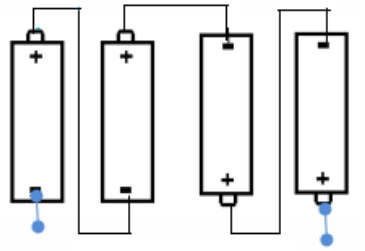


Figure 11.5

Draw a line to connect their terminals to obtain maximum voltage with the cells at the same positions.

Answer: *To obtain maximum voltage, cells are connected in series i.e. negative (-) end of one cell is connected to positive (+) end of another cell or vice versa.*

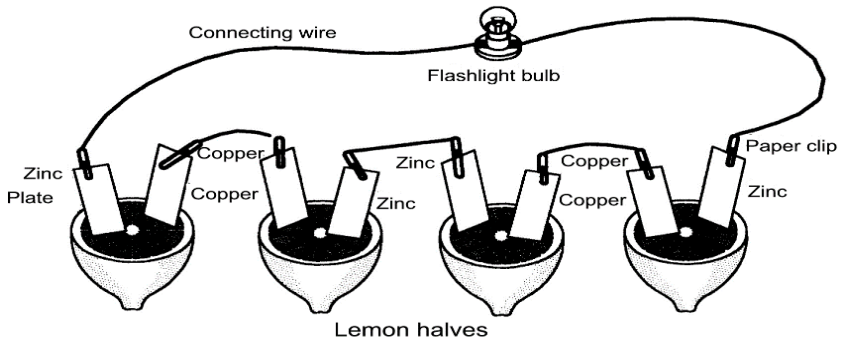


Question 16. **[Creating]**

Design an electrical circuit using the following materials:

- *lemon/ potato*
- *copper strip*
- *zinc strip*
- *circuit wire*
- *LED light bulb*

Answer:



Question 17. **[Evaluating]**

Rechargeable batteries are preferred over disposable batteries. Do you agree? Justify

Answer: *Yes, because (Sample response)*

- ***Save Money:*** *When used properly, rechargeable batteries can be used hundreds or even thousands of times! They do cost more initially, but can definitely pay for themselves over time.*
- ***Conserve Resources:*** *Because rechargeable batteries can be used over and over, fewer batteries need to be manufactured (and transported) than with single use varieties. In fact, rechargeable batteries consume up to* ***23 times*** *less non-renewable natural resources than disposable batteries.*
- ***Protect the Environment:*** *Most people don't realize the extent of single use batteries' environmental impacts. Heavy metals, corrosive materials, and other nasty chemicals combined with (all-too-common) improper disposal spells bad news for the environment. But rechargeable batteries have 28 times less impact on global warming, 30 times less*

impact on air pollution, 9 times less impact on air acidification, and 12 times less impact on water pollution!

- ***Performance:*** *Many of today's rechargeable batteries actually last longer on a single charge than their disposable counterparts, especially in high-drain devices*.

No, because

- ***Recharging:*** *Obviously, rechargeable batteries will need to be recharged. If you're used to just grabbing single use batteries and popping them in, recharging can initially seem like a bit of a hassle. Having backups helps ensure you won't be left powerless waiting for your batteries to juice up.*
- ***Self-Discharge:*** *Some self-discharge can be expected, meaning you may need to charge batteries before their initial use and after storing for any length of time.*

2. MAINS ELECTRICITY

Learning Outcomes

At the end of the lesson, a student should be able to:

11.2.1 State the differences between direct current (d.c) and alternating current(a.c),
11.2.2 Describe the function of live, neutral, earth wires, use of insulation, earthing, fuses,
11.2.3 Circuit breakers in the domestic main supply and
11.2.4 Calculate the costs of using common domestic appliances using measurements of energy.

Assessment Items

Question 1. **[Understanding]**

Which one of the following is the source of alternating current?

A cell
B battery
C voltage stabilizers
D mains electricity

Answer: *D mains electricity*

Question 2. **[Understanding]**

Which one of the following devices operates on direct current?

A washing machine
B mobile phone
C rice cooker
D television

Answer: *B mobile phone*

Question 3. **[Remembering]**

Table 11.3 below shows the properties of alternating current and direct current. Fill in the blanks numbered 1, 2, 3 and 4 with appropriate word(s).

Table 11.3

Type of current	Properties
1…….	flows always in same direction in a circuit
alternating current	2……..
direct current	3…….
4……	produced by dynamo

Answer:

1) direct current
2) changes its direction in a circuit alternatively with time
3) produced by cell or battery
4) alternating current

Question 4. **[Understanding]**

Figure 11.6 below shows a current flowing in a circuit powered by two different sources.

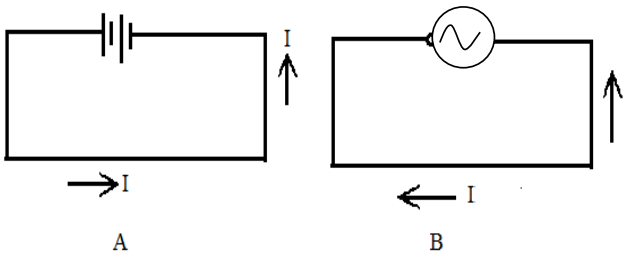


Figure.11.6

1. The current that flows in circuit A is .....in nature and the current that flows in circuit B is.....in nature
2. The voltage across circuit A is …….approximately

Answer: *1) direct current, alternating current 2) 3 V*

Question 5. **[Remembering]**

The safety method used for protecting electrical appliances from short circuiting is

A earthing.
B use of fuse.
C use of stabilizers.
D use of electric meter.

Answer: *B use of fuse*

Question 6. **[Understanding]**

Figure 11.7 below shows an electric plug.
What are the nature of the X and Y?

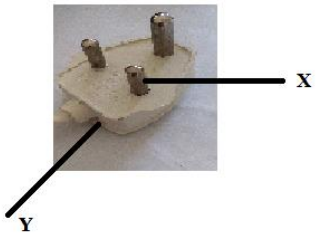


Figure 11.7

	X	Y
A	neutral	insulator
B	conductor	insulator
C	conductor	live
D	produce heat	absorb heat

Answer: *B X- conductor and Y-insulator*

Question 7. **[Understanding]**

Match the electrical component given in Column B against the words that describe their functions in Column A. Rewrite the correct matching pairs in a form of a sentence.

Table 11.4

Functions (clue)		Electrical components	
1	makes, breaks, circuit	a	earth wire
2	supply, voltage ,mains	b	fuse
3	drain, leaked current, ground	c	switch
4	prevent, damage appliances, short circuiting.	d	socket
5	carries, current, circuit	e	stabilizer
		f	live wire

Answer:

1. *Switch makes or breaks the electric circuit.*
2. *Socket supplies voltage from the mains to the appliances.*
3. *Earth wire drains the leaked current to the ground.*
4. *Fuse prevents damage of appliances from short circuiting.*
5. *Live wire carries the current in the circuit.*

Question 8. **[Remembering]**

The riddles are about the colour coding of wire.

a. I am brown and always alive, therefore I am the .....wire.

b. I am green or yellow. I protect electrical appliances, therefore I am the .....wire.

c. I am blue and always the complete the loop in the circuit, therefore I am the .....wire

Answer: *a) live* *b) earth* *c) neutral*

Question 9. **[Evaluating]**

Fire destroys automobile workshop

An automobile workshop, located in the town in Paro, caught fire in the wee hours today. The fire, which started at around 2:45 AM, is suspected to have started from an electric short circuit.

(Source: *Kuensel, dated 30th December, 2015*)

I What happens when an electric short circuit occurs?

II Is this kind of hazards preventable? Justify your answer.

Answer:

I Electric short circuit occurs when the current leaks and starts flowing in the whole of the conducting body of appliances that may lead to fire. .

II Yes, short circuiting is generally because of overloading of appliances at a single point, weak wirings, no safety fuses and earthing connection, etc. We can prevent hazards caused by electric short circuit by not using many appliances in one socket, by replacing old and weak wiring with new one, using quality MCB, wires and appliances, installing safety devices like MCB, fuses and earthing, etc.

Question 10. **[Applying]**

Pema uses four tube lights of 40W each and two fans of 100W each which are connected to 220V mains power supply. It consumed 86.4kWh energy in a month. How many hours has Pema been using those appliances daily?

A 2 hours
B 4 hours
C 8 hours
D 10 hours

Answer: *C 8 h*ours

Question 11. **[Applying]**

The electricity meter in a house is an instrument to measure consumption of energy. The reading on the meter gives the total energy consumed in Units. Each unit is equal to 1kWh.
The Figure 11.8 shows the meter reading at the beginning and the end of the month for December 2016 for Karma's house located in the town.

Figure 11.8

Calculate the bill for Karma after reading the meter boxes referring to the electricity tariff as given in table 11.5.

Table 11.5

Tariff Structure	(Nu./kWh)
LV Block I (rural domestic) (0-100 kWh)	0
LV Block I (others)(0-100 kWh)	1.28
LV Block II (all)(>100-300 kWh)	2.45
LV Block III (all)(>300 kWh)	3.23
LV Bulk	3.68

Answer: *Energy consumed = 2360.8kWh-2158.7 kWh=202.1 kWh*

Cost of energy for 100 units = 100kWh×1.28= Nu 128.00

Cost of energy for 102.1 units = 102.1kWh×2.45 = Nu 250.10

Electricity bill for Karma = Nu 378.10

Question 12. **[Analyzing]**

'Rural homes to gain more from domestic tariff policy and need not pay for first 100 units of energy consumption '. What is your view on this revised policy as a responsible citizen?

Answer: *The revised policy encourages the people to judiciously use electricity at homes by not wasting them. Its main objective is to save energy.*

Question 13. **[Evaluating]**

Pema uses three 60W bulb for 30 minutes and 1kW heater for 2 hours daily. She calculated her electric bill at the end of the month as shown below using the table 11.4.

Is her calculation correct? If not rectify the mistake and recalculate it.

Energy consumed by bulb = power× time = (0.06 kW ×0.5 h) ×2 = 0.06Wh

Energy consumed by heater = 1×2 = 2kWh

Total energy consumed = (0.06+2) = 2.06 kWh

Electricity bill at the end of the month = 2.06kWh×1.28 = Nu 2.6

Answer*:*

No, she has calculated energy consumed by only one bulb instead of 3 bulbs and then she has calculated bill for only one day.

energy consumed by 3 bulb = power× time = (0.06 kW ×0.5 h) ×3×2 = 0.18kWh

energy consumed by heater = 1×2 = 2kWh

Total energy consumed in 30 days = (0.18+2)×30 = 65.4 kWh

electricity bill at the end of the month = 65.4 kWh×1.28 = Nu 83.70

Question 14. **[Applying]**

Dechen decides to replace five 60W filament bulbs with five 15W low energy bulbs. If she uses them for 4 hours daily, what will be her annual saving?

Answer: *Energy supplied = power ×time*

Power = 5×60 = 300W= 0.3kWh

Total energy consumed by five 60Wbulb in one year = 0.3× 4 ×365

=438kWh

Total cost= 100kWh×1.28+ 300kWh×2.45+38kWh×3.23

= Nu 128+Nu735+Nu122.74

= Nu985.74

Total power for five 15W low energy bulb = 5×15=75W=0.075kWh

Total energy consumed by five 15 W low energy bulb = 0.075×4×365 =109.5kWh

Total cost = 100 kWh ×1.28+9.5 kWh×2.45 = Nu128+23.3=Nu151.30

Therefore saving in a year = 985.74-151.30 = Nu 834.40

Question 15. **[Applying]**

The chart below shows the tariff rate for electricity in Bhutan

Table 11.6

Tariff		1st October 2013 to 30th June 2014	1st July 2014 to 30th June 2015	1st July 2015 to 30th June 2016
Wheeling(Nu/kWh)		.114	.114	.114
Low Voltage				
Block	kWh/month	Energy Charges(Nu/kWh)		
I (Rural)	0-100	0	0	0
I (Others)	0-100	0.98	1.12	1.28
II (All)	101-300	1.86	2.13	2.45
III (All)	Above 300	2.46	2.82	3.23

Calculate the electricity consumption by the electrical appliances used at home for a month in Table 11.7.

Table 11.7

Name of appliances	Power rating(W)	Duration of use	Electrical energy (kWh)	Cost in Nu. (Per day)	Cost in Nu (per month)
1					
2					
3					
Total cost					

3. MAGNETISM

Learning Outcomes

At the end of the lesson, a student should be able to:

11.3.1 Explain natural magnets and horse shoe magnet,
11.3.2 List the uses of electromagnet and
11.3.3 Describe working of an electric bell.

Assessment Items

Question 1. **[Understanding]**

Horseshoe magnets have stronger force of attraction and repulsion than bar magnets. Give reasons.

Answer: *Horse shoe magnets are U-shaped such that its magnetic poles are close to each other pointing in the same direction. Therefore the magnetic lines of force are closer to each other and concentrated in a small region, resulting into a powerful magnet. Unlike horse shoe magnets, bar magnets have poles at the two opposite ends, such that magnetic lines of force are spread in a wider region making the magnet weak.*

Question 2. **[Remembering]**

Lodestone is a naturally occurring magnet containing magnetite, which is an

A oxide of iron.
B oxide of brass.
C oxide of nickel.
D oxide of cobalt.

Answer: *A an oxide of iron*

Question 3. **[Understanding]**

When Sonam placed the north pole of a bar magnet near an iron bar it repelled the iron bar. Which statement is true about the iron bar?

A bar magnet is defective
B iron bar itself is a magnet
C iron bar is not a magnetic material
D bar magnet was brought too close to iron bar

Answer: *B* iron bar itself is a magnet

Question 4. **[[Understanding]**

Which one of the following actions make a magnet lose its magnetic properties?

A wrapping the magnet with a plastic sheet
B bring the magnet close to a nail
C hammering the magnet
D colouring the magnet

Answer: *C hammering the magnet*

Question 5. **[Remembering]**

Why is a lodestone a naturally occurring magnet? How is it different from man-made magnet?

Answer: *A lodestone is a naturally occurring magnet in which the molecular magnets are naturally pre-aligned in an orderly manner forming the two poles as South and North pole, while the man-made magnets are generally made from pure or alloys of steel, nickel or cobalt in which the molecular magnets are not orderly arranged but these molecular magnets have tendency to align in orderly manner under the influence of external factors and form the magnet. The natural magnets never lose their magnetism.*

Question 6. **[Applying]**

Figure 11.9 shows toy cars with a bar magnet attached to each car and placed close to one another.

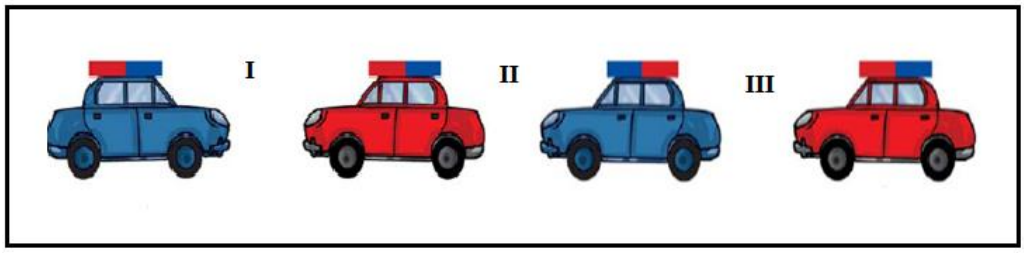


Figure 11.9

What type of force exists at locations I, II and III?

A I-repulsion, II-repulsion and III- attraction
B I-repulsion, II-attraction and III-attraction
C I-attraction, II-attraction and III- repulsion
D I-attraction, II-repulsion and III-repulsion

Answer: *D I-attraction, II-repulsion and III-repulsion*

Question 7. **[Understanding]**

Why is electromagnet used in various devices and places?

A electromagnets are stronger than permanent magnets
B the strength of electromagnets can be varied
C electromagnets can be made into any shape
D electromagnets are colourful

Answer: *B the strength of electromagnets can be varied*

Question 8. **[Understanding]**

The strength of an electromagnet in an electric bell can be increased by

I increasing the current
II decreasing the current
III increasing the number of turns in the coil
IV decreasing the number of turns in the coil

A I and III.
B I and IV.
C II and III.
D II and IV.

Answer: *A I and III*

Question 9. **[Understanding]**

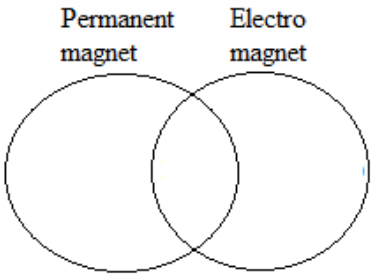
Do you think an electromagnet can be used for segregating solid waste? Explain.

Answer: *Yes: Solid waste generally contains pieces of magnetic substance like iron, electronic gadgets, etc. which can be attracted by a magnet.*

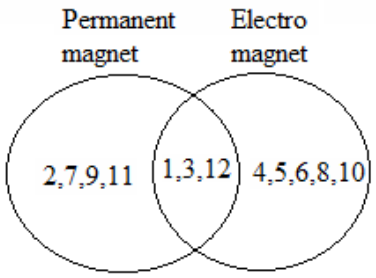
Question 10. **[Analyzing]**

The similarities and differences of permanent magnet and electromagnet are given below. Fill in the given Venn diagram using the given descriptions.

1. used in electrical appliances
2. polarity cannot be reversed
3. it has two poles
4. made from steel
5. strength of magnetic field can be varied
6. requires electric current
7. loses its magnetic properties over time
8. polarity can be reversed
9. no electric current needed
10. creates a magnetic field so long as current flows
11. fixed initial magnetic strength
12. it is of various sizes and shapes



Answer:



Question 11. **[Analyzing]**

How would an electric bell work if an electromagnet with a steel core is used? Explain.

Answer: *Electric bell works when the electromagnet attracts the hammer that hits the gong and immediately demagnetizes it when the flow of current stops. Therefore, the electromagnet in an electric bell is generally made of soft iron core. Steel has the property to retain magnetism for a longer period of time. If iron is replaced by steel, it will behave as a permanent magnet and strikes the gong only once and may take a longer time to demagnetize, complete the circuit and strike the gong again. Therefore, electric bell will not produce a ringing sound.*

Question 12. **[Remembering]**

Figure 11.10 shows an electric bell.

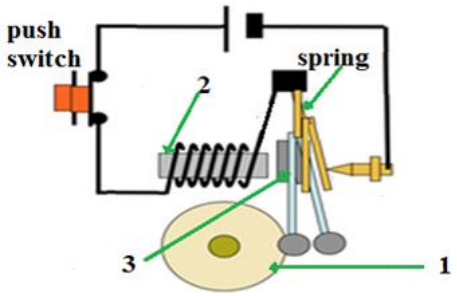


Figure 11.10

The parts labeled 1, 2 and 3 are.

	1	**2**	**3**
A	gong	electromagnet	armature
B	electromagnet	gong	armature
C	armature	electromagnet	gong
D	electromagnet	armature	gong

Answer: *A 1. gong 2. electromagnet 3. armature*

Question 13. **[Understanding]**

Arrange the following sentences in the correct order to explain the working of an electric bell.

1. A current flows through the coil.
2. The circuit is broken at contact screw.
3. Switch is pressed or put on.
4. The circuit is completed again.
5. The electromagnet attracts the iron armature.
6. The hammer strikes the gong.
7. The metal spring pulls the hammer back.

Answer:

1. *Switch is pressed or put on.*
2. *A current flows through the coil.*
3. *The electromagnet attracts the iron armature.*
4. *The hammer strikes the gong.*
5. *The circuit is broken at contact screw.*
6. *The metal spring pulls the hammer back.*
7. *The circuit is completed again.*

CHAPTER 12
LIGHT AND SOUND

1. REFRACTION OF LIGHT

Learning Outcomes

At the end of the lesson, a student should be able to:

12.1.1 Describe how light is refracted at the boundary between different materials and

12.1.2 Demonstrate the formation of an image by lenses and give some applications of lenses.

Assessment Items

Question 1. **[Understanding]**

Figure 12.1 below shows a metal spoon in a glass of water.
Which property of light causes the metal spoon to appear split?

A total internal reflection
B diffraction
C refraction
D reflection

Answer: *C refraction*

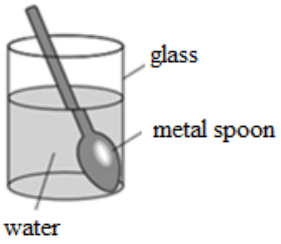


Figure 12.1

Question 2. **[Applying]**

Figure 12.2 shows a ray of light striking the water surface and entering a pond.
The refracted ray of light at the water surface will

A pass undeviated.
B scatter in all directions.
C bend towards the normal.
D bend away from the normal.

Answer: *C bend towards the normal*

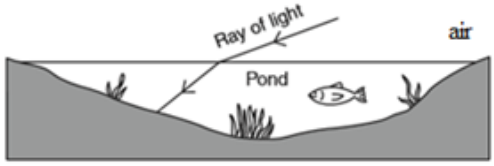


Figure 12.2

Question 3. **[Applying]**

Figure 12.4 shows a student observing a bee using a magnifying lens in a biology laboratory.
What is the distance of the convex lens from the bee?

A twice the focal length of the convex lens
B equal to the focal length of the convex lens
C less than the focal length of the convex lens
D more than the focal length of the convex lens

Answer: *C less than the focal length of the convex lens*

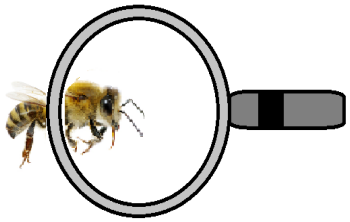


Figure 12.4

Question 4. **[Analyzing]**

Figure 12.3 shows a ray of light passing from air into glass at an angle of incidence 0^0.

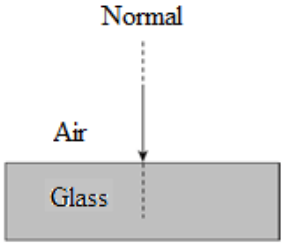


Figure 12.3

Which statement describes the phenomenon of the light ray as it passes into the glass?

A speed of light ray changes as it enters the glass
B intensity of light ray changes as it enters the glass
C direction of light ray changes as it enters the glass
D both speed and direction of light ray changes as it enters the glass

Answer: *A speed of light ray changes as it enters the glass*

Question 5. **[Understanding]**

The following is the list of optical density of some transparent materials.

Table 2.5

Material	Optical density
Water	1.33
Crown Glass	1.52
Diamond	2.417
Ethyl Alcohol	1.36

When a ray of light passes through each material, the ray of light will travel with the greatest speed in

A water.
B diamond.
C crown glass.
D ethyl alcohol.

Answer: *B diamond*

Question 6. **[Analyzing]**

A convex lens of focal length 20 cm is used in a camera. If the distance between the object and the photographer is more than 50 cm, then the characteristics of the image formed in the camera will be

A real, inverted and diminished.
B virtual, upright and diminished.
C real, inverted and highly magnified.
D virtual, upright and same size as object.

Answer: *A real, inverted and diminished*

Question 7. **[Analyzing]**

Figure 12.5 shows two parallel rays X and Y incident on a transparent object.The transparent object used in the box marked 'L' is a

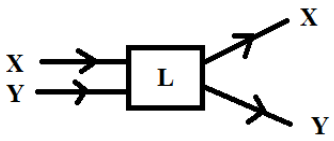


Figure 12.5

A prism.
B convex lens.
C concave lens.
D concave mirror.

Answer*: C concave lens*

Question 8. **[Applying]**

Complete Figure 12.6 to show the refraction of light through a prism.

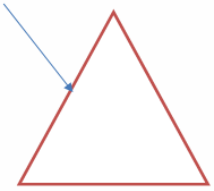
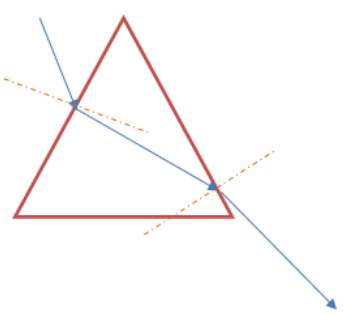


Figure 12.6

Answer:



2. COLOURS

Learning Outcomes

At the end of the lesson, a student should be able to:

12.2.1 Identify primary colours and secondary colours of light and pigments,
12.2.2 Explain how coloured objects appear in white light and in other colours of light and
12.2.3 Describe the effect of colour filters on white light and in other colours of light.

Assessment Items

Question 1. **[Remembering]**

Figure 12.7 shows part of the light formed by overlapping of coloured lighs.
Which of the following pairs of light forms the primary colour of light?

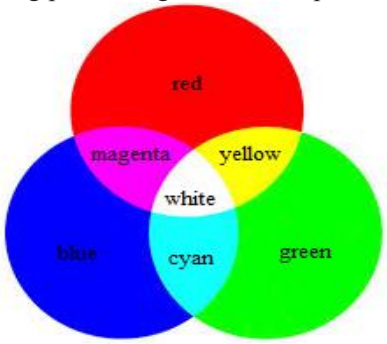


Figure 12.7

A red and cyan
B cyan and blue
C green and magenta
D yellow and magenta

Answer: *D yellow and magenta*

Question 2. **[Applying]**

Which pair of pigments must be applied to colour a white thread blue?

A	yellow pigment	red pigment
B	cyan pigment	yellow pigment
C	magenta pigment	cyan pigment
D	magenta pigment	yellow pigment

Answer: *C magenta pigment-cyan pigment*

Question 3. **[Remembering]**

Which of the following shows the pairs of secondary colours of light?

A blue and red
B cyan and blue
C red and yellow
D yellow and cyan

Answer: *D yellow and cyan*

Question 4. **[Applying]**

The red coloured dresses of dancers appear different under different colours of light that shine on them. Which one of the following coloured light makes the dresses appear black?

A cyan
B green
C yellow
D magenta

Answer: *A cyan*

Question 5. **[Understanding]**

In Figure 12.8, the coloured lights from two sources P and Q fall on the white screen. The region Y at which the coloured lights overlap appears white.

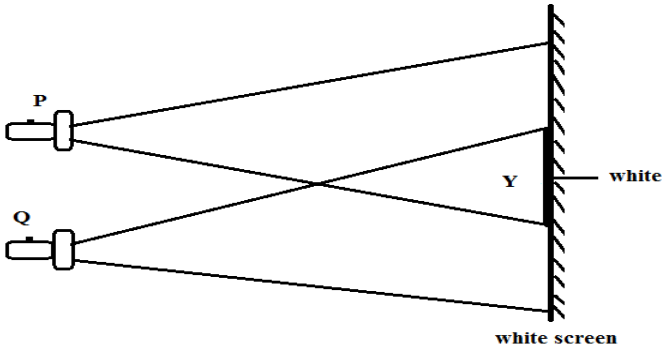


Figure 12.8

What are the colours of light 'P' and 'Q'?

A red and cyan
B blue and cyan
C green and cyan
D yellow and cyan

Answer: *A red and cyan*

Question 6. **[Understanding]**

Fill in the blank using appropriate words.

1) A piece of cloth appears yellow in white light because it reflects ……. and red lights.
2) A green leaf appears..... .....under a magenta light.
3) A ……..flower appears green under green light.

Answer: *1) green 2) black 3) white*

Question 7. **[Applying]**

When a person wears a pair of blue-glassed goggles, a red rose will appear

A red.
B blue.
C black.
D yellow.

Answer: *C black*

Question 8. **[Understanding]**

Figure 12.9 shows an object 'P' kept under white light. The colour of the object 'P' is

A red.
B cyan.
C yellow.
D magenta.

Answer: *D magenta*

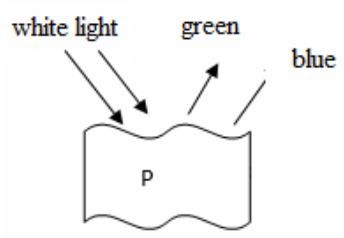


Figure 12.9

Question 9. **[Analyzing]**

Diagram 12.10 shows a shirt and bag placed under sunlight. The shirt appears white while the bag appears black to an observer.

Figure 12.10

i) Why does the shirt appear white?

Answer: *The shirt reflects all the component spectral colours of sunlight.*

ii) Why does the bag appear black?

Answer: *The bag absorbs all the component spectral colours of sunlight.*

Question 10. **[Understanding]**

Figure12.11 shows a ray of light directed towards a pair of coloured filters. What is the colour of filter 'P'?

A red
B cyan
C white
D magenta

Answer *A red*

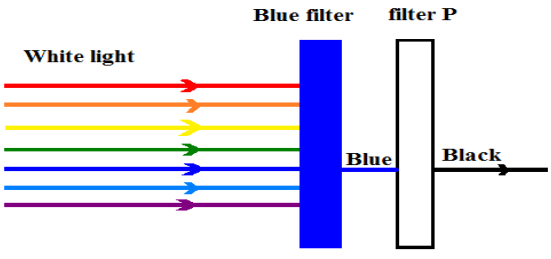


Figure 12.11

Question 11. **[Analyzing]**

Figure 12.12 shows the colour of a piece of cloth under white light and then under light 'P'. What is the colour of light P?

A cyan
B blue
C yellow
D magenta

Answer: *D magenta*

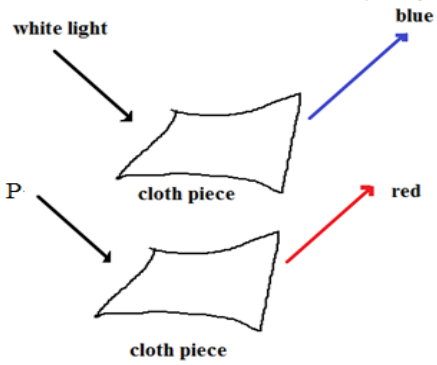


Figure 12.12

Question 12. **[Analyzing]**

Figure 12.13 shows white light passing through two coloured filters.

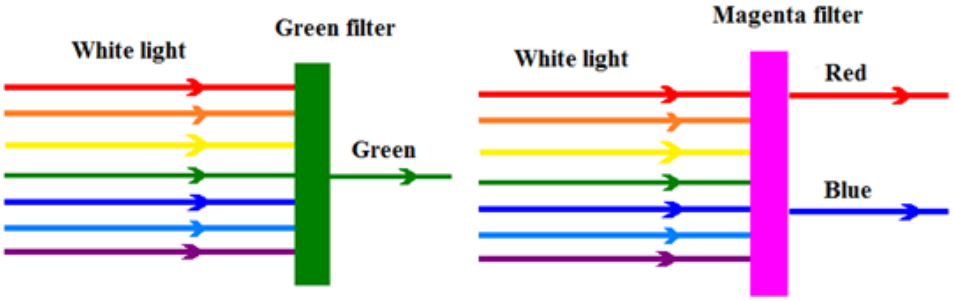


Figure 12.13

a) Based on the diagram, write down one characteristics of a filter.
b) State the manipulated and controlled variables of the experiment.
d) Predict the colours of light that pass through the yellow filter when green light falls on it.

Answer: *a) Green coloured light passes through green filter and red and blue pass through the magenta filter. Therefore, the filter allows only the spectral colours of its own colours.*
b) i) Manipulated variable - coloured filter ii) Controlled variable - White light
c) red light

Question 13. **[Understanding]**

The following are the characteristics of pigments.

- They are impure colours.
- The colour depends on the reflection and absorption properties of pigments.
- White colour is obtained when primary pigments are mixed.
- There are three primary pigments: cyan, magenta and yellow.

Write four characteristics of the spectral colours referring to the characteristics of pigments.

Answer:

- *They are pure colours.*
- *The colour depends on the wavelength of the spectral light.*
- *Black colour is obtained when primary pigment are mixed.*
- *There are three primary spectral colours: red, blue and green.*

3. SOUND

Learning Outcomes

At the end of the lesson, a student should be able to:

12.3.1 Explain the relationship between the loudness and amplitude of the sound,
12.3.2 Investigate the relationship between pitch and the frequency of the sound,
12.3.3 Describe the conversion of sound vibrations into nerve impulses by the ear and
12.3.4 Explain that sound travels with different speed in different media.

Assessment Items

Question 1. **[Understanding]**

The sound waves in the Figure 12.14 have the same frequency. Compared to sound wave A, sound wave B represents a

A louder sound.
B fainter sound.
C higher pitch.
D lower pitch.

Answer: *A louder sound*

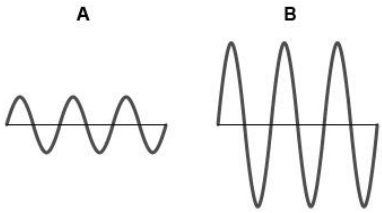


Figure 12.14

Question 2. **[Analyzing]**

Figure 12.15represents the change in nature of a sound over a time period. Which property of the sound changes in the diagram?

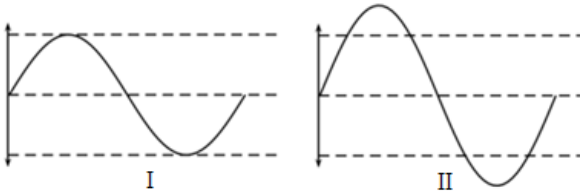


Figure 12.15

A pitch
B loudness
C shrillness
D wavelength

Answer: *B loudness*

Question 3. **[Applying]**

A sound is produced when a person strikes a drum. If the person hits the drum harder, the sound wave will probably increase in

A period.
B frequency.
C amplitude.
D wavelength.

Answer: *C amplitude*

Question 4. **[Understanding]**

Figure 12.16 shows a graph of displacement against the distance of a wave.

The amplitude of the wave is

A -8m.
B 4m.
C 8m.
D 12m.

Answer: *C* *8m*

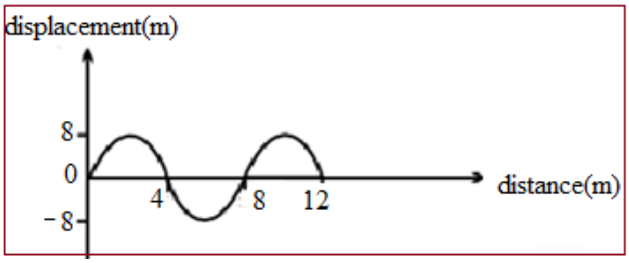


Figure 12.16

Question 5. **[Applying]**

The sound wave produced by four different people is shown in Figure 12.17.

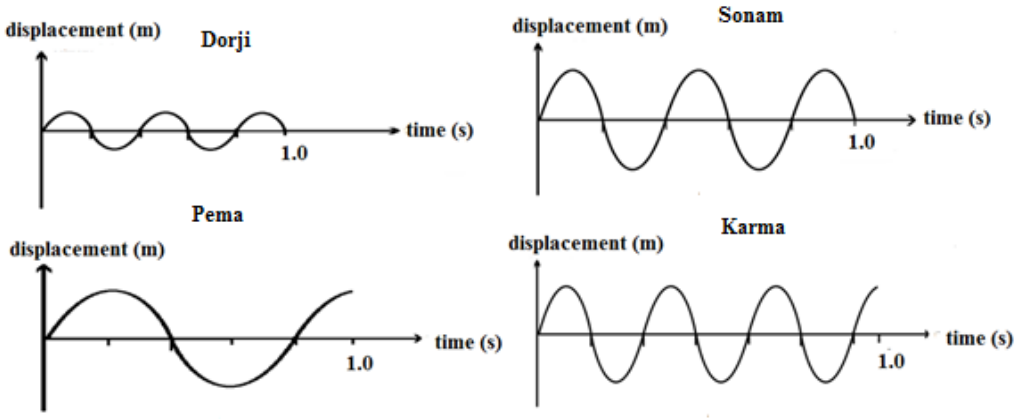


Figure 12.17

Who has the shrillest sound?

A Dorji
B Pema
C Karma
D Sonam

Answer: *C* *Karma*

Question 6. **[Understanding]**

The speed of sound depends on

A temperature of medium.
B weight of the medium.
C volume of the medium.
D source of the sound.

Answer: *A* *temperature of medium*

Question 7. **[Understanding]**

Figure 12.18 shows a boy producing a sound by holding a plastic ruler against the spokes of a spinning rear wheel. He found that sound produced by the slow spinning wheel is dull and flat, and the shrillness of the sound increases with the increase in the speed of the spin of wheel against the ruler.

The above experiment is to investigate relationship between

A pressure and force.
B period and wavelength.
C pitch and frequency of sound.
D amplitude and loudness of sound.

Answer: *C pitch and frequency of sound*

Figure 12.18

Question 8. **[Remembering]**

The inability of hearing a faint or high frequency sound may be caused by

A an affected cochlea by age or diseases.
B different shapes of human ears.
C blockage in the auditory canal.
D an absent pinna.

Answer: *C blockage in the auditory canal*

Question 9. **[Remembering]**

Humans cannot hear sound of all frequencies. The normal audible range for human being is

A below 20 Hz.
B above 50,000Hz.
C 20Hz- 20,000Hz.
D 21,000 Hz - 50,000Hz.

Answer. *C 20Hz- 20,000Hz*

Question 10. **[Analyzing]**

Prolonged exposure to loud and high pitched sounds can lead to hearing impairment. Do you agree? Justify with reasons.

Answer: *Yes, the cochlea and auditory nerve can be damaged by prolonged exposure to loud sound above 85 Hz. A very loud sound may even rapture the ear drum. Therefore, it may result in hearing impairment.*

Question 11. **[Understanding]**

The main factor which determines the speed of a sound wave is the

A properties of the medium.
B amplitude of the sound.
C intensity of the sound.
D pitch of the sound.

Answer: *A properties of the medium*

Question 12. **[Understanding]**

The figure 12.19 given below shows a human ear.

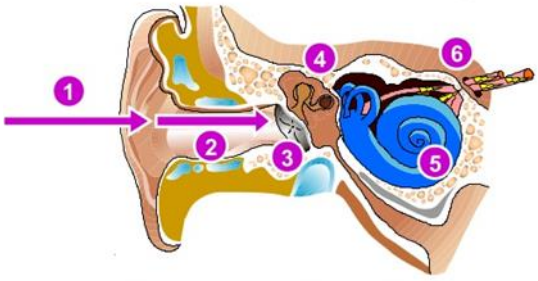


Figure 12.19

Name the part of the ear that is responsible for the following functions

Functions of the parts in ear		**Name of the part**
1.	Sound waves are collected	
2.	Vibrates due to sound waves	
3.	Sound waves travel through it	
4.	Converts into electrical signals	
5.	Amplify the vibrations	
6.	Send signals to the brain	

Answer:

Functions of the parts in ear		***Name of the part***
1.	*Sound waves are collected*	*Pinna*
2.	*Vibrates due to sound waves*	*Eardrum*
3.	*Sound waves travels through it*	*Auditory canal*
4.	*Converts into electrical signals*	*Cochlea*
5.	*Amplify the vibrations*	*Ossicles*
6.	*Send signals to the brain*	*Auditory nerve*

Question 13. **[Understanding]**

Which of the following changes when sound travels from one medium to another?

I. velocity
II. frequency
III. amplitude
IV. wavelength

A I and II
B I, II and III
C I and IV
D III and IV

Answer: *C I and IV*

Question 14. **[Understanding]**

Fill in the blanks with appropriate word(s).

Sound waves enter through the ...1..... and travel through the ....2..... . Sound waves causes the .....3.... to vibrate. Tiny bones pass on the vibrations to fluid filled tube called the .....4.... There, the vibrations are detected by tiny hairs cells. These sends signal along the .....5.... to the brain, where the impulse are interpreted as sound.

Answer*: 1. pinna 2. auditory canal 3.eardrum 4. cochlea 5. auditory nerve*

Question 15. **[Applying]**

Sound travels faster through elastic material. Therefore, sound travels the fastest through

A air.
B oil.
C water.
D iron rod.

Answer*: D iron rod*

CHAPTER 13
EARTH AND BEYOND

1. VISIBILITY OF HEAVENLY OBJECTS

Learning Outcomes

At the end of the lesson, a student should be able to:

13.1.1 Explain that planet and other heavenly objects are seen because they reflect light from the sun and

13.1.2 Identify the factors that enable object to be seen in the sky from the earth.

Assessment Items

Question 1. **[Understanding]**

We can see the Moon from the Earth because the Moon

A produces its own light as the Sun.
B reflects the sunlight falling on it.
C is very close to the Earth.
D is very large.

Answer: *B* *reflects the sunlight falling on it*

Question 2. **[Analyzing]**

All planets, asteroids and the Moon reflect light from the Sun. However, the Moon is distinctly visible in the clear night sky as the

A Moon is close to the Sun.
B Moon is close to the Earth.
C Moon is far away from the Sun.
D Moon is far away from the other planets and the asteroids.

Answer: *B* *Moon is close to the Earth.*

Question 3. **[Analyzing]**

Which of the following best explains the waxing and waning of the Moon?

A The rotation of the Earth.
B The changing clouds cover the Moon.
C The rotation of the Moon around the Earth.
D The changing shape of the orbit of the Moon.

Answer: *C* *The rotation of the Moon around the Earth.*

Question 4. **[Understanding]**

Unlike any other planets, Venus is seen from the Earth because

A Venus is the brightest planet.
B Venus produces light like a star.
C Venus is the closest planet to the Earth.
D Venus receives and reflects more light from the Sun.

Answer: *C* *Venus is the closest planet to the Earth.*

Question 5. **[Remembering]**

The brightness of the planets and the satellites depends upon factors like

I. apparent size of planets and the satellites
II. distance of planets and the satellites from the Sun
III. the amount of cloud cover on planets and the satellites
IV. the reflectivity features on the surface of planets and the satellites
V. the relative position of the planets and the satellites from the Earth

A I, II.
B I, II, V.
C III, IV, V.
D I, II, III, IV,V.

Answer: *D I,II, III,IV,V*

Question 6. **[Understanding]**

Stars appear very small at night when viewed from Earth because stars

A are small in size.
B are far away from the Earth.
C are far away from the Moon.
D produce small amount of light.

Answer: *B are far away from the Earth*

Question 7. **[Remembering]**

Classify the objects or materials given below as luminous or non-luminous:
(air, sun, mirror, water, a piece of red hot iron, lighted torch, smoke, flame of gas burner, star)

Answer:

Luminous	*Non-luminous*
sun, star, a piece of hot iron, lighted torch, flame of gas burner	*air, water, mirror, moon and smoke*

Question 8. **[Analyzing]**

Why does the Sun appear to move across the sky?

Answer*: The Earth rotates on its axis while revolving around the Sun. The rotation of the Earth makes it appear like the Sun is moving across the sky.*

Question 9. **[Understanding]**

The Moon appears grey-white in colour while Mars appears reddish-orange in colour when viewed through a telescope. Write the possible reasons.

Answer: *The colour of the heavenly bodies is generally determined by the reflectivity features such as its crust matter, cloud cover and its relative position with respect to the viewer on the Earth and the Sun. The dust which covers the surface of the Mars is rich in iron that reacts with oxygen producing red rust colour. Similarly, the dust particle on the surface makes it appear grey-white. However, the moon sometimes appears reddish in colour due to the sunlight scattered through the Earth's atmosphere.*

Question 10. **[Remembering]**

Look at Figure 13.1 given below. The Earth appears to be brightest among other heavenly objects. Explain.

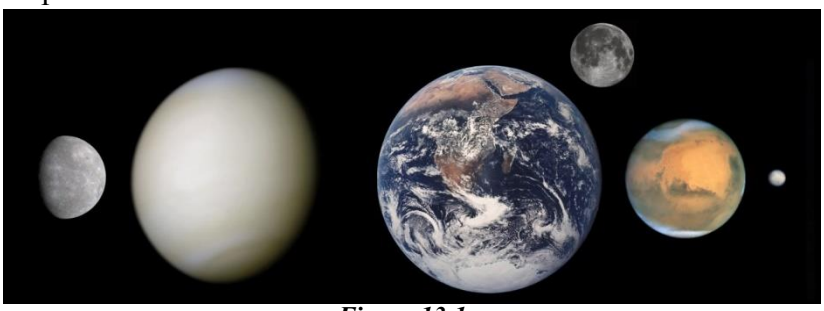


Figure 13.1

Answer: *The Earth appears to be brightest among other heavenly objects because three-fourth of the surface of the Earth is covered with water. Water is a good reflector of light, making the Earth appear brighter.*

2. THE PLANETART MOTION

Learning Outcomes

At the end of the lesson, a student should be able to:

13.2.1 Understand centripetal force and centrifugal force and their applications and
13.2.2 Describe how the movements of planets relate to gravitational forces.

Assessment Items

Question 1. **[Remembering]**

The force that acts on an object, directed to the center of a circular path of motion is the

A concentric force.
B centrifugal force.
C centripetal force.
D gravitational force.

Answer: *C* *centripetal force*

Question 2. **[Understanding]**

The magnitude of the centripetal force acting on an object travelling in a circular path will decrease if the

A radius of the path is increased.
B mass of the object is increased.
C speed of the object is increased.
D direction of the motion of the object is reversed.

Answer: *A* *radius of the path is increased*

Question 3. **[Understanding]**

The gravitational force between the Moon and the Earth depends on the

A mass of the Moon and the Earth.
B size of the Moon and the Earth only.
C size and distance between the Moon and the Earth.
D mass and distance between the Moon and the Earth.

Answer: *D* *mass and distance between the Moon and the Earth*

Question 4. **[Remembering]**

The centripetal force which keeps the planet in their orbits around the Sun is

A gravitational force.
B frictional force.
C electrical force.
D magnetic force.

Answer: *A* *gravitational force*

Question 5. **[Applying]**

Pema is playing a whirling game where a ball attached to a string is moved at constant speed in a circular path. Pema's aim is to hit the target as shown in the Figure 13.1

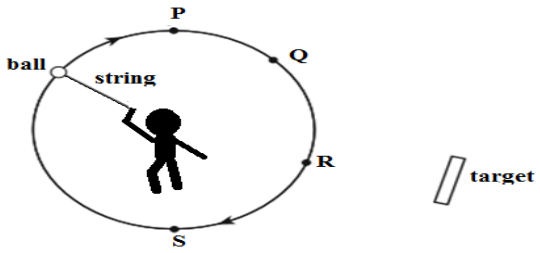


Figure 13.1

At which point along the ball's path of motion should the string be released, if the ball is to hit the target?

A P
B Q
C R
D S

Answer: *B* *Q*

Question 6. **[Applying]**

Figure 13.2 shows a truck carrying a box, moving in a straight path at Point A and then goes round the curve path at Point B.

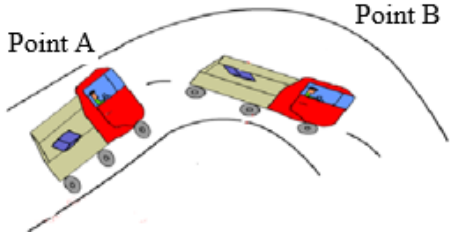
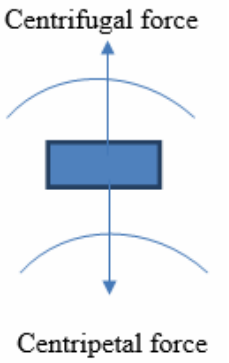


Figure 13.2

i. Draw the box and indicate the centripetal and centrifugal force acting on the box in the truck with the help of an arrow at Point B.

Answer:



ii. Differentiate between centripetal and centrifugal force.

Answer:

Centripetal force	*Centrifugal force*
- *It gives rise to circular motion.* - *It is directed towards the center of curvature or axis of rotation.*	- *It always tends to bring about motion along a straight line due to inertia of motion.* - *It is equal and opposite to the centripetal force directed away from the center of rotation.*

iii. List down some of the applications of centripetal and centrifugal force in our day to day life.

Answer: (Suggestive)

Some of the examples of centripetal and centrifugal force are:

- *large centrifuges to test astronauts and prepare them for this extreme acceleration*
- *laboratory centrifuge is used to accelerate the precipitation of particles suspended in liquid*
- *high-speed gas centrifuges can also be used to separate the lighter and rarer uranium-235 isotope from the heavier and much more common uranium-238*

Question 7. **[Understanding]**

The two factors that combine to keep the planet in orbit are

A mass and inertia of the planet.
B gravity and inertia of the planet.
C orbital speed and mass of the planet.
D gravity and orbital speed of the planet.

Answer: *B gravity and inertia of the planet*

Question 8. **[Analyzing]**

Table 13.1 shows the mass of all the planets.

Table 13.1

Sl.no	Name of the planet	Mass in kg
1	Mercury	3.3022×10^{23}
2	Venus	4.8685×10^{24}
3	Earth	5.9736×10^{24}
4	Mars	6.4185×10^{23}
5	Jupiter	1.8986×10^{27}
6	Saturn	5.6846×10^{26}
7	Uranus	8.6810×10^{25}
8	Neptune	10.243×10^{25}

Arrange the planets in the descending order of their gravitational pull.

A Jupiter, Saturn, Neptune, Uranus, Earth, Venus, Mars and Mercury
B Mercury, Mars, Venus, Earth, Uranus, Neptune, Saturn, and Jupiter
C Neptune, Uranus, Saturn, Jupiter, Mars, Earth, Venus and Mercury
D Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune

Answer: *A Jupiter, Saturn, Neptune, Uranus, Earth, Venus, Mars and Mercury*

Question 9. **[Analyzing]**
Why does Earth have gravity?
Answer: *All matter attracts other matter and the more matter an object has, the stronger it's gravitational pull. Gravity is a property of matter. Therefore, our Earth has gravity.*

Question 10. **[Analyzing]**
What would happen if there is no gravity on the earth?
Answer: *Gravity is a part and parcel of our life. Life without gravity is impossible. If there is no gravity on earth, one would be weightless, but always nauseous. It would be very difficult to complete a lot of our daily activities such as walking, picking up things from the ground and lying on bed. Without the force of gravity acting on all objects, there is nothing keeping us attached to the earth. We would simply float away from the earth unless we nail our toes to the floor boards. Not only would we be constantly puking, but we wouldn't be able to read or really even enjoy doing anything except floating.*

Question 11. **[Understanding]**
Explain the motion of a body with and without a centripetal force.
Answer: *Body exhibits motion in two ways: translation and rotational motion. Without a centripetal force, an object in motion cannot travel in circular path, but continues along the horizontal line, while the presence of centripetal force will make the motion of object to accelerate and change its direction.*

Question 12. **[Analyzing]**
What keeps the Moon from falling to the Earth due to Earth's gravitational pull?
Answer: *The Moon remains in orbit around the Earth due to gravity and the sideway motion. The Moon in its orbit is moving sideways, approximately at right angles (90 degrees) to the force of gravity of the Earth. The Moon would travel in a straight line with a constant speed if it were not for the gravitational attraction of the Earth. The attractive force changes the motion of the Moon from a straight line to a closed curve as it begins orbiting the Earth. In effect, the centrifugal and centripetal forces are balanced preventing the Moon from falling into the Earth.*

Question 13 **[Creating]**
Design a paper model to explain the revolution of the Moon around Earth and the Earth around the Sun.
Answer: (Sample)