Class IX Session 2024-25
Subject - Science
Sample Question Paper - 12

Time: 3 Hours.   **Total Marks: 80**

General Instructions:

i. *All questions would be compulsory. However, an internal choice of approximately 33% would be provided. 50% marks are to be allotted to competency-based questions.*
ii. *Section A would have 16 simple/complex MCQs and 04 Assertion-Reasoning type questions carrying 1 mark each.*
iii. *Section B would have 6 Short Answer (SA) type questions carrying 02 marks each.*
iv. *Section C would have 7 Short Answer (SA) type questions carrying 03 marks each.*
v. *Section D would have 3 Long Answer (LA) type questions carrying 05 marks each.*
vi. *Section E would have 3 source based/case based/passage based/integrated units of assessment (04 marks each) with sub-parts of the values of 1/2/3 marks.*

SECTION - A

Select and write the most appropriate option out of the four options given for each of the questions 1-20. There is no negative mark for incorrect response.

1. Little Ravina was playing with a balloon. She noticed that the balloon felt firm when she squeezed it since the gas exerts pressure on the walls of the container because: [1]
   a) Because gas particles are static.
   b) Because gas particles hit the walls of the container.
   c) Because gas particles react with each other.
   d) Because gas particles have random motion.

2. Virat was learning about tiny atoms that are the building blocks of matter. The smallest atom of all is [1]
   a) Helium
   b) Lithium
   c) Carbon
   d) Hydrogen

3. The atomic number of an element having mass number 23 and number of neutrons 12 is: [1]
   a) 11
   b) 23
   c) 12
   d) 35

4. Which of the following statements is NOT true? [1]
    a) The solubility of solids in liquids increases on increasing the temperature.
    b) The solubility of gases in liquids decreases on increasing the temperature.
    c) The solubility of gases in liquids increases on increasing the temperature.
    d) The solubility of solids in liquids remains unaffected by changes of pressure.

5. Relative molecular mass of H_2S is: [1]
    a) 16 a.m.u.
    b) 34 a.m.u.
    c) 64 a.m.u.
    d) 18 a.m.u.

6. The element which has same molecular mass as its atomic mass is: [1]
    a) Nitrogen
    b) Chlorine
    c) Neon
    d) Oxygen

7. Nikhil was burning an incense stick in his room. He noticed that the pleasant smell spread throughout the room. Spreading of fragrance of a burning incense stick in a room shows that [1]
    a) Particles of matter have spaces between them
    b) Particles of matter are constantly moving.
    c) Particles of matter attract each other
    d) Particles of matter have smell

8. Neena prepared a stained temporary mount of human cheek cells. She observed the slide under the compound microscope and noted her observations in the given diagram. However, she did not observe ribosomes and mitochondria. It is because [1]

    a) Cheek cells lack ribosomes and mitochondria.
    b) Ribosomes and mitochondria do not get stained.
    c) Ribosomes and mitochondria are small and so cannot be observed under a compound microscope.
   d) The cheek cells were not stained properly.

9. Find the correct match of the cell organelles and their functions in the cell.   [1]
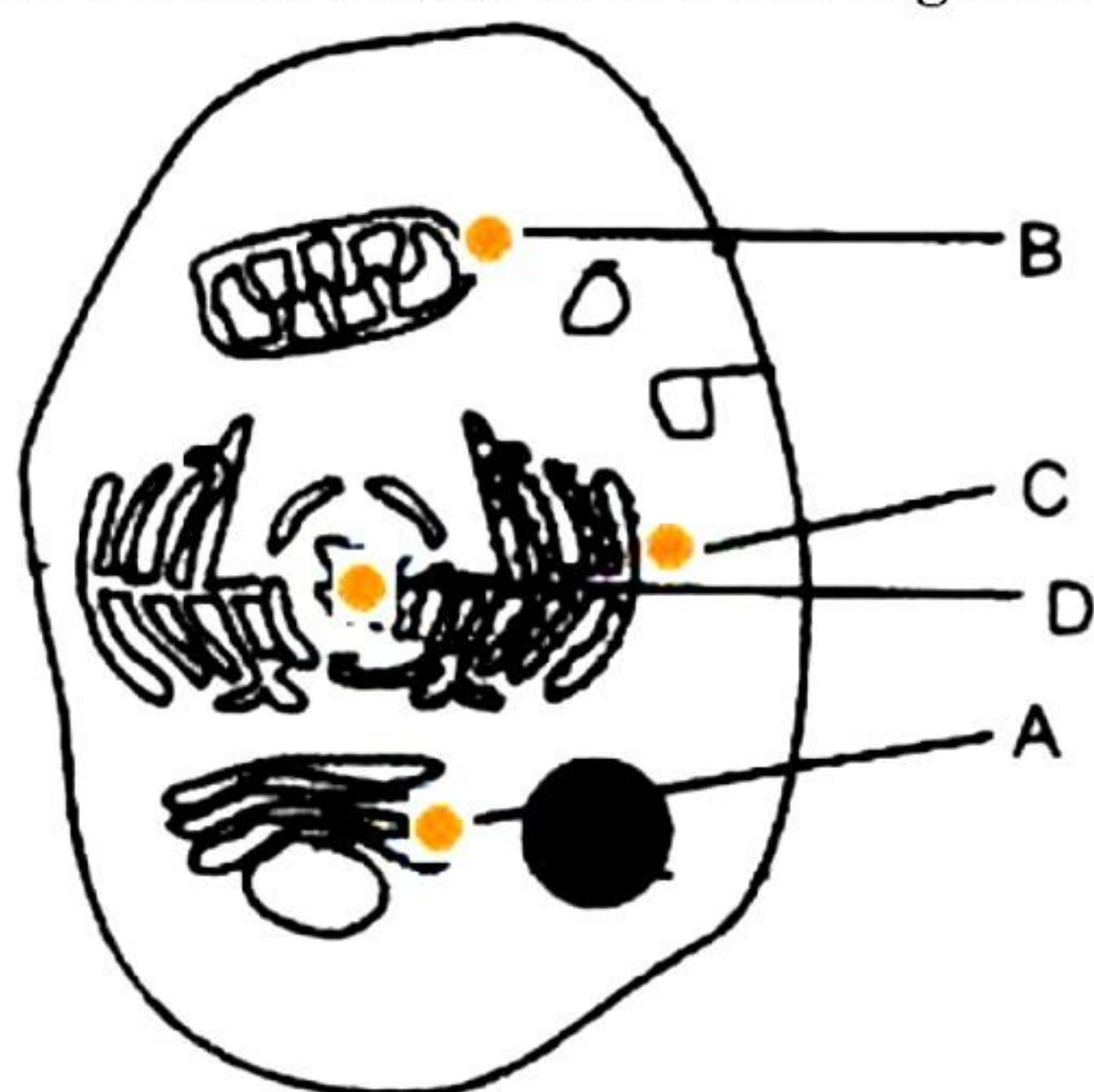
	A	B	C	D
a)	Helps in the transport of material	Packaging organelle	Provides energy	Carries the hereditary information
b)	Packaging organelle	Provides energy	Helps in the transport of material	Carries the hereditary information
c)	Carries the hereditary information	Packaging organelle	Provides energy	Helps in the transport of material
d)	Provides energy	Carries the hereditary information	Packaging organelle	Helps in the transport of material

10. A nail is inserted in the trunk of a tree at a height of 1 metre from the ground level. After 3 years the nail will   [1]
    a) move downwards
    b) move upwards
    c) remain at the same position
    d) move sideways

11. Anil prepared a slide of an animal tissue and noted the following observations: [1]
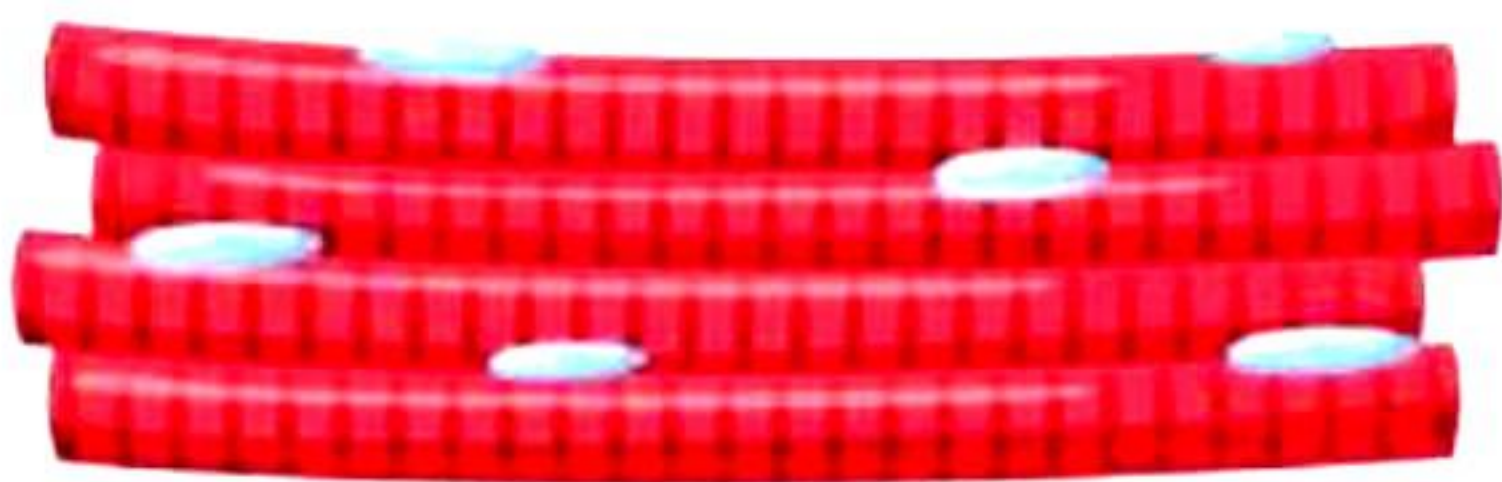
- Long, cylindrical, and unbranched cells
- Multinucleated
- Presence of dark and light bands

The tissue could be of
a) Unstriated muscle fibres
b) Nerve fibres
c) Striated muscle fibres
d) Cardiac muscle fibres

12. Crop rotation is an important part of organic farming. Why is mono-cropping problematic? [1]
a) The crop is vulnerable to organised crop thieves.
b) It encourages the build-up of diseases and pests that destroy a particular crop.
c) It does not use minerals.
d) It is expensive.

13. What is the total momentum of the bullet and gun before firing a bullet of mass m and velocity v? [1]
a) mv
b) 2mv
c) mv/2
d) zero

14. When you travel 40 km towards East and then 10 km towards West, your net displacement is [1]
a) 30 km towards East
b) 30 km towards West
c) 50 km towards East
d) 50 km towards West

15. If the sides of a cube are decreased from 5 cm to 4 cm and then submerged in water, what will happen to the buoyant force experienced by the cube compared to when it had 5 cm sides? [1]
a) The buoyant force will remain the same
b) The buoyant force will increase
c) The buoyant force will decrease
d) The buoyant force will be zero in both cases.

16. A stationary rail engine produces whistle with a frequency 2600 Hz. A person standing at a distance of 550 m from the engine will listen to _____ number of waves within one minute. [1]
a) 26×10^4
b) 156×10^3
c) 156×10^5
d) 26×10^5

Question No. 17 to 20 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:
(a) Both A and R are true, and R is the correct explanation of A
(b) Both A and R are true, and R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

17. **Assertion (A):** All noble gases are monoatomic. [1]
    Reason (R): Noble gases are highly stable and does not dimerise or polymerise.

18. **Assertion (A)**: Chromosomes are constituted by RNA and proteins. [1]
    Reason (R): Chromosomes are thread-like structures present in the nucleus of a cell.

19. **Assertion (A):** When you jump on a concrete surface, your feet hurt more than when you jump on the sand. [1]
    Reason (R): According to Newton's second law of motion force is directly proportional to its mass and rate of acceleration.

20. **Assertion (A)**: The inner lining of the intestine has tall epithelial cells. [1]
    Reason (R): Columnar epithelium facilitates absorption and secretion.

SECTION - B
Question No. 21 to 26 are very short answer questions.

21. During a science fair, Nisha presents their research on different elements: Argon (Ar), Protium (^{1}H), Calcium (Ca), and Deuterium (^{2}H). They aim to educate attendees about isotopes and isobars.

    Classify the following pairs into isotopes and isobars:
    - Protium (^{1}H) and Deuterium (^{2}H)
    - Argon (Ar) and Calcium (Ca)

    Explain: The isotopes differ in physical properties. [2]

22. Can you consider a cluster of eggs as a tissue? Justify your answer. [2]

23. Rita observed a temporary mount of an onion peel under the microscope. [2]
    (a) What cell characteristics would have been noted by Rita?
    (b) Which stain is used to observe the cells of an onion peel?
    ### OR
    Identify the cell component based on the clues provided.
   (a) Type of plastid which stores food
    (b) Site for ribosome formation

24. An object of volume V is immersed in a liquid of density ρ.   [2]
Calculate the magnitude of buoyant force acting on the object due to the liquid.
Mention the direction of buoyant force.

25. An object moving in a certain direction with acceleration in the perpendicular direction.
Is this situation possible? Give an example of such situation.   [2]

OR

For a particle in motion distance-time graph is shown in Fig. From graph answer the
following:
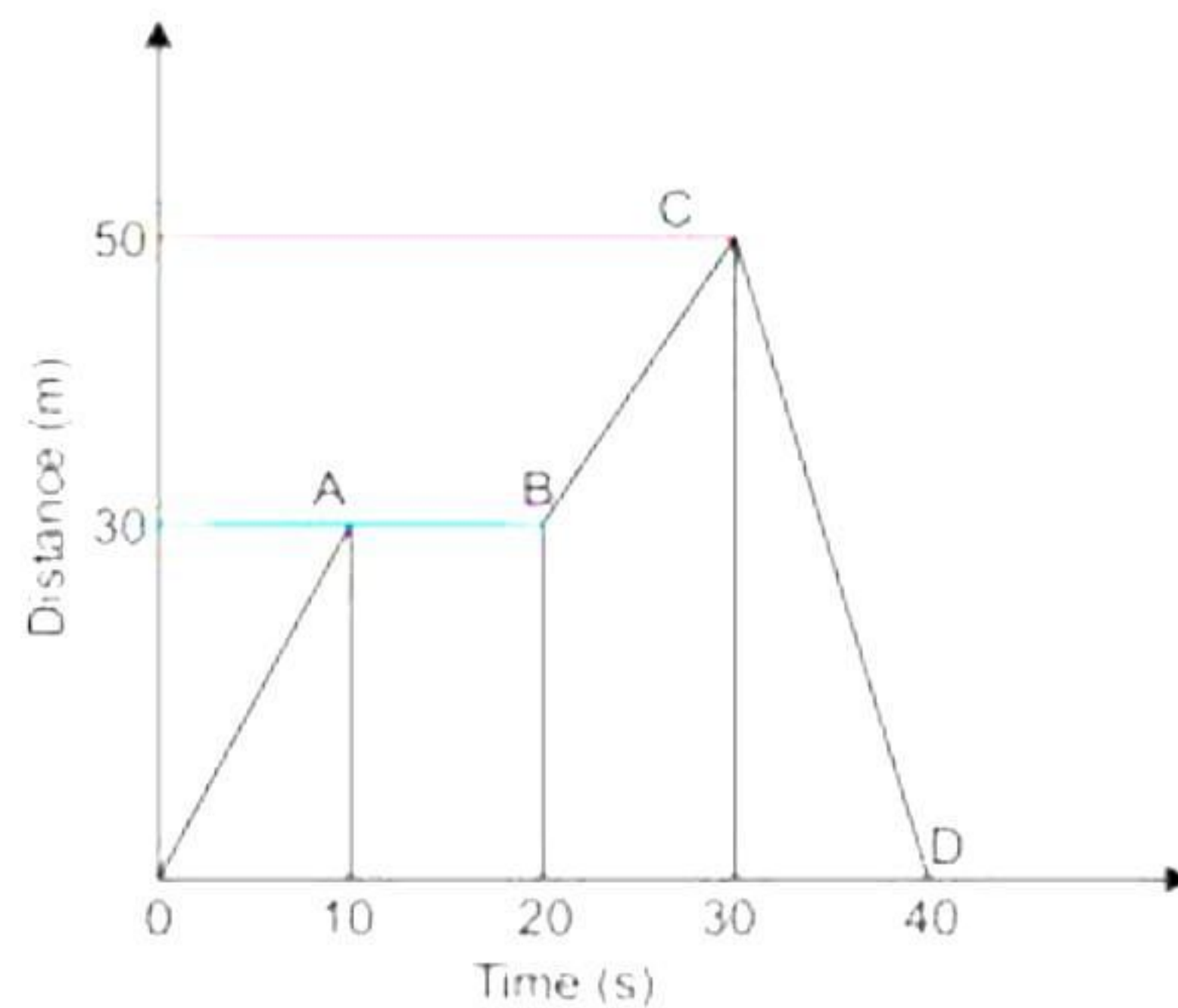
a) During which time period particle is stationary?
b) Find magnitude of velocity in OA, AB, and BC parts.

26. A variety of fishes survive together in a pond. However, these fishes often die due to
certain factors. What may be the reasons for mass mortality of fishes in a pond?   [2]

SECTION - C
Question No. 27 to 33 are short answer questions.

27. Ritika is an intern working in a chemistry laboratory in R and D department. She was asked by her supervisor to prepare a report on the types of molecules for an upcoming presentation. To complete this task, she needs to explain the basic classification of molecules.

She was given two samples as follows:

Sample A: A gas cylinder containing oxygen (O_2).

Sample B: A beaker containing water (H_2O).

She needs to answer the following questions:

What are the two main types of molecules?

How would you classify oxygen (O_2) and water (H_2O) based on these types of molecules?   [3]

28. Elements are classified as metals, non-metals, and metalloids. Give any one property of each. Also give one example of each.   [3]
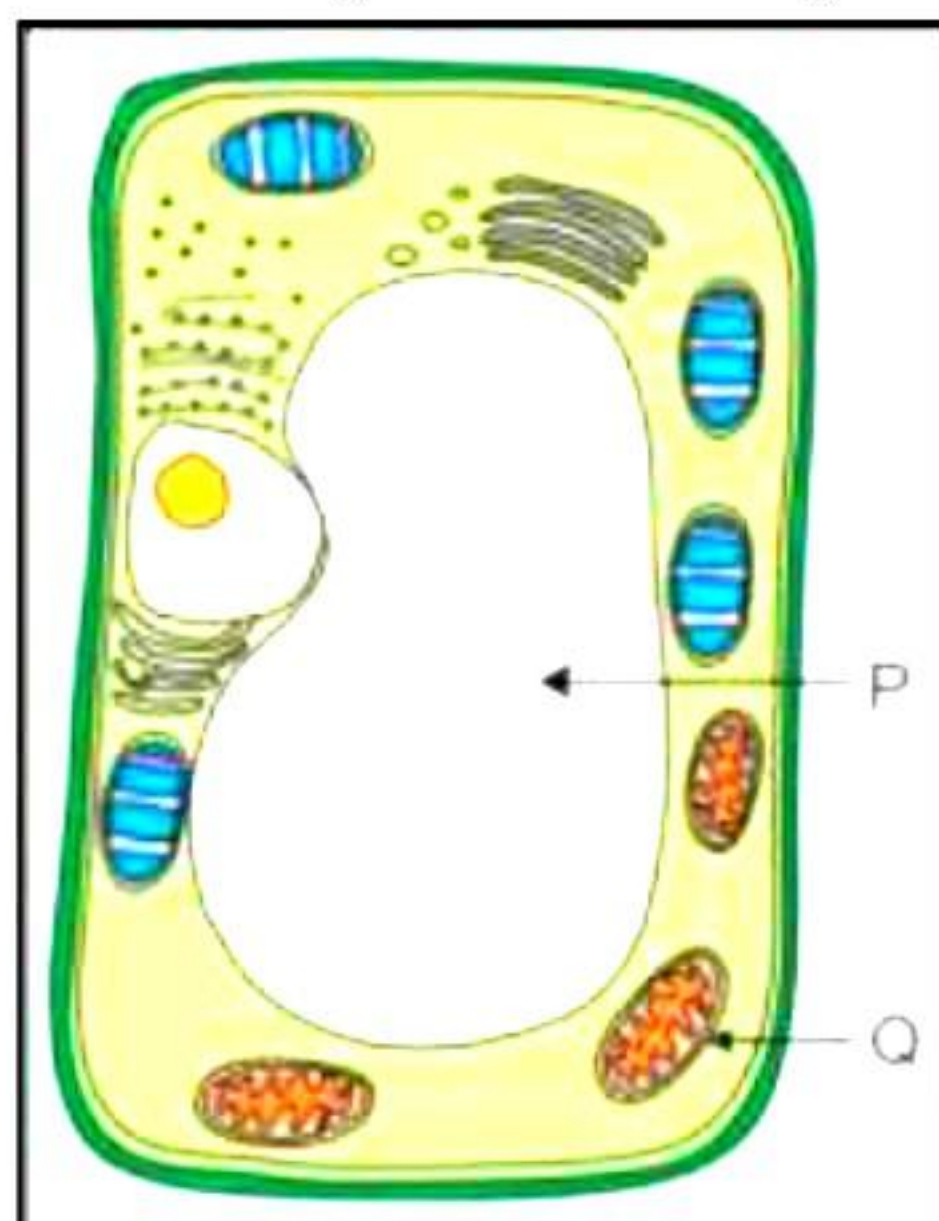
OR

Amisha was asked by her teacher to fill up the empty spaces given in the below illustration based one element symbol, atomic number, and atomic mass number. Could you help her to do so?   [3]
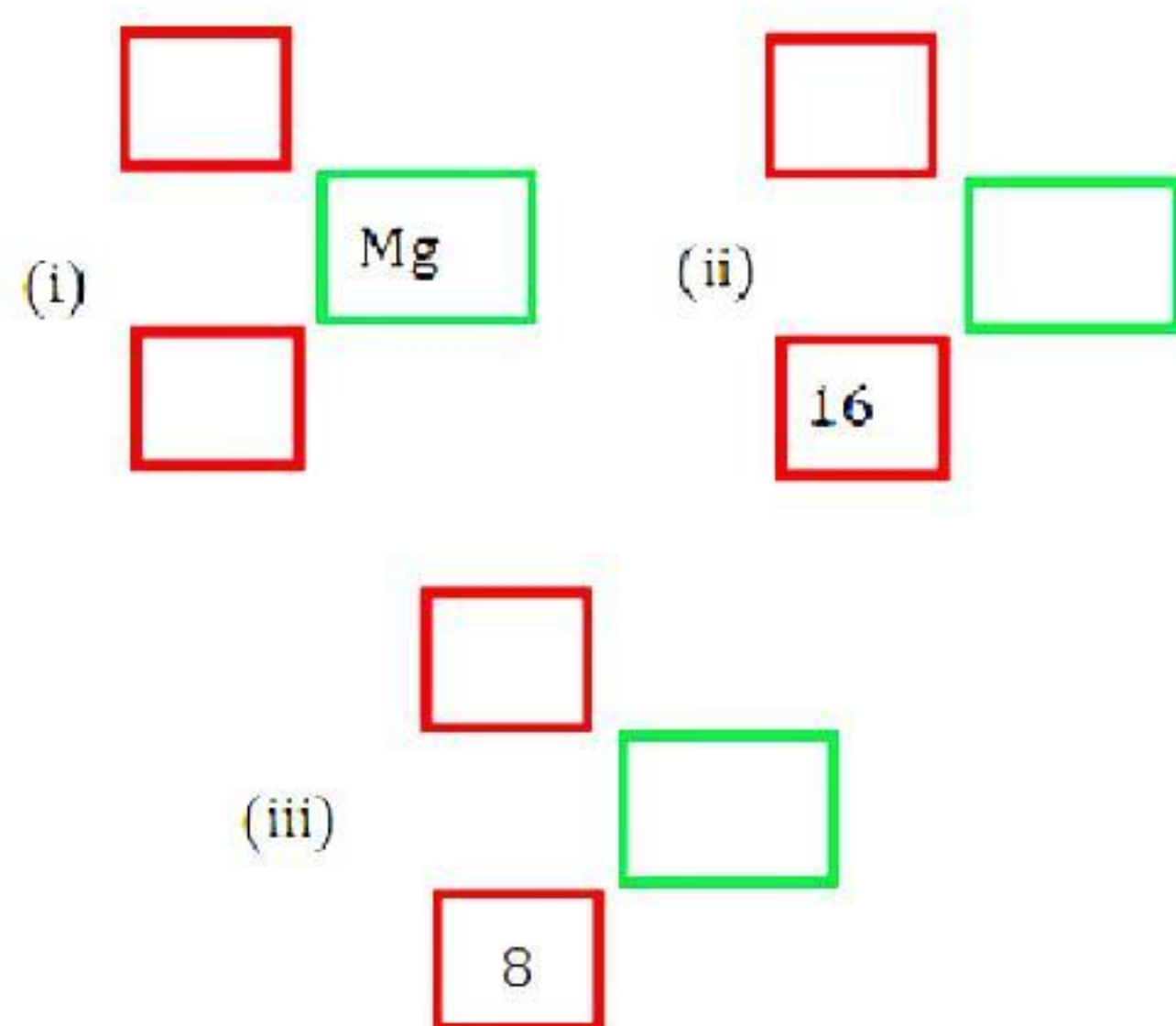
29. Observe the figure carefully and answer the questions based on it. [3]

(a) Identify P and Q.

(b) What is the role of P in the cell?

(c) What will happen in the absence of Q in the cell?

30. The model shows how a farmer plants the crop in different beds in three consecutive years. [3]

(a) What is the common term used for this pattern of crop harvesting?

(b) What are the benefits of this pattern of planting crops?

31. Rajiv dropped the ball from every floor of his building, and each floor was 3 m in height on average. He tried to find the difference in the potential and kinetic energy of the ball as he changed the height from which it was dropped. [3]

(Consider, g = 10 m/s²; √3 ≈ 1.73)

Floor of Building	Height (m)	Kinetic Energy (J)	Potential energy (J)
5	15	0	750
4	12	--	--
3	9	300	..
2	6	--	300
1	3	--	..
Just above the ground	0	750	0

Answer the following questions based on the given information.
  (a) Find the total energy of the ball when it is about to be dropped from the 5th floor.
  (b) Find the mass of the ball.
  (c) Complete the given table.

32. [3]
  (a) Define force and state its three effects.
  (b) Why do the fruits and leaves fall off the branches in a strong wind?
  (c) Calculate the force that produces an acceleration of $3m/s^2$ on a body of mass of 20 g.

33. [3]
  (a) List two factors on which speed of sound depends.
  (b) Distinguish between intensity of sound and loudness of sound.
  (c) The frequency and wavelength of sound wave are 2 kHz and 0.35 m respectively. Find the time it will take to travel a distance of 1.5 km.

SECTION - D

Question No. 34 to 36 are long answer questions.

34. Sejal is a graduate student presenting at a science conference, and her topic is the historical development of atomic models. During her presentation, she focuses on Niels Bohr and his contributions to atomic theory. The audience is particularly interested in understanding how Bohr's model improved upon earlier models of the atom. [5]

- What were Bohr's key contributions to the understanding of atomic structure?
- Describe Bohr's model of the atom in detail, including a neat and labelled diagram.

OR

Answer the following questions:

(a) Describe Rutherford's model of an atom.

(b) Give reasons:
   i. After a hot sunny day, people sprinkle water on the roof or open ground.
   ii. A wooden table should be called a solid.

35. Radhika conducted an experiment to know how plant cells lose or gain water through osmosis. She cut out 5 cm long potato strips and placed three potato strips in each of the following beakers:
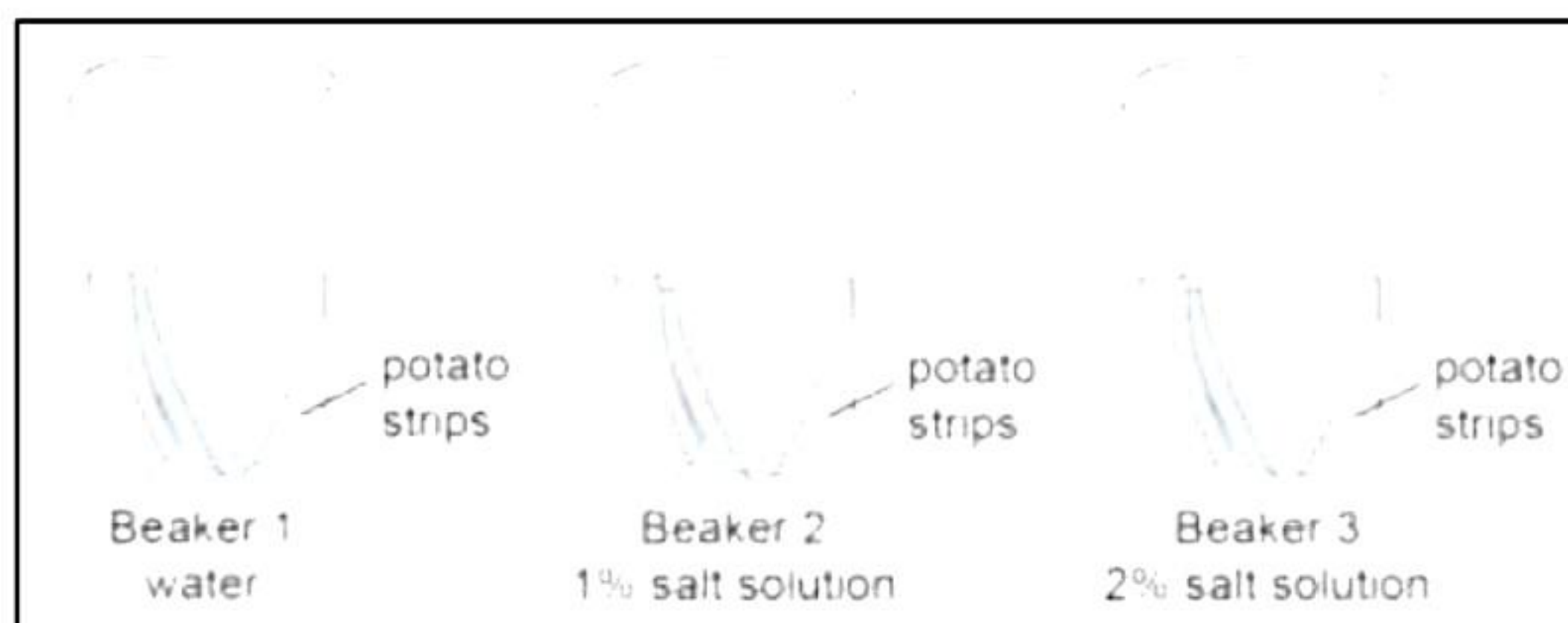
Radhika left the potato strips in the beaker for 5 hours. She recorded the length of the potato strips in each beaker after 5 hours.

	Length of the potato strip before placing in the beaker (cm)	Length of the potato strip after 5 hours in the beaker (cm)
Beaker 1 (water)	5.0	5.3
	5.0	5.2
	5.0	5.2
Beaker 2 (1% salt solution)	5.0	5.0
	5.0	5.0
	5.0	4.9
Beaker 3 (2% salt solution)	5.0	4.8
	5.0	4.9
	5.0	4.7

(a) How will you explain the movement of water during osmosis from the above experiment?

(b) In which beaker was the concentration of water molecules inside and outside the potato cells likely to be the same? Explain your answer.

(c) Why did Radhika place three potato strips in each beaker?

OR

(a) Draw a neat diagram of a plant cell and label the following parts:
  i. Mitochondria
  ii. Nucleus
  iii. Vacuole
  iv. Golgi apparatus

(b) Name the energy currency of the cell. Which cell organelle releases this currency?

(c) What is the role of cell wall in a plant cell?

36.   [5]

(a) Swimmers are provided with an inflated rubber jacket/tube. Explain why?

(b) A body whose volume is 100 cm³ weighs 10 N in air. Find its weight in water.
    (Take g = 10 ms^{-2}, density of water = 1000 kg m^{-3})

(c) A body is weighed first in air, then in liquid A and then in liquid B. The observations are 100 N, 50 N and 60 N, respectively.
   i.   Which liquid is denser?
   ii. What is the density ratio of liquid A to liquid B?

OR

(a) On what factors does the gravitational force between the two bodies depend? How does the gravitational force between the two bodies change if the distance between them is tripled?

(b) What is meant by free fall? A man weighs 600 N on earth. What is his mass? (g=10ms^{-2}). On moon, his weight would be 100N. What is the acceleration due to gravity on the moon?

(c) Distinguish between mass and weight of an object.

SECTION - E

Question No. 37 to 39 are case-based/data -based questions with 2 to 3 short sub-parts. Internal choice is provided in one of these sub-parts.

37. The simplest compounds, which are made up of two different elements are termed as binary compounds. While writing the chemical formulae for compounds, the constituent elements and their valencies are written. Then crossover the valencies of the combining atoms. For the ionic compound, the symbol of cation written first followed by the symbol of the anion. Then their charges are criss-crossed to get the formula. The positive and negative charges must balance each other, and the overall structure must be neutral. The molecular mass of the substance is the sum of the atomic masses of all the atoms in a molecule of the substance.   [4]

   (a) Deduce molecular formula for:

      i. Aluminium chloride

      ii. Magnesium sulphate

(b) Deduce molecular formula for ammonium hydrogen carbonate and calculate its molecular mass.

OR

(c) Write significance of molecular formula.

38. Suppose a plant cell or a group of cells (beetroot cells) like the one in figure (A) is placed in a very concentrated solution of sucrose. After few minutes, it will appear as in figure (B). This condition is said to be plasmolysed. Based on this, answer the following questions: [4]
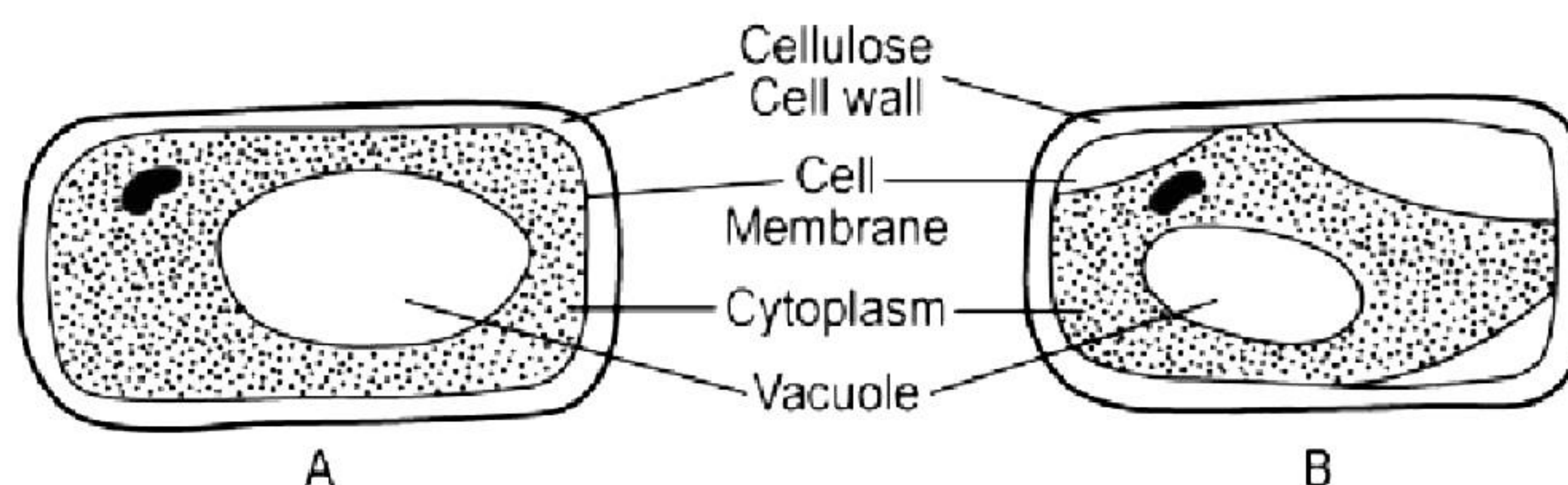
(a) Which of the two, the cell wall or the cell membrane, acts as a semipermeable membrane?

(b) In the given experiment, what fills the space between the cell wall and the cell membrane in the plasmolysed cell?

(c) Suppose you are given both, fresh potato cells and fresh beetroot cells. Which cells would you prefer for demonstrating plasmolysis? Give reason.

OR

(c) What feature of figure (B) above is evident for your answer to question (c) above? Define plasmolysis.

39. Ram started jumping down from a slow-moving bus. His friend Shyam asked him not to do so as this act would injure him. Ram was not ready to listen to his friend Shyam. Then Shyam asked Ram to run in the direction of the moving bus as soon as his foot touches the road. Ram did so and landed safely. [4]

(a) Why did Shyam ask Ram to run in the direction of the moving bus as soon as his foot touches the road?

(b) Is getting down from a moving bus a safe or dangerous act according to Shyam? Justify your answer.

(c) An athlete always runs some distance before taking a jump. Why?

(d) Give one more application in our nature of Newton's first law of motion.

OR

(d) Why do passengers in the bus tend to lean forward when it stops suddenly?

Solution

SECTION - A

1. Correct option – b: Because gas particles hit the walls of the container.
   Gas exerts pressure on the walls of a container because gas particles hit them.

2. Correct option – d: Hydrogen
   The hydrogen atom is the smallest atom of all. The atomic radius of a hydrogen atom is 10^{-10} meters.

3. Correct option – a: 11
   Atomic number = Number of protons = Mass number – Number of neutrons
   = 23 – 12 =11

4. Correct option –c: The solubility of gases in liquids increases on increasing the temperature.
   The solubility of gases in liquids usually decreases on increasing the temperature and increases on decreasing the temperature.

5. Correct option – b: 34 a.m.u.
   The atomic mass of hydrogen = 1 a.m.u.
   The atomic mass of sulphur = 32 a.m.u.
   Thus, the molecular mass of hydrogen sulphide, which contains two atoms of hydrogen, and one atom of Sulphur, is = (2×1) + (1×32) = 34 a.m.u.

6. Correct option – c: Neon
   Neon has same molecular mass as its atomic mass.

7. Correct option – b: Particles of matter are constantly moving.
   Spreading of fragrance of a burning incense stick in a room shows that particles of matter are constantly moving.

8. Correct option – c: Ribosomes and mitochondria are small and so cannot be observed under a compound microscope.
   Ribosomes and mitochondria are very small and so cannot be observed under a compound microscope. An electron microscope is required to observe these structures.

9. Correct option – b:

A (Golgi body)	B (Mitochondria)	C (Endoplasmic reticulum)	D (Nucleus)
Packaging organelle	Provides energy	Helps in the transport of material	Carries the hereditary information

10. Correct option – c: remain at the same position.

The plant grows in length by apical meristems. Apical meristem is present at the tip of roots and shoot. A nail is inserted in the trunk i.e., a permanent tissue which does not divide.

11. Correct option – c: Striated muscle fibres.

The given figure shows long, cylindrical, and unbranched cells with dark and light bands. The cells also possess several nuclei. These are characteristics of striated muscle fibres.

12. Correct option – b: It encourages the build-up of diseases and pests that destroy a particular crop.

Mono-cropping is a method in which the same crop is planted on the same land area every year. Hence, the plants become weak in progeny every following year. This increases the build-up of diseases. The pests destroy the crops as they have the information of the crop.

13. Correct option – d: Zero

Before firing, the velocity of the gun and the bullet is zero. We know that momentum = mass × velocity → Momentum is zero.

14. Correct option – a: 30 km towards East

Total displacement = (40 East – 10 West) km
= 30 km towards East

15. Correct option – c: The buoyant force will decrease

Now according to Archimedes principle, when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it. Now if the object is a smaller cube with sides reduced from 5 cm to 4 cm, it will displace less fluid, and consequently, the weight of the fluid displaced, and the buoyant force experienced by the cube will decrease.

16. Correct option – c: 156×10^3

Given that frequency $v = 2600$ Hz The number of oscillations of the wave per unit time is called the frequency (n) of the wave. No. of waves = $2600 \times 60 = 156000 = 156 \times 10^3$

17. Both A and R are true, and R is the correct explanation of A.

All noble gases have stable electronic configuration that is they have octet complete. Hence, they are unreactive or inert and remain monoatomic in nature. So, both assertion and reason are true, and the reason is the correct explanation of the assertion.

18. A is false but R is true.

Chromosomes are made up of DNA and proteins. So, the assertion is false.
Chromosomes are thread-like structures present in the nucleus of the cell and contain genetic information that is transferred from the parents to the offspring. So, the reason is true.

19. Both A and R are true, but R is not the correct explanation of A.

When you jump onto the concrete surface, your feet are brought to rest almost instantaneously because the rate of change of momentum is very high. Hence, you get injured due to a large force on your body on account of the hard floor. But, when you jump on the sand, you come to rest for a longer period. So, the change in momentum takes place in a longer interval of time. Hence, a small force is exerted on your body, and you don't get injured.

20. Both A and R are true, and R is the correct explanation of A.

The inner lining of the intestine has tall epithelial cells. These cells are called columnar epithelial cells. They are long and narrow and are arranged in a single layer. The columnar epithelium is found in the inner lining of the intestine because it facilitates absorption and secretion of nutrients present in food.

SECTION - B

21. Isotopes – Protium and Deuterium, both are isotopes of hydrogen. Isobars – Argon and calcium, both have mass equal to 40. Since isotopes have identical electronic configuration containing same number of valence electrons, they have similar chemical properties, but because the masses are slightly different hence, the physical properties (density, melting point, boiling point etc.) are different.

22. A tissue is a group of similar cells from the same origin that together carry out a specific function in the body. An egg is a zygote or a cell, but a cluster of eggs cannot be considered as a tissue. A group of tissues form an organ. However, a cluster of eggs does not form an organ. Instead, it gives rise to a new organism if the eggs get fertilised. Therefore, we cannot consider a cluster of eggs as a tissue.

23.

(a) <u>Rita would have noted the following cell characteristics:</u>
- Presence of a single nucleus
- Cells attached edge to edge without intercellular spaces
- Presence of a cell wall around each rectangular cell

(b) Safranin is generally used to stain plant cells such as an onion peel. It reacts with the lignin present in the tissues of the plant cell wall and stains it red.

OR

(a) Leucoplast

(b) Nucleolus

24.

a) Volume of the immersed body = Volume of the liquid displaced = V

Mass of the liquid displaced = $v\rho$

Thus, weight of the liquid displaced = buoyant force = $V\rho g$

b) The buoyant force acts in the upward direction.

25. Yes, this given condition is possible.

e.g., When a stone tied to a string is whirled in a circular path, the acceleration acting on it is always at right angle to the direction of motion of stone.

OR

a) Particle is stationary during time 10 s to 20 s as the displacement-time graph is a straight line parallel to time axis during this time interval.

b) Velocity in OA part= Slope of line OA= 30/10 = 3 m/s

Velocity in AB part = 0 m/s ($\because$ the particle is stationary.)

Velocity in BC part = Slope of line BC

$$= \frac{50-30}{30-20}$$

26. <u>In a pond, mass mortality of fishes may occur due to the following reasons:</u>
- Release of pesticides from nearby crop fields
- Release of toxic industrial wastes
- Mixing of hot water from an industry or a thermal power plant
- Release of wastes rich in heavy metals
- Blockage of the gills of fishes by some suspended pollutant
- Absence of enough oxygen for the respiration of fishes

SECTION – C

27. There are two types of molecules - molecules of elements and molecules of compounds.

    <u>Molecules of Elements</u>
    - The molecule of an element contains two or more similar atoms combined together.
    - They are classified as diatomic, triatomic, tetra-atomic, and polyatomic molecules depending upon the number of atoms present.
    - **Sample A (O_2)** is an example of a **diatomic molecule of an element** since it consists of two oxygen atoms.

    <u>Molecules of Compounds</u>
    - The molecule of a compound contains two or more different types of atoms chemically combined together.
    - Atoms of different elements join together in definite proportions to form molecules of compounds.
    - **Sample B (H_2O)** is an example of a **molecule of a compound**, as it contains two hydrogen atoms and one oxygen atom chemically combined.

28.
    (i) Metals: Iron
       They are lustrous and good conductors of electricity.
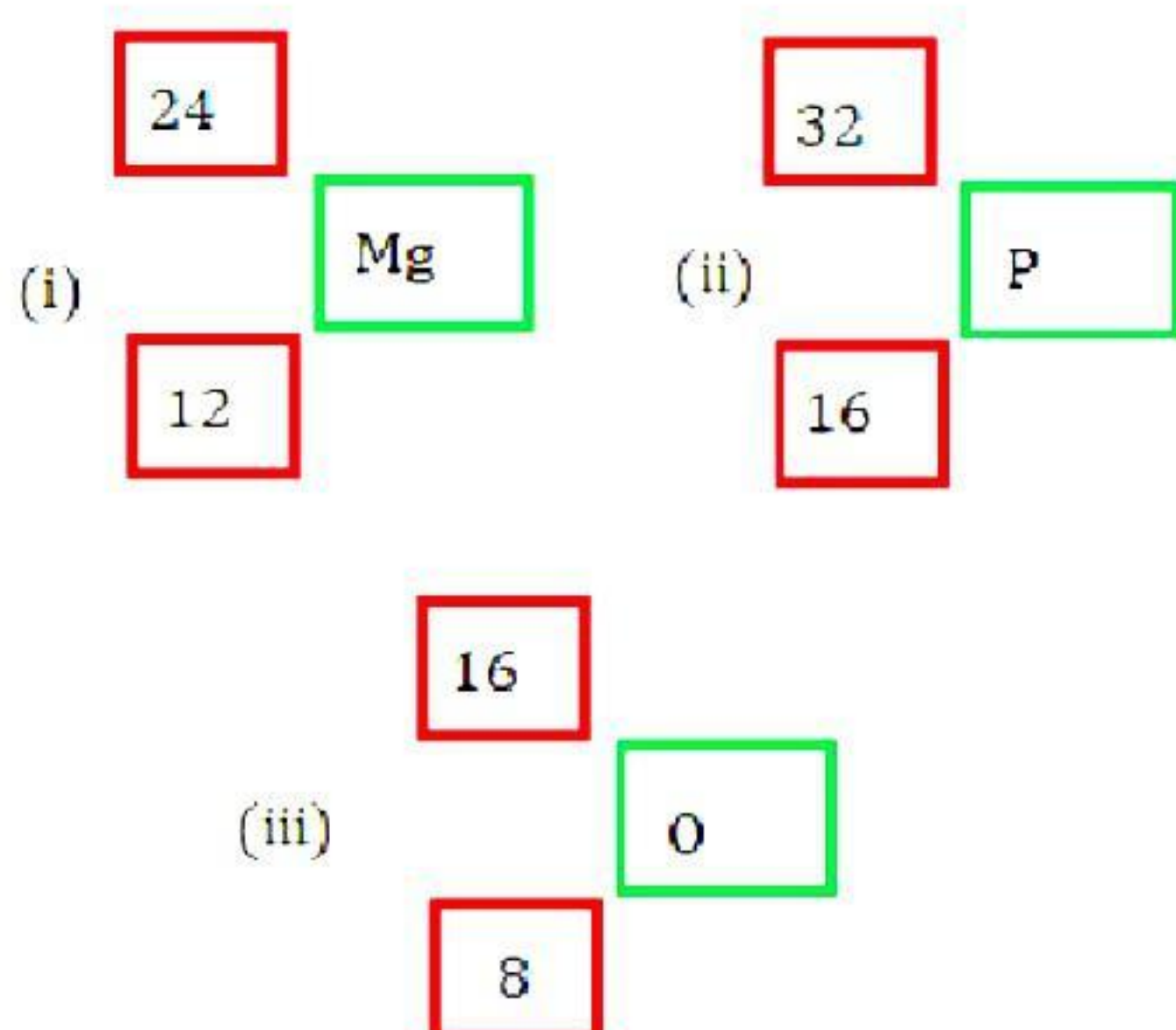   (ii) Non-metals: Oxygen
       They are non-lustrous and poor conductors of electricity.
    (iii) Metalloids: Germanium
       They show intermediate properties between those of metals and non-metals and are semiconductors.

    OR

    The answer is as follows:

    (i)
    24
    Mg
    12

    (ii)
    32
    P
    16

    (iii)
    16
    O
    8

29. The given figure shows a plant cell.

    (a) P – Vacuole; Q – Mitochondria

    (b) Vacuoles (P) help maintain the osmotic pressure in a cell. They store toxic metabolic by-products of plant cells. They also provide turgidity and rigidity to plant cells.

    (c) Mitochondria (Q) synthesise energy-rich compounds (ATP) for the cell. In the absence of mitochondria, the cell will not have energy to carry out important life processes such as photosynthesis, respiration, and protein synthesis.

30.

    (a) Crop rotation is the practice of growing a series of dissimilar or different types of crops in the same area in sequenced seasons.

    (b) <u>Benefits of planting crops through crop rotation:</u>
- It improves the soil fertility.
- It avoids depletion of a particular nutrient from soil.
- It minimises pest infestation and diseases.
- It helps in weed control.
- It prevents change in the chemical nature of the soil.

31.

  (a)

    As we know,

    Total energy = Kinetic energy + Potential energy

    i.e., T.E = 750 + 0 = 750 J

    Now,

    P.E = mgh

    Thus, if the ball is dropped from the 5th floor:

  (b) P.E = 750 J = m × 10× 15

    ∴ m= 5 kg

  (c) The complete table for the given case is given below.

Floor of Building	Height(m)	Kinetic Energy (J)	Potential energy (J)
5	15	0	750
4	12	150	600
3	9	300	450
2	6	450	300
1	3	600	150
0	0	750	0

32.

(a) A force is a push or pull acting upon an object as a result of its interaction with another object. Effects of force: (Any two)
   1. It may move a body at rest.
   2. Stop a moving body.
   3. Change the speed of a body.
   4. Change the direction of a moving body.
   5. Change the size and shape of a body.

(b) In the beginning the fruits and leaves on the branches are in state of rest. When a strong wind blows, the branches move rapidly. However, on account of inertia of rest, the fruits and leaves tend to continue in their state of rest and fall off the branches.

(c) Given that,
   Mass $= 20g = 0.02$ kg
   $a = 3$ m/s^2
   Now,
   $F = ma$
   $\therefore F = 0.02 \times 3 = 0.06$N

33.

(a) Speed of sound depends upon
   (i) Medium (ii) Temperature.

(b) The amount of sound energy passing each second through unit area is called the intensity of sound. Loudness is a measure of the response of the ear to the sound.

(c) Given that,
   Frequency, $\nu = 2$ kHz $= 2000$ Hz
   Wavelength, $\lambda = 35$ cm $= 0.35$ m
   Now,
   We know that speed $v = \nu \times \lambda$
   $$= 2000 \times 0.35 = 700 \text{ m/s}$$
   Now time taken by a wave to travel a distance of 1.5 km is:
 $$t = \frac{d}{v}$$
   $$t = \frac{1500}{700} = 2.1s$$

SECTION - D

34. Bohr developed the Bohr model of the atom, in which he proposed that energy levels of electrons are discrete and that the electrons revolve in stable orbits around the atomic nucleus but can jump from one energy level (or orbit) to another.

Bohr's Model of an Atom

- Niels Bohr revised Rutherford's atomic model and put forth the following suggestions:
- Niels Bohr proposed that the electrons possess a specific amount of energy which allows them to revolve around the nucleus.
- An atom contains discrete orbits which correspond to specific amount of energy. Hence, these orbits are also known as energy levels.
- The energy levels of an atom are represented as K, L, M, N and so on or the numbers n = 1, 2, 3, 4 and so on.
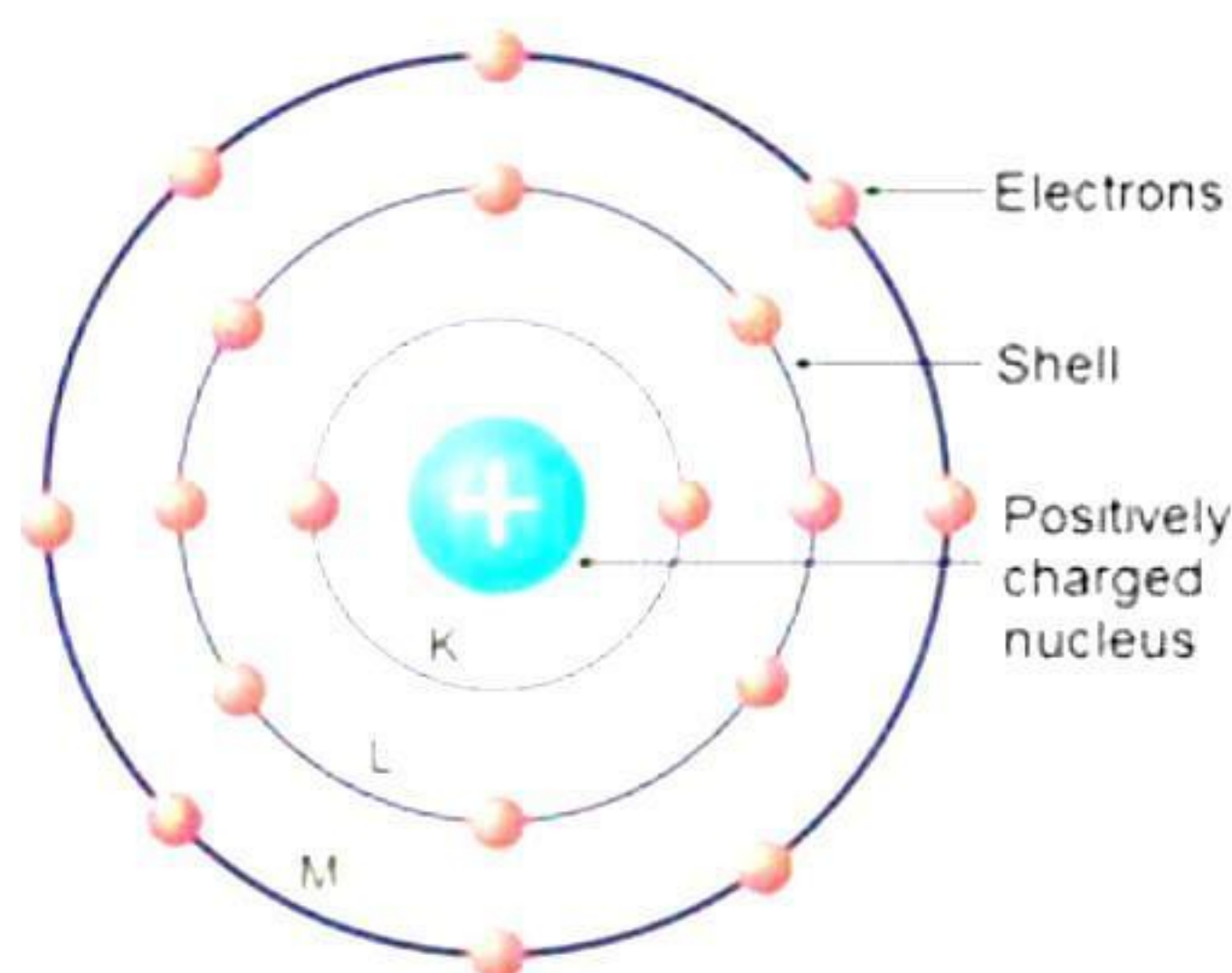
Niels Bohr's Atomic Model

- Electrons are confined to these energy levels. While revolving in these discrete orbits, the electrons do not radiate energy. Hence, these orbits are also known as stationary orbits or stationary shells. Smaller the size of the orbit, smaller is its energy.
- As we move away from nucleus, the energy of the orbit increases progressively.
- The transfer of an electron from one orbit to another is always accompanied with absorption or emission of energy.
- When an electron jumps from a lower energy level to a higher energy level, it absorbs energy.

- When an electron returns from a higher energy level to a lower energy level, it emits energy.

Distribution of electrons in orbits

- According to Bohr's model, electrons occupy certain stable orbits or shells. Each shell has a definite energy.
- These orbits or shells are represented by the letters K, L, M, N… or the numbers 1, 2, 3, 4….
- The maximum number of electrons present in the shell is given by the formula $(2n^2)$, where n is the orbit number or shell number.
- The maximum number of electrons in different shells is as follows:
  - The first orbit or K shell will have $2 \times 1^2 = 2$ electrons.
  - The second shell will have $2 \times 2^2 = 8$ electrons.
  - The third shell will have $2 \times 3^2 = 18$ electrons.
  - The fourth shell will have $2 \times 4^2 = 32$ electrons and so on.
  - The maximum number of electrons which can be accommodated in the outermost orbit is 8.
  - The orbits or shells are filled in a stepwise manner.
  - Electrons are not accommodated in a given shell unless the inner shells are filled.

Octet Rule: The maximum number of electrons that the outermost shell of an electrically neutral and chemically stable atom can have is 8.

Exception: If the atom has only one shell, it can hold only 2 electrons. For example, hydrogen and helium can have only 2 electrons (duplet).

OR

(a) Rutherford's Atomic Model

- Based on the results of the α-particle scattering experiments, Rutherford put forth his atomic model.
- An atom contains a positively charged centre called the nucleus of the atom. Almost all the mass of the atom is concentrated in the nucleus.
- The electrons of the atom revolve around the nucleus in fixed, circular orbits.
- The size of the nucleus is many times smaller than the size of the atom. The nucleus of an atom is 10,000 times smaller than the atom.
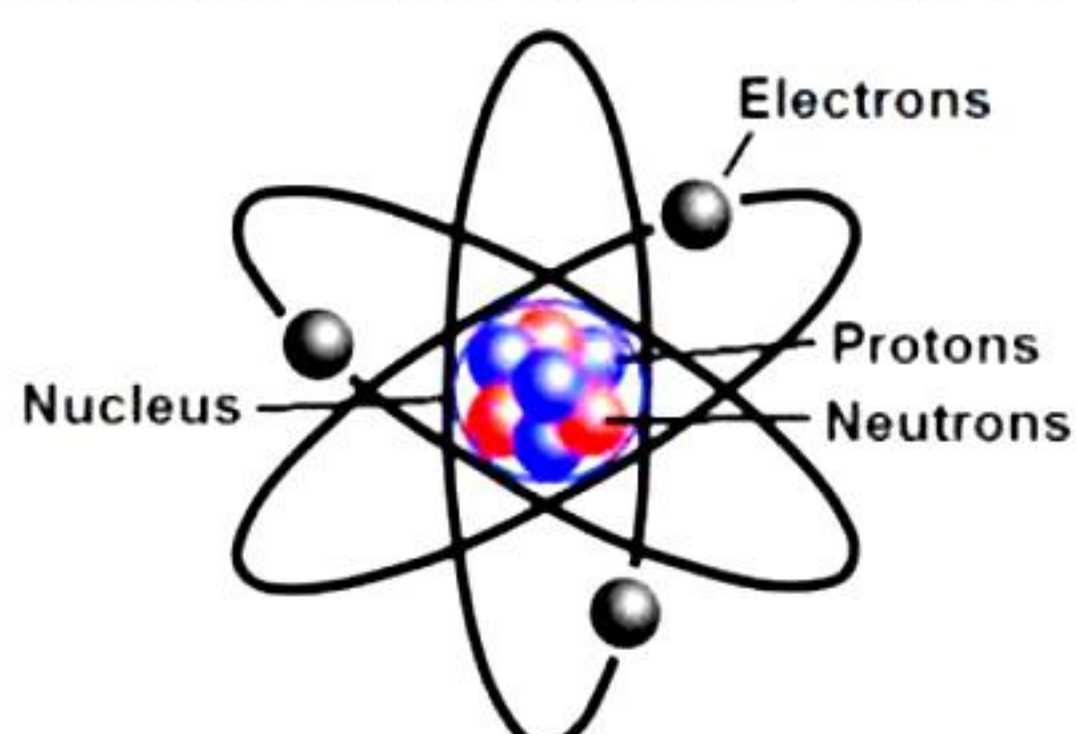

Rutherford's Atomic Model

(b)
    i. After a hot sunny day, people sprinkle water on the roof or open ground because the large latent heat of vaporisation of water helps to cool the hot surface.
    ii. Particles of a wooden table are rigid and have a fixed location. They also possess a definite shape and volume. Because of these properties, we should call a wooden table a solid substance.

35.

(a) Osmosis is the diffusion of water across a semi-permeable membrane from an area of high concentration of water, to an area of low concentration. In the above experiment, water molecules move out of the cell based on the amount of salt in the solution. Water will move from an area of less salt to more salt (more water to less water), and so when the potato is placed in the saltwater, all the water that is inside the potato moves out by osmosis.

(b) In Beaker 2 with 1% salt solution, the concentration of water molecules inside and outside the potato cells is likely to be the same. This is because the lengths of the potato strips placed in beaker 2 are almost the same before and after the experiment. There is hardly any change in the length of the strips. This implies that there is hardly any osmosis and hence, no noticeable swelling or shrinking of the potato cells.

(c) Radhika placed three potato strips in each beaker for the following reasons-
- Reduce errors in measurement
- Confirm the results of the experiment
- Be sure about the readings

OR

(a) Plant cell
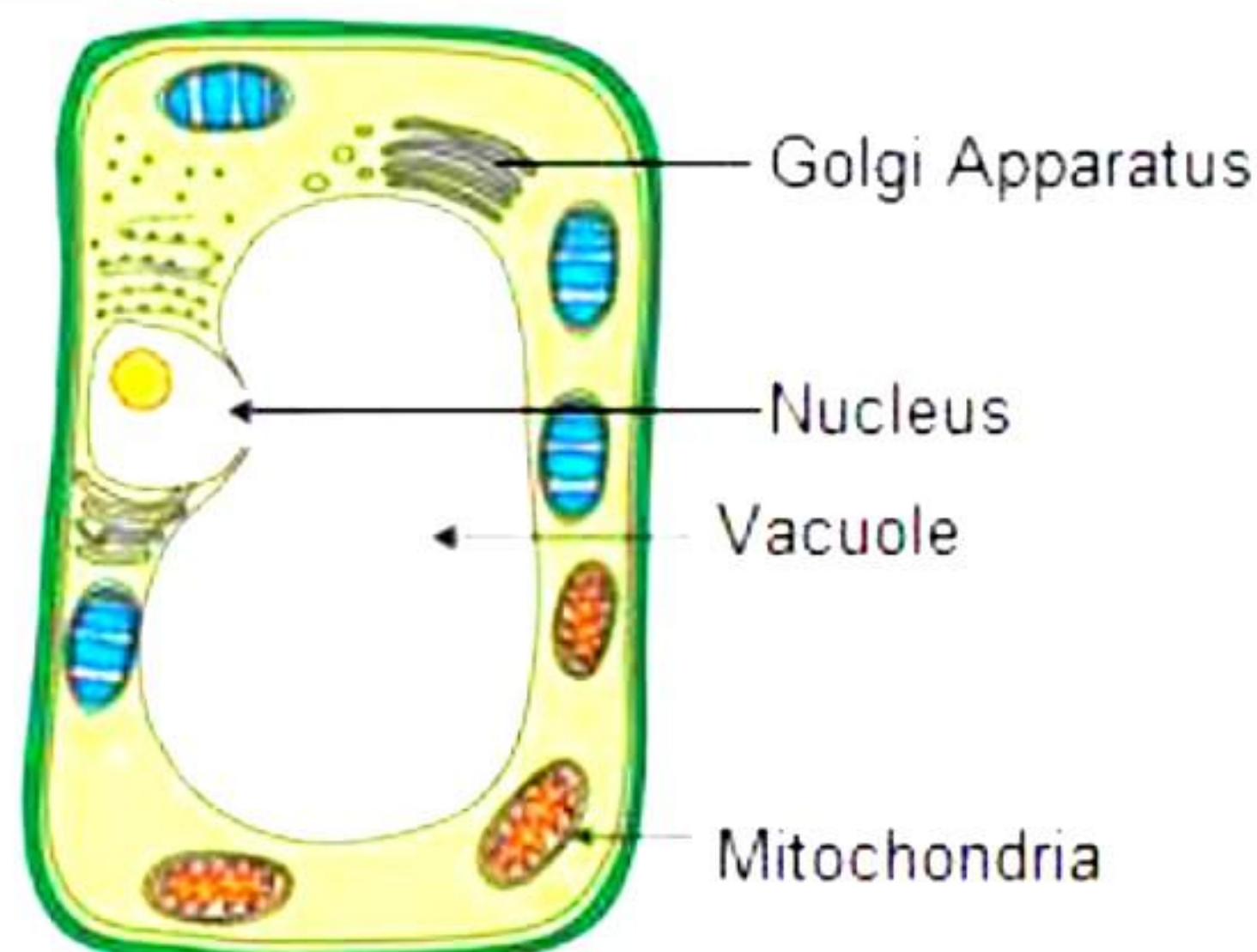
(b) Adenosine Triphosphate (ATP) molecule is called the energy currency of the cell. Mitochondria releases ATP.

(c) Role of cell wall in a plant cell:
- Provides definite shape, strength, and rigidity to the cell.
- Provides protection against mechanical stress and physical shocks.
- Helps to control cell expansion due to the intake of water.
- Helps in preventing water loss from the cell.

36.

(a) Swimmers are provided with an inflated rubber jacket or rubber tube. The jacket tube has low weight and large volume. Hence, it displaces large volume of water. As a result, up thrust due to water increases and the person remains afloat, i.e., there is no chance of drowning of the swimmer in such case.

(b) Given that,

$V = 100 \text{ cm}^3 = 100 \times 10^{-6} \text{ m}^3 = 10^{-4} \text{ m}^3$

$\rho = 1000 \text{ kg m}^{-3}$

$g = 10 \text{ m/s}^2$

Now,

Upthrust = Weight of liquid displaced

Weight of the object = Volume × Density × g

Upthrust = $v\rho g = 10^{-4} \times 10^3 \times 10 = 10^{-1} \times 10 = 1 \text{ N}$

∴ weight in water = 10 N – 1 N = 9 N

(c)

i. Since, the body weighs least in liquid A, liquid A is denser.

ii. Ratio of density of liquid A to liquid B

$$= \frac{\text{loss of wt. in liquid A}}{\text{loss of wt. in liquid B}}$$

$$= \frac{100 - 50}{100 - 60} = \frac{50}{40} = \frac{5}{4}$$

∴ ratio = 5 : 4

OR

(a) Gravitational force between two bodies depends on:

1. Masses of the two **bodies**. The greater an object's mass, the greater its gravitational force.

2. Distance of separation between them. The smaller the distance greater is the gravitational force.

   Now,

   $$F = \frac{Gm_1 m_2}{r^2}$$

   When distance is tripled, $r' = 3r$

   $$\rightarrow F' = \frac{Gm_1 m_2}{(r')^2}$$

   $$= \frac{Gm_1 m_2}{(3r)^2}$$

   $$= \frac{1}{9} \times F$$

(b) Whenever objects fall towards the earth under the influence of gravitational force alone, it is called free fall. Both bodies will hit the ground at the same time as acceleration due to gravity is independent of mass of the falling object.

$W_e = 600 \text{ N}$, $m = \dfrac{W_e}{g_e} = \dfrac{600}{10} = 60 \text{ kg}$

$g_m = \dfrac{W_m}{m} = \dfrac{100}{60} = 1.67 \text{ ms}^{-2}$

(c)

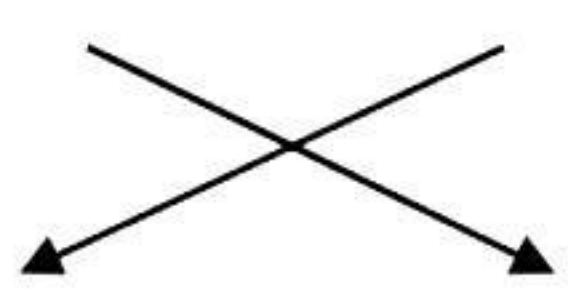| Mass	Weight
The quantity of matter contained in a body is called mass of the body	The force with which the earth attracts a body towards its centre is called the weight
Mass is a scalar quantity	Weight is a vector quantity.

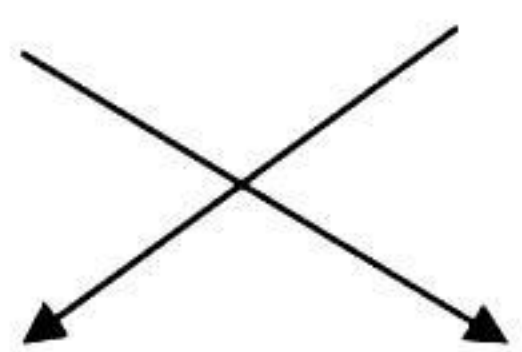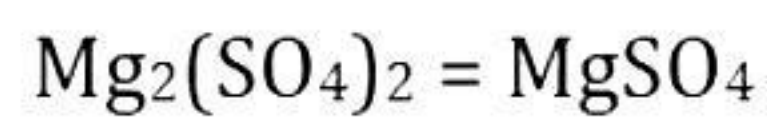## SECTION - E

37.

(a)

(i) Ammonium chloride

	Aluminium	Chlorine
Symbols	Al	Cl
Valency	3+	1-
Interchanging Valency	1	3

Therefore, the molecular formula of aluminium chloride is $AlCl_3$.

(ii)
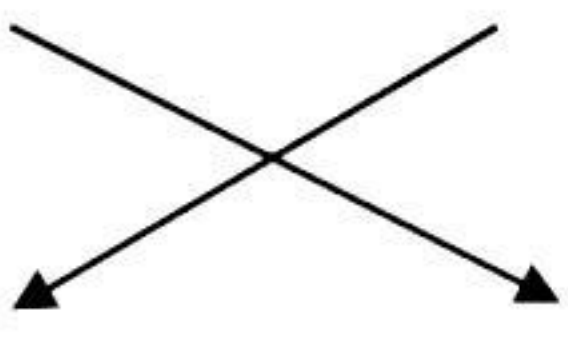
	Magnesium	Sulphate
Symbols	Mg	SO_4
Valency	2+	2-
Interchanging Valency	2	2

$$Mg_2(SO_4)_2 = MgSO_4$$

Therefore, the molecular formula of magnesium sulphate is $MgSO_4$.

(b) Ammonium hydrogen carbonate

	Ammonium	Hydrogen carbonate
Symbols	NH_4	HCO_3
Valency	1+	1-
Interchanging Valency	1	1

Therefore, the molecular formula of ammonium hydrogen carbonate is NH_4HCO_3.
Molecular mass of ammonium hydrogen carbonate is the sum of all the atomic mass of all the atoms present in the molecule.

Molecular mass of NH_4CO_3 =

Atomic mass of 1 nitrogen+ Atomic mass of 5 hydrogen atoms + Atomic mass of 1 carbon atom + Atomic mass of 3 oxygen atoms

$= [(1×14) +(5×1) + (1×12) +(3×16)]$

$=14+5+12+48$

$=79$ u

Atomic mass of NH_4CO_3 is 79 u.

OR

(c) Significance of Molecular formula:

The molecular formula of a compound has a quantitative significance. It represents the following:

(i) The name of the substance.

(ii) Both, the molecule, and the molecular mass of the compound.

(iii) The respective numbers of different atoms present in one molecule of a compound.

(iv) The ratios of the respective masses of the elements present in the compound.

38.

(a) Cell membrane acts as a semipermeable membrane. Cell wall is freely permeable.

(b) In the given experiment, the space between the cell wall and the cell membrane in the plasmolysed cell is filled by sucrose solution.

(c) Beetroot cells contain soluble sugar, whereas potato cells contain insoluble starch. Osmotic processes readily occur in beetroot cells than in potato cells. Hence, fresh beetroot cells are preferred over fresh potato cells as a material for demonstrating plasmolysis.

OR

(c) Plasmolysis occurs due to the presence of sucrose solution. The cell membrane withdraws itself from the cell wall and the cell gets plasmolysed.

Plasmolysis is the process of contraction or shrinkage of the protoplasm of a plant cell caused due to the loss of water in the cell.

39.

(a) When a person gets down from a moving bus, he may fall. This is because the foot of the person comes to rest as soon as it touches the ground, but the upper part of the body remains in motion due to inertia of motion, and hence, the person falls.

However, if a person starts running in the direction of the moving bus, the body does not come to rest at once, and the person does not fall.

Hence, Shyam asked Ram to run in the direction of the moving bus as soon as his foot touches the road.

(b) Shyam is concerned about Ram because he knows that, getting down from a moving bus is a dangerous act because of which he may fall and get injured.

(c) If the athlete runs some distance before taking the jump, then inertia of motion helps the athlete to continue the state of motion which aids him to take a longer jump.

(d) Fruits and leaves fall off the branches in strong wind because of Newton's first law of motion. In the beginning the fruits and leaves on the branches are in state of rest. When a strong wind blows, the branches move rapidly. However, on account of inertia of rest, the fruits and leaves tend to continue in their state of rest and fall off the branches.

OR

(d) When the bus is moving the passengers are in a state of motion and they have inertia of motion. When the bus stops suddenly, the lower part of the body of passengers, which is in contact with the bus, comes to rest, but upper part of their body tends to be in the state of motion and thus the passengers lean forward.