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SAMPLE QUESTION PAPER-I

SCIENCE

Time allowed: 3 hours

Maximum Marks: 80

NOTE:

- (i) Please check that this question paper contains **39** questions.
- (ii) **Please write down the serial number of the question in the answer-book before attempting it.**
- (iii) 15 minutes time has been allotted to read this question paper. The students will read the question paper only and will not write any answer on the answer-book during this period.

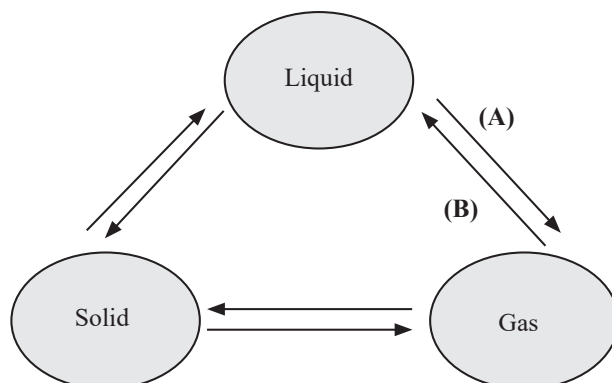
General Instructions:

Read the following instructions very carefully and strictly follow them:

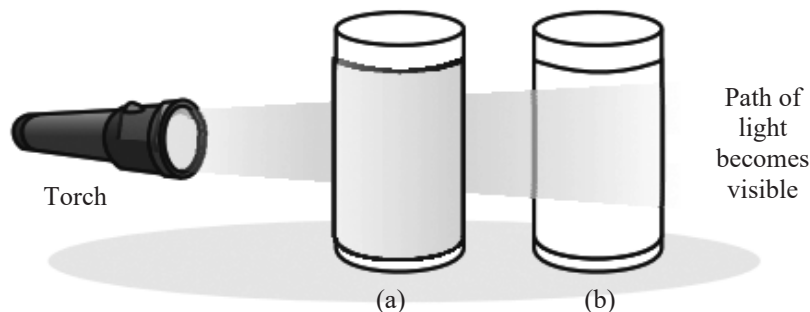
- (i) This question paper comprises **39** questions. **All** questions are compulsory.
- (ii) This question paper is divided into **five** sections - **A, B, C, D** and **E**.
- (iii) **Section A** - Questions No. **1** to **20** are multiple choice questions. Each question carries **1** mark.
- (iv) **Section B** - Questions No. **21** to **26** are very short answer type questions. Each question carries **2** marks. Answer to these questions should be in the range of 30 to 50 words.
- (v) **Section C** - Questions No. **27** to **33** are short answer type questions. Each question carries **3** marks. Answer to these questions should be in the range of 50 to 80 words.
- (vi) **Section D** - Questions No. **34** to **36** are long answer type questions. Each question carries **5** marks. Answer to these questions should be in the range of 80 to 120 words.
- (vii) **Section E** - Questions No. **37** to **39** are of **3** source-based/case-based units of assessment carrying **4** marks each with sub-parts.
- (viii) There is no overall choice. However, an internal choice has been provided in some sections. Only one of the alternatives has to be attempted in such questions.

SECTION - A

1. The following figure illustrates the three states of matter and their interconversion. Identify the processes represented by A and B. 1

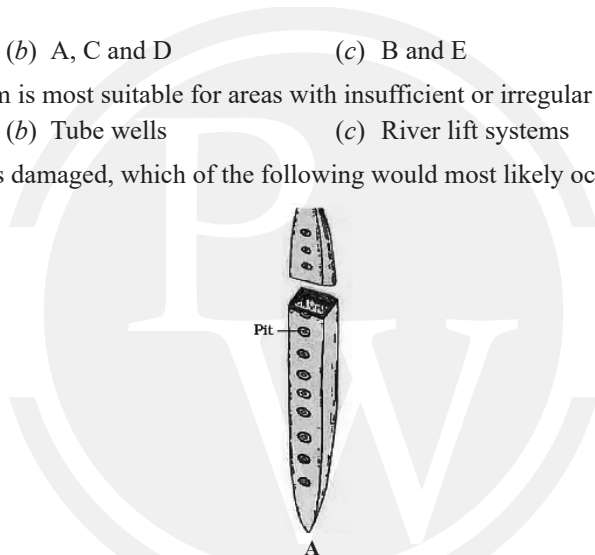


- (a) (A) Vapourisation, (B) Condensation (b) (A) Fusion, (B) Condensation
 (c) (A) Sublimation, (B) Condensation (d) (A) Fusion, (B) Solidification
2. How many protons, electrons, and neutrons are present in X^- if the atomic number of X is 17 and the mass number is 35? 1
 (a) P = 35, E = 35, N = 18 (b) P = 17, E = 17, N = 16
 (c) P = 17, E = 18, N = 18 (d) P = 35, E = 18, N = 16
3. Ravi has prepared a 0.02% (by mass) solution of sodium chloride (NaCl) in water. Which of the following options correctly describes the composition of the solution? 1
 (a) 2.00 g of NaCl + 100 g of water (b) 0.20 g of NaCl + 100 g of water
 (c) 0.02 g of NaCl + 99.98 g of water (d) 0.40 g of NaCl + 99.60 g of water
4. The chemical symbol for copper is 1
 (a) Co (b) Cu (c) Cp (d) K
5. According to the law of constant proportions, which of the following statements is true for a compound like carbon dioxide (CO_2)? 1
 (a) The ratio of carbon to oxygen by mass is always 1:2, regardless of its source.
 (b) The ratio of carbon to oxygen by mass varies depending on the preparation method.
 (c) The ratio of carbon to oxygen by mass is 3:8 regardless of whatever the method or the source from which it is obtained.
 (d) The ratio of carbon to oxygen by mass is not fixed and can vary widely.
6. In the given experiment, a torch is used to pass light through two beakers. Beaker (a) contains a solution of copper sulphate, and beaker (b) contains a mixture of water and milk. Why is the path of light visible in a beaker (b) but not in a beaker (a)? 1



- (a) The solution in a beaker (a) is opaque.
 (b) The mixture in a beaker (b) is a colloid, which scatters light due to larger particles.
 (c) Beaker (a) is made of a different material that absorbs light.
 (d) The torch is brighter when directed at the beaker (b).

7. Which of the following statements about Rutherford's model of atom are correct? 1
 (i) considered the nucleus as positively charged
 (ii) established that the α -particles are four times as heavy as a hydrogen atom
 (iii) can be compared to solar system
 (iv) was in agreement with Thomson's model
 (a) (i) and (iii) (b) (ii) and (iii) (c) (i) and (iv) (d) only (i)
8. During an experiment, a scientist discovers that a bacterial cell lacks ribosomes. What critical cellular process would be primarily affected? 1
 (a) DNA synthesis (b) Protein synthesis (c) ATP synthesis (d) Nutrient absorption
9. Which characteristic of meristematic cells primarily contributes to their ability to continuously divide and form new tissues in plants? 1
 A. Presence of thin cellulosic cell walls
 B. Lack of vacuoles
 C. Dense cytoplasm and prominent nuclei
 D. Presence of thick cellulosic cell walls
 E. Presence of vacuoles
 Choose the correct option:
 (a) A and C (b) A, C and D (c) B and E (d) A, B and C
10. Which type of irrigation system is most suitable for areas with insufficient or irregular canal flow? 1
 (a) Dug wells (b) Tube wells (c) River lift systems (d) Tanks
11. If in a plant, the structure 'A' is damaged, which of the following would most likely occur? 1



- (a) The plant will not transport food properly. (b) The plant will not transport water and minerals vertically.
 (c) The plant's roots will not grow properly anymore. (d) The plant will not grow new leaves anymore.
12. A satellite is moving in a circular orbit around the Earth with constant speed. Which of the following statements is true? 1
 (a) The satellite is accelerating. (b) The satellite is in uniform motion.
 (c) The satellite is in non-uniform motion. (d) The satellite's velocity is zero.
13. A force of 10 N is applied to a mass of 2 kg at rest. What will be its velocity after 5 seconds? 1
 (a) 25 m/s (b) 10 m/s (c) 50 m/s (d) 100 m/s
14. Which of the following frequencies is beyond the human hearing range? 1
 (a) 10 Hz (b) 1000 Hz (c) 10 kHz (d) 100 kHz
15. Which of the following statements is true according to Newton's First Law of Motion? 1
 (a) An object at rest will remain at rest unless acted upon by an external force.
 (b) An object in motion will continue in motion with the same speed and in the same direction unless acted upon by an external force.
 (c) Both A and B
 (d) Neither A nor B

16. A solid cube of wood with a density of 700 kg/m^3 and a volume of 0.5 m^3 is placed in water. Will the cube float or sink, and why? 1
- Float, because its density is less than that of water.
 - Sink, because its density is greater than that of water.
 - Float, because its volume is greater than its mass.
 - Sink, because its volume is less than its mass.

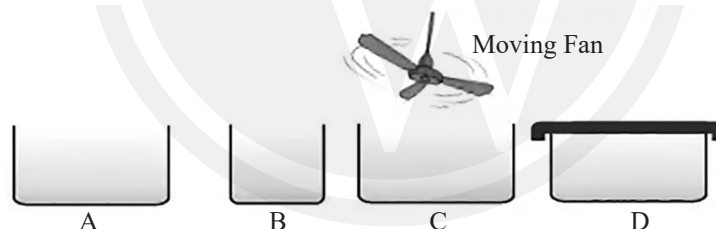
Q. no. 17 to 20 are Assertion - Reasoning based questions. These consist of two statements – Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below:

- Both A and R are true and R is the correct explanation of A.
 - Both A and R are true and R is not the correct explanation of A.
 - A is true but R is false.
 - A is false but R is true.
17. **Assertion (A):** The rate of mixing of copper sulphate or potassium permanganate crystals is faster in hot water than in cold water. 1
Reason (R): The increased temperature of water decreases the kinetic energy of the water molecules, leading to faster movement and quicker dissolution of the crystals.
18. **Assertion (A):** Chromosomes are composed of DNA and proteins. 1
Reason (R): Chromosomes are visible as thread-like structures in non-dividing cells.
19. **Assertion (A):** In a velocity-time graph, the area under the graph represents the distance traveled by the object. 1
Reason (R): The slope of a velocity-time graph gives the acceleration of the object.
20. **Assertion (A):** Nerve impulses allow us to move our muscles and enable rapid responses to stimuli in animals. 1
Reason (R): Many nerve fibres bound together by connective tissue make up a nerve.

SECTION - B

Q. no. 21 to 26 are Very Short Answer Questions

21. Imagine you are conducting an experiment to measure the rate of water evaporation under controlled conditions. You have four different vessels as shown below:



- In which vessel, rate of evaporation will be the highest? 2
22. Explain why sound travels faster in water than in air. Include a brief explanation related to the medium's properties. 2
23. What traits are aimed for the cross-breeding of Indian breeds like *Aseel* with foreign breeds like Leghorn? 2

OR

- What are the key practices involved in organic farming that promote sustainable agricultural systems? 2
24. What is an echo? Under what conditions can it be heard? 2
25. Define kinetic energy and provide its formula. 2

OR

- A cyclist travels along a straight path with a constant acceleration of 2 m/s^2 . If the cyclist's initial velocity is 5 m/s , what is the cyclist's velocity after 4 seconds? Also, calculate the total distance covered in this time. 2
26. (a) Explain the process of membrane biogenesis and the role of ER in it. 2
 (b) How are chloroplasts and mitochondria similar in terms of genetic material?

SECTION - C

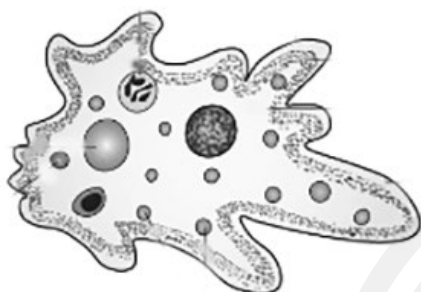
Q. no. 27 to 33 are Short Answer Questions

27. Match the following animal tissues with their position/location:

3

	Tissue		Position/location
A.	Squamous epithelium	i.	Between skin and muscles
B.	Columnar epithelium	ii.	Inner intestinal lining
C.	Cuboidal epithelium	iii.	Kidney tubules
D.	Areolar tissue	iv.	Oesophagus
E.	Adipose tissue	v.	Nose
F.	Cartilage	vi.	Below skin and between internal organs

28.



- (a) Identify the type of organism shown in the image.
- (b) What process does this organism use to acquire its food?
- (c) These organisms have food vacuole. How does the food vacuole function in these organisms?

3

OR

How are chromatin, chromosomes, and genes structurally and functionally related within the nucleus, particularly during cell division?

3

29. A block of metal is submerged in water and experiences an upthrust of 10 N. If the density of the metal is 8000 kg/m^3 and the volume of the block is 0.001 m^3 , calculate the buoyant force acting on the block. 3
30. A car's velocity-time graph shows a straight line increasing from 0 to 20 m/s over 10 seconds. Calculate the car's acceleration and the total distance traveled. 3
31. Define the following terms: 3
 - (a) Pasturage
 - (b) Vermicompost
 - (c) Crop rotation
32. (a) Under which category of mixtures will you classify suspensions and why?
 (b) A colloid is always a solid. Comment.
 (c) Can a colloid be homogeneous? 3
33. Provide explanations:
 - (a) Imagine you are in a desert area during a hot summer day. You notice that your neighbour is using a desert cooler while others are using regular fans. Why do you think the neighbour finds the desert cooler more comfortable, and how does it work better than a fan in such conditions?
 - (b) During a family picnic in the summer, you decide to bring along an earthen pot (matka) filled with water. After a few hours, you find the water in the pot to be cooler than the water from plastic bottles. Can you explain why the water in the earthen pot is cooler and how this cooling process works?
 - (c) You're enjoying a cold drink on a hot day, and you notice that water droplets have formed on the outside of your glass. Your friend asks why this happens. How would you explain the process that causes these droplets to appear? 3

SECTION - D

Q. no. 34 to 36 are Long Answer Questions

34. (a) Classify each of the following on the basis of their atomicity. 5
- | | |
|------------------------------|-----------------------------|
| (i) Cl_2 | (ii) SO_2 |
| (iii) N_2O_3 | (iv) C_3H_8 |
| (v) S_8 | (vi) H_2O |
- (b) You start with a container that holds exactly 4 grams of nitrogen gas (N_2). According to your lab manual, the reaction to form ammonia requires nitrogen and hydrogen to combine in a mass ratio of 14 : 3.
Given this information, calculate the mass of hydrogen gas (H_2) you need to react completely with your 4 grams of nitrogen gas.

OR

- (a) Give the names of the elements present in the following compounds. 5
- | | |
|----------------|--------------------|
| (i) Table salt | (ii) Slaked lime |
| (iii) Vinegar | (iv) Baking powder |
- (b) How many atoms are present in a
- | | |
|----------------------------|--------------------------|
| (i) CO_2 molecule | (ii) NH_4^+ ion |
|----------------------------|--------------------------|
- (c) Write down the names of compounds represented by the following formulae:
- | | |
|-------------------------------|---------------------------|
| (i) KNO_2 | (ii) H_2S |
| (iii) K_2SO_4 | (iv) MgCl_2 |
35. In brief, explain what happens when the following organelles are removed from a plant cell: 5
- | | | | |
|---------------------|---------------|-------------------|-------------|
| (a) Nucleus | (b) Cell wall | (c) Cell membrane | (d) Vacuole |
| (e) Golgi apparatus | | | |

OR

- Give reason for the following: 5
- (a) Meristematic cells possess a prominent nucleus and dense cytoplasm but are devoid of vacuoles.
- (b) Plants like cacti have thick epidermis.
- (c) Chewing a pear fruit gives a crunchy and granular sensation.
- (d) It is challenging to remove the husk from a coconut.
- (e) Bones are strong and non-flexible.
36. (a) A car accelerates uniformly from rest to a speed of 30 m/s in 10 seconds. Draw the velocity-time graph for this motion and calculate the acceleration of the car. 1
- (b) If the car continues to travel at a constant speed for an additional 20 seconds, calculate the total distance covered during the entire motion. 2
- (c) Explain how the distance-time graph for uniform motion differs from that of uniformly accelerated motion. 2

SECTION - E

Q. no. 37 to 39 are Case Based/Source-Based Questions with 2 to 3 short sub-parts.

37. Isotopes and isobars are two important concepts in nuclear chemistry that help us understand the behaviour of elements. Isotopes are variants of the same element that have the same number of protons but different numbers of neutrons, resulting in different atomic masses. For example, carbon-12 and carbon-14 are isotopes of carbon, with six protons but different neutron counts. In contrast, isobars are atoms of different elements that have the same mass number but different atomic numbers, meaning they contain different numbers of protons and neutrons. An example of isobars includes argon-40 and calcium-40, both having a mass number of 40 but differing in their elemental identity. Understanding isotopes and isobars is crucial in fields such as radiocarbon dating, nuclear medicine, and understanding the stability of atomic nuclei.

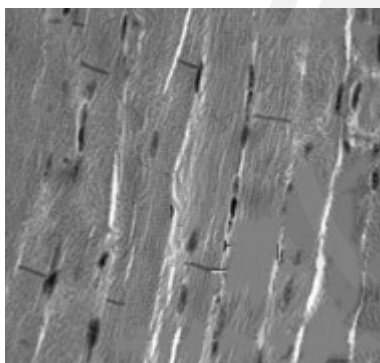
- (a) The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes $^{16}_8\text{X}$ and $^{18}_8\text{X}$ in the sample? 2
- (b) The atomic numbers of potassium and calcium are 19 and 20 respectively, but the mass number of both these elements is 40. What is the name given to such a pair of elements? 1
- (c) The chemical properties of isotopes are similar, but their physical properties differ. Why? 1

OR

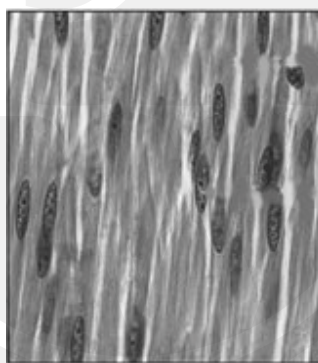
- (c) Which element's isotope is used in the treatment of cancer and goitre? 1
38. An astronaut named Alex is exploring a newly discovered planet, Xylon, which has a mass of 5×10^{24} kg and a radius of 6,400 km. Alex, with a mass of 80 kg, is on the surface of Planet Xylon. The planet is unique because it has only one-sixth of the density of Earth but the same surface gravity.
- (a) Calculate the acceleration due to gravity on the surface of Planet Xylon. 1
- (b) Alex notices that he weighs less on Xylon compared to Earth. Calculate Alex's weight on Xylon and compare it to his weight on Earth (using $g_{\text{Earth}} = 10\text{m/s}^2$). 1
- (c) If the radius of Planet Xylon were to double while keeping its mass constant, how would the acceleration due to gravity change? 1

OR

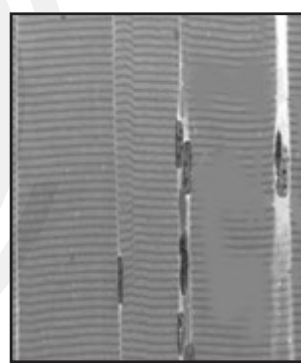
- (c) Alex is exploring the gravitational field at a height of 10,000 km above the planet's surface. How would the gravitational force on Alex change at this height compared to his weight on the surface? 1
39. While preparing for a practical exam, a student reviewed slides A, B and C of muscle tissues under a microscope. Observe these and answer the following questions:



A



B



C

- (a) Identify and name the muscle tissue in each slide. 1
- (b) Which muscle type is responsible for the rhythmic contractions of the heart? 1
- (c) Which muscle type is striated and voluntary? Mention other characteristic features of cells of this type of muscle. 2

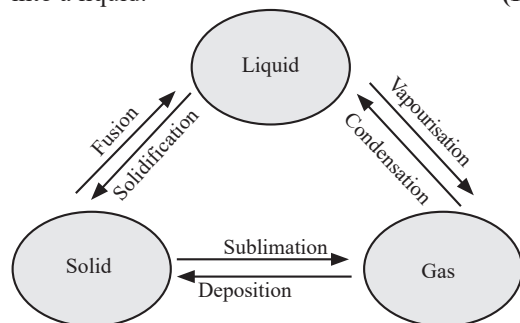
OR

- (c) Where is muscle B typically found? Mention the characteristic features of cells of this type of muscle. 2

EXPLANATIONS

1. (a) Vapourisation (A) is the process where a liquid turns into a gas.

Condensation (B) is the process where a gas turns into a liquid. (1 M)



2. (c) The atomic number of X (17) indicates that it has 17 protons.

For X^- , it has gained one extra electron, making the total number of electrons 18.

The mass number (35) is the sum of protons and neutrons. Therefore, the number of neutrons is $35 - 17 = 18$. (1 M)

3. (c)
$$\text{Mass \%} = \frac{\text{Mass of solute}}{\text{Mass of solute} + \text{Mass of solvent}} \times 100$$

$$\text{Mass \%} = \frac{0.02}{0.02 + 99.98} \times 100 = 0.02\% \quad (1 M)$$

4. (b) The chemical symbol for copper is Cu. (1 M)

5. (c) The law of constant proportions states that a chemical compound always contains exactly the same proportion of elements by mass. In the case of carbon dioxide (CO_2), the mass of carbon is 12 atomic mass units (amu) and the mass of oxygen is 16 amu. Since there are two oxygen atoms in CO_2 , the total mass of oxygen is 32 amu. Therefore, the ratio of the mass of carbon to the mass of oxygen in CO_2 is 12:32, which simplifies to 3:8. This ratio is constant for all samples of carbon dioxide, regardless of their source or method of preparation. (1 M)

6. (b) The primary reason for the visibility of the light path in the beaker (b) is that the mixture of water and milk forms a colloidal solution in which the particle size is too small to be seen with the naked eye, but is big enough to scatter light. In contrast, the copper sulphate solution in beaker (a) is a true solution with particles too small to scatter light, resulting in the absence of the Tyndall effect. (1 M)

7. (a) Rutherford's model proposed that the atom consists of a dense, positively charged nucleus around which electrons orbit, similar to planets orbiting the sun. It did not establish the mass of α -particles

in comparison to hydrogen atoms, nor was it in agreement with Thomson's model (which proposed a "plum pudding" structure). (1 M)

8. (b) Ribosomes are responsible for synthesizing proteins in the cell. Without ribosomes, protein synthesis cannot occur, affecting the cell's ability to function properly. (1 M)

9. (d) Meristematic cells divide continuously due to thin cell walls for flexibility, lack of vacuoles, and dense cytoplasm with prominent nuclei essential for active division and growth. (1 M)



Mistakes 101 : What not to do!

Students might mistakenly focus on the physical structure of the cell walls or vacuole presence, which do not directly contribute to the cell's ability to divide. Confusing the functions of various cell components can lead to incorrect answers.

10. (c) River lift systems are suitable for areas with insufficient or irregular canal flow, as they draw water directly from rivers for irrigation. (1 M)

11. (b) If structure 'A' (tracheids) is damaged, the plant will not transport water and minerals vertically. This causes wilting and impaired growth, as tracheids are crucial for water and minerals transport. (1 M)

12. (a) Even though the speed is constant, the velocity direction continuously changes, which means the satellite is accelerating (centripetal acceleration). (1 M)

13. (b) Using Newton's second law, $F = ma$. Here, $10 = 2 \cdot a$
 $a = 5 \text{ m/s}^2$

The velocity after 5 seconds,

$$v = u + at = 0 + 5 \times 5 = 25 \text{ m/s.} \quad (1 M)$$

14. (d) The range of human hearing is typically 20 Hz to 20 kHz. Frequencies beyond 20 kHz are considered ultrasound and are beyond the range of human hearing. (1 M)

15. (c) Newton's First Law of Motion states that an object will remain at rest, or in uniform motion in a straight line, unless acted upon by an external force. Statement (a) covers the case of an object at rest, and statement (b) covers the case of an object in motion. Hence, both statements (a) and (b) are true. (1 M)

16. (a) The density of water is approximately 1000 kg/m^3 . Since the density of the wood is 700 kg/m^3 , which is less than the density of water, the cube will float. Objects float in water if their density is less than that of water. (1 M)



17. (c) Particles of matter are continuously moving, that is, they possess the kinetic energy. The rate of mixing of copper sulphate or potassium permanganate crystals is faster in hot water than in cold water because the increased temperature of the water increases the kinetic energy of the water molecules. This higher kinetic energy causes the water molecules to move more rapidly, which in turn helps the solid particles to disperse and dissolve more quickly. **(1 M)**
18. (c) Chromosomes are visible as rod-shaped structures during cell division. Chromatins are entangled mass of thread-like structures in non-dividing cells. **(1 M)**
19. (b) The area under a velocity-time graph does represent the distance (or displacement) traveled by the object. While the slope of the velocity-time graph indeed gives the acceleration, it does not explain why the area under the graph represents distance. **(1 M)**
20. (b) Assertion (A) is correct as nerve impulses facilitate muscle movement and rapid responses in animals. However, Reason (R) does not correctly explain the assertion as connective tissue binding to nerve fibers does not directly explain how nerve impulses facilitate these functions. **(1 M)**
21. The rate of evaporation will be the highest in vessel C. **(½ M)**

The rate of evaporation depends on the surface area of the container: the larger the surface area, the higher the evaporation rate. **(½ M)**

It also depends on the wind speed: the higher the wind speed, the more particles evaporate from the surface. **(½ M)**

Therefore, in vessel C, which has both a large surface area and a moving fan, the rate of evaporation will be the highest. **(½ M)**

22. Sound travels faster in water than in air because water is denser and the molecules are closer together, which facilitates quicker transmission of sound waves through the medium. Additionally, the bulk modulus of water is higher, which means water is less compressible than air. **(2 M)**
23. Cross-breeding programs between indigenous (e.g., *Aseel*) and exotic (e.g., Leghorn) breeds aim to develop new varieties with the following desirable traits:
- Increased number and quality of chicks.
 - Development of dwarf broiler parents for commercial production.
 - Adaptation to high temperatures.
 - Low maintenance requirements.
 - Reduction in the size of the egg-laying bird with ability to utilise more fibrous cheaper diets formulated using agricultural by-products. **[Any four] (½ × 4 = 2 M)**

OR

Organic farming promotes sustainable agricultural systems through several key practices:

- (i) Organic manures and recycled farm waste (straw and livestock excreta): For soil fertility. **(½ M)**
 - (ii) Bio-agents: Such as blue-green algae for biofertilizers. **(½ M)**
 - (iii) Bio-pesticides: Like *neem* leaves or turmeric for grain storage. **(½ M)**
 - (iv) Healthy cropping practices: Including mixed cropping, inter-cropping, and crop rotation to enhance nutrient availability and control pests and harmful insects. **(½ M)**
24. An echo is the reflection of sound that arrives at the listener some time after the direct sound. It can be heard when the reflecting surface is at least 17.2 meters away from the sound source and the time interval between the original sound and the reflected sound is at least 0.1 seconds. **(2 M)**
25. Kinetic energy is the energy possessed by an object due to its motion. It is given by the formula: **(1 M)**

$$KE = \frac{1}{2}mv^2 \quad \text{(½ M)}$$

where m is the mass of the object and v is its velocity.

It is expressed in Joules(J). **(½ M)**

OR

Velocity $v = u + at$

$$v = 5 \text{ m/s} + (2\text{m/s}^2 \times 4 \text{ s}) = 13 \text{ m/s} \quad \text{(1 M)}$$

$$\text{Distance } s = ut + \frac{1}{2}at^2$$

$$s = (5 \text{ m/s} \times 4 \text{ s}) + \frac{1}{2} \times 2 \text{ m/s}^2 \times (4 \text{ s})^2$$

$$= 20 \text{ m} + 16 \text{ m} = 36 \text{ m} \quad \text{(1 M)}$$



Nailing the Right Answer

Remember to use to correct kinematic equations for uniformly accelerated motion. Start by calculating the final velocity using the formula $v = u + at$. Then, apply the formula $s = ut + \frac{1}{2}at^2$ to find the distance, ensuring all units are consistent.

26. (a) Membrane biogenesis involves the formation of new membranes. The endoplasmic reticulum (ER) plays a crucial role by synthesizing lipids and proteins that are essential for membrane formation. **(1 M)**
- (b) Both chloroplasts and mitochondria have their own DNA and ribosomes, allowing them to synthesize some proteins independently. **(1 M)**

27.

Tissue	Position/location
A. Squamous epithelium	iv. Oesophagus
B. Columnar epithelium	ii. Inner intestinal lining
C. Cuboidal epithelium	iii. Lining of kidney tubules
D. Areolar tissue	i. Between skin and muscles
E. Adipose tissue	vi. Below skin and between internal organs
F. Cartilage	v. Nose

($\frac{1}{2} \times 6 = 3 M$)

28. (a) The organism shown is an *Amoeba*, a single-celled organism. (1 M)
- (b) An *Amoeba* acquires its food through endocytosis, where the cell membrane engulfs food particles from the external environment. (1 M)
- (c) The food vacuole in *Amoeba* contains the food items that the *Amoeba* has consumed and helps in digesting them. (1 M)

OR

- Chromatin, composed of DNA and proteins, appears as an entangled mass of thread-like structures in non-dividing cells. (1 M)
- During cell division, chromatin organizes into rod-shaped chromosomes, which are visible under a microscope. These chromosomes carry hereditary information in the form of DNA molecules. (1 M)
- Functional segments of DNA, called genes, are crucial for constructing and organising cells. (1 M) Thus, chromatin, chromosomes, and genes are structurally and functionally interconnected, facilitating cellular organisation and inheritance.

Nailing the Right Answer

Focus on how chromatin transforms into chromosomes during cell division, and how genes, as functional segments of DNA, are involved in this process. Ensure clarity in describing the structural changes and their functional significance in inheritance.

29. According to Archimedes' Principle, the buoyant force equals the weight of the displaced water:
 Buoyant Force = Density of water \times Volume of block \times g
 (1½ M)
- Assuming the density of water is 1000 kg/m³:
 Buoyant Force = 1000 kg/m³ \times 0.001 m³ \times 9.8 m/s² = 9.8 N
 The buoyant force acting on the block is 9.8 N. (½ M)

30. Acceleration: The acceleration a is the slope of the velocity-time graph:

$$a = \frac{\Delta v}{\Delta t} = \frac{20 \text{ m/s}}{10 \text{ s}} = 2 \text{ m/s}^2 \quad (1\frac{1}{2} M)$$

Distance Traveled: The area under the velocity-time graph is the distance traveled:

$$\text{Distance} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 10 \text{ s} \times 20 \text{ m/s} = 100 \text{ m} \quad (1\frac{1}{2} M)$$

The car's acceleration is 2m/s² and the total distance traveled is 100 meters.

31. (a) Pasturage refers to the availability of flowers to the bees for easy accessibility for pollen collection and nectar. (1 M)
- (b) Vermicompost is organic compost produced using earthworms to hasten the decomposition of plant and animal waste, enriching soil nutrients. (1 M)
- (c) The growing of different crops on a piece of land in pre-planned succession is called crop rotation. (1 M)
32. (a) Suspensions are classified as heterogeneous mixtures. This is because the particles in a suspension are large enough to be seen with the naked eye and they do not dissolve in the solvent. (½ M)
 They are distributed non-uniformly throughout the mixture and tend to settle down over time. (½ M)
- (b) Colloids can exist in various states of matter, including solid, liquid, and gas. (½ M)
 For example, milk is a liquid colloid (emulsion), while smoke is a gaseous colloid (solid particles dispersed in gas). (½ M)
- (c) No, a colloid cannot be considered truly homogeneous. Colloids are heterogeneous mixtures because they consist of two distinct phases: the dispersed phase and the dispersion medium. (½ M)
 Although the particles in a colloid are small enough to remain evenly distributed and not settle out, they are still distinguishable at the microscopic level. (½ M)
33. (a) A desert cooler is more effective on a hot, dry day because the low humidity allows for greater evaporation of water. (½ M)
 As the water evaporates, it absorbs heat from the air, thus lowering the temperature and providing a cooling effect. (½ M)
- (b) Water stored in an earthen pot (matka) becomes cool during the summer due to the process of evaporation. The porous nature of the earthen pot allows water to seep through and evaporate from the surface. (½ M)
 As the water evaporates, it absorbs heat from the remaining water inside the pot, causing the temperature of the water to drop and keeping it cool. (½ M)

- (c) Water droplets form on the outer surface of a glass containing ice-cold water due to condensation. When warm, humid air comes into contact with the cold surface of the glass, the temperature of the air drops. ($\frac{1}{2}$ M)

This cooling causes the moisture in the air to condense into liquid water droplets on the glass surface. ($\frac{1}{2}$ M)

34. (a)
- | | | |
|-------------------------------------|------------|---------------------------------|
| (i) Cl ₂ | Diatomic | |
| (ii) SO ₂ | Triatomic | |
| (iii) N ₂ O ₃ | Polyatomic | |
| (iv) C ₃ H ₈ | Polyatomic | |
| (v) S ₈ | Polyatomic | |
| (vi) H ₂ O | Triatomic | ($\frac{1}{2} \times 6 = 3$ M) |



Mistakes 101 : What not to do!

Students might mistakenly forget to consider subscripts while counting the number of atoms in a particular compound or molecule.

For example: Students might incorrectly identify SO₂ as the diatomic; but it's actually triatomic with 3 atoms (1 sulphur and 2 oxygen).

- (b) The mass ratio of nitrogen to hydrogen in ammonia is 14:3. This means 14 grams of nitrogen reacts with 3 grams of hydrogen.

$$\frac{14 \text{ grams of N}_2}{3 \text{ grams of H}_2} = \frac{4 \text{ grams of N}_2}{x \text{ grams of H}_2} \quad (\frac{1}{2} \text{ M})$$

Cross-multiplying to solve for x: $14 \times x = 4 \times 3$

$$14x = 12$$

$$x = \frac{12}{14} \quad (\frac{1}{2} \text{ M})$$

$$x = \frac{6}{7} \approx 0.857 \text{ grams of H}_2 \quad (1 \text{ M})$$

OR

- (a) (i) Table salt: Sodium (Na) and Chlorine (Cl) ($\frac{1}{2}$ M)
 (ii) Slaked lime: Calcium (Ca), Oxygen (O), and Hydrogen (H) ($\frac{1}{2}$ M)
 (iii) Vinegar: Carbon (C), Hydrogen (H), and Oxygen (O) ($\frac{1}{2}$ M)
 (iv) Baking powder: Sodium (Na), Hydrogen (H), Carbon (C), Oxygen (O) ($\frac{1}{2}$ M)
- (b) (i) CO₂ molecule:
 Total atoms in CO₂ molecule: 1 Carbon atom + 2 Oxygen atoms = 3 atoms ($\frac{1}{2}$ M)

- (ii) NH₄⁺ ion:
 Total atoms in NH₄⁺ ion: 1 Nitrogen atom + 4 Hydrogen atoms = 5 atoms ($\frac{1}{2}$ M)

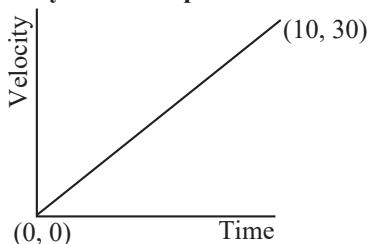
- (c) (i) KNO₂: Potassium nitrite ($\frac{1}{2}$ M)
 (ii) H₂S: Hydrogen sulphide ($\frac{1}{2}$ M)
 (iii) K₂SO₄: Potassium sulphate ($\frac{1}{2}$ M)
 (iv) MgCl₂: Magnesium chloride ($\frac{1}{2}$ M)

35. (a) Nucleus: The nucleus controls cell activities, including growth and reproduction. Without it, the cell cannot divide and regulate gene expression, leading to eventual cell death. (1 M)
- (b) Cell wall: The cell wall provides structural support and protection. Its removal makes the plant cell vulnerable to mechanical damage and unable to maintain its shape, resulting in collapse. (1 M)
- (c) Cell membrane: The cell membrane regulates the movement of substances in and out of the cell. Without it, the cell loses integrity, leading to uncontrolled material exchange, which could result in cell death due to the loss of essential ions and molecules. (1 M)
- (d) Vacuole: Removing the vacuole from a plant cell leads to loss of turgidity and rigidity, disrupting storage of essential substances and affecting the cell's overall function and health. (1 M)
- (e) Golgi apparatus: The Golgi apparatus modifies, sorts, and packages proteins and lipids. Its removal disrupts the cell's ability to process and distribute these molecules, affecting cell function and growth. (1 M)

OR

- (a) Meristematic cells have a prominent nucleus and dense cytoplasm to support active cell division and growth, while the absence of vacuoles allows for quick and efficient cell division. (1 M)
- (b) Plants like cacti have a thick epidermis to reduce water loss, serving as a protective layer that helps conserve water in arid environments. (1 M)
- (c) Chewing a pear fruit gives a crunchy and granular sensation due to the presence of sclerenchyma cells, which have thick, lignified walls. (1 M)
- (d) Removing the husk from a coconut is challenging because it is made of sclerenchyma tissue, which has thick, lignified walls that provide strength and rigidity. (1 M)
- (e) Bones are strong and non-flexible due to a hard matrix of calcium and phosphorus, providing structural support and protection to the body. (1 M)

36. (a) **Velocity-Time Graph:**



Acceleration Calculation:

$$a = \frac{\text{Change in velocity}}{\text{Time}} = \frac{30 \text{ m/s}}{10 \text{ s}} = 3 \text{ m/s}^2 \quad (1 \text{ M})$$

(b) Distance during acceleration phase (first 10 second):

$$S = ut + \frac{1}{2} at^2$$

$$\text{Distance} = \frac{1}{2} \times 0 \times 10 + \frac{1}{2} \times 3 \times 10^2 = 150 \text{ m.} (1 \text{ M})$$

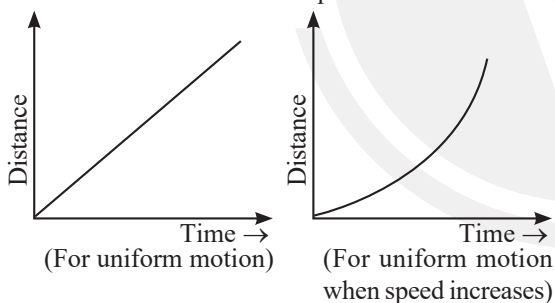
Distance during constant speed phase (next 20 sec):

$$\text{Distance} = \text{Speed} \times \text{Time} = 30 \text{ m/s} \times 20 \text{ s} = 600 \text{ m}$$

Total distance covered:

$$\text{Total Distance} = 150 \text{ m} + 600 \text{ m} = 750 \text{ m} \quad (1 \text{ M})$$

(c) The distance-time graph for uniform motion is a straight line with a constant slope, indicating constant velocity. For uniformly accelerated motion, the distance-time graph is a parabola, showing that distance increases with the square of time.



(2 M)



Mistakes 101 : What not to do!

Students often confuse uniform motion with uniform acceleration, leading to errors in graph interpretation. Mislabeling axes on velocity-time and distance-time graphs or using incorrect units can also result in calculation mistakes, affecting the accuracy of their answer.

37. (a) Let x be the percentage (as a decimal) of $^{16}_8\text{X}$.

The percentage of $^{18}_8\text{X}$ will then be $1 - x$.

The average atomic mass can be expressed as:

$$16.2 = 16 \cdot x + 18 \cdot (1 - x) \quad (\frac{1}{2} \text{ M})$$

Expanding this equation gives:

$$16.2 = 16x + 18 - 18x$$

Combining like terms:

$$16.2 = -2x + 18 \quad (\frac{1}{2} \text{ M})$$

Rearranging to solve for x :

$$-2x = 16.2 - 18$$

$$-2x = -1.8$$

$$x = \frac{-1.8}{-2} = 0.9 \quad (\frac{1}{2} \text{ M})$$

Thus, the percentage of $^{16}_8\text{X}$ is:

$$0.9 \times 100 = 90\%$$

The percentage of $^{18}_8\text{X}$ is:

$$(1 - 0.9) \times 100 = 10\%$$

- Percentage of $^{16}_8\text{X}$: 90%

- Percentage of $^{18}_8\text{X}$: 10% (1/2 M)



Nailing the Right Answer

To ensure students get full credit, they should start by setting up the equations for the average atomic mass: $(x \times 16) + [(1 - x) \times 18] = 16.2$. Then solve for x , which represents the fraction of the isotope $^{16}_8\text{X}$. The percentage of $^{16}_8\text{X}$ is $x \times 100\%$ and for $^{18}_8\text{X}$ is $(1 - x) \times 100\%$. The calculations and final percentages should be clearly shown and explained.

(b) The pair of elements with the same mass number but different atomic numbers are called isobars. (1/2 M)

In this case, potassium and calcium are isobars, both having a mass number of 40. (1/2 M)

(c) Isotopes have similar chemical properties because they possess the same number of protons and electrons, which determine their chemical behaviour.

(1/2 M)

However, their physical properties differ due to variations in mass and nuclear stability caused by differing numbers of neutrons. (1/2 M)

OR

(c) • An isotope of cobalt is used in the treatment of cancer. (1/2 M)

• An isotope of iodine is used in the treatment of goitre. (1/2 M)

38. (a) The formula for acceleration due to gravity is:

$$g = \frac{GM}{R^2}$$



where $G = 6.674 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$, $M = 5 \times 10^{24} \text{ kg}$, and $R = 6.4 \times 10^6 \text{ m}$.

$$g = \frac{6.674 \times 10^{-11} \times 5 \times 10^{24}}{(6.4 \times 10^6)^2} \approx 6 \text{ m/s}^2 \quad (1 \text{ M})$$

(b) Weight on Xylon : 480 N; Weight on Earth: 800 N

Weight on Xylon $W_{\text{Xylon}} = mg_{\text{Xylon}}$

where $m = 80 \text{ kg}$ and $g_{\text{Xylon}} = 6 \text{ m/s}^2$

$$W_{\text{Xylon}} = 80 \times 6 = 480 \text{ N}$$

Weight on Earth $W_{\text{Earth}} = mg_{\text{Earth}}$

where $g_{\text{Earth}} = 10 \text{ m/s}^2$

$$W_{\text{Earth}} = 80 \times 10 = 800 \text{ N} \quad (1 \text{ M})$$

(c) It would decrease by a factor of four

The acceleration due to gravity is inversely proportional to the square of the radius:

$$g \propto \frac{1}{R^2}$$

If the radius doubles, g decreases by $(2^2) = 4$. (1 M)

OR

(c) The distance from the center of the planet at this height is $R + h = 6.4 \times 10^6 + 10,000 \times 10^3 = 16.4 \times 10^6 \text{ m}$.

The gravitational force at this height F is:

$$F = \frac{GMm}{(R + h)^2}$$

Given that the original force $F_0 = \frac{GMm}{R^2}$, the new force will be:

$$F = F_0 \left(\frac{R^2}{(R + h)^2} \right)$$

Substituting $R + h \approx 2R$:

$$F \approx \frac{F_0}{(2^2)} = \frac{F_0}{4}$$

Thus, the force decreases to one-fourth. (1 M)

39. (a) A: Cardiac muscle tissue

B: Smooth muscle tissue

C: Skeletal muscle tissue (1 M)

(b) A (Cardiac muscle) is responsible for the rhythmic contractions of the heart. (1 M)

(c) C (Skeletal muscle) is striated and voluntary. (½ M)

The cells of skeletal tissue are long, cylindrical, unbranched and multinucleate (having many nuclei).

(1½ M)

OR

(c) Smooth muscles (muscle B) are typically found in iris of the eye, in ureters and in the bronchi of the lungs. (1 M)

The cells are long with pointed ends (spindle-shaped) and uninucleate (having a single nucleus). (1 M)