MATH LOVE INSTITUTE

Education as a Service (EaaS)

SAMPLE PAPER - SET 4

SESSION: 2025-26

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Class	IX	Subject	Science (086)
Time Allowed	3 Hours	Maximum Marks	80
Date	_____	Student Name	_____

GENERAL INSTRUCTIONS:

1. This question paper consists of **39 questions** in **5 sections**.
2. **All questions are compulsory.** However, an internal choice is provided in some questions. A student is expected to attempt only one of these questions.
3. **Section A** consists of 20 Objective Type questions carrying **1 mark each**.
4. **Section B** consists of 6 Very Short Answer questions carrying **2 marks each**. Answers to these questions should be in the range of 30 to 50 words.
5. **Section C** consists of 7 Short Answer type questions carrying **3 marks each**. Answers to these questions should be in the range of 50 to 80 words.
6. **Section D** consists of 3 Long Answer type questions carrying **5 marks each**. Answers to these questions should be in the range of 80 to 120 words.
7. **Section E** consists of 3 source-based/case-based units of assessment of **4 marks each** with sub-parts.

SECTION A (20 × 1 = 20 Marks)

Q1. Which state of matter has definite shape and volume? **[1]**

(a) Solid

(b) Liquid

(c) Gas

(d) Plasma

Q2. Which of the following is a compound? **[1]**

(a) Air

(b) Water

(c) Milk

(d) Soil

Q3. The chemical formula of calcium oxide is: **[1]**

(a) CaO

(b) Ca_2O

(c) CaO_2

(d) Ca_2O_3

Q4. The nucleus of an atom contains: **[1]**

(a) Protons only

(b) Neutrons only

(c) Protons and neutrons

(d) Protons, neutrons and electrons

Q5. Which cell organelle is responsible for protein synthesis? **[1]**

(a) Ribosome

(b) Mitochondria

(c) Golgi apparatus

(d) Lysosome

Q6. Which tissue is found only in plants? **[1]**

(a) Epithelial tissue

(b) Meristematic tissue

(c) Connective tissue

(d) Muscular tissue

Q7. Displacement is a: **[1]**

(a) Scalar quantity

(b) Vector quantity

(c) Dimensionless quantity

(d) Derived quantity

Q8. Newton's first law of motion is also known as: **[1]**

(a) Law of inertia

(b) Law of momentum

(c) Law of action-reaction

(d) Law of acceleration

Q9. The value of acceleration due to gravity (g) on earth is approximately: **[1]**

(a) 8.9 m/s^2

(b) 9.8 m/s^2

(c) 10.8 m/s^2

(d) 11.8 m/s^2

Q10. The SI unit of work is: **[1]**

(a) Newton

(b) Joule

(c) Watt

(d) Pascal

Q11. Sound travels fastest in: **[1]**

(a) Vacuum

(b) Air

(c) Water

(d) Steel

Q12. The process of separating cream from milk is called: **[1]**

(a) Centrifugation

(b) Evaporation

(c) Filtration

(d) Crystallization

Q13. One mole of any substance contains how many particles? **[1]**

(a) 6.022×10^{22}

(b) 6.022×10^{23}

(c) 6.022×10^{24}

(d) 6.022×10^{25}

Q14. Which of the following has maximum number of electrons in the outermost shell? **[1]**

(a) Sodium (11)

(b) Chlorine (17)

(c) Argon (18)

(d) Potassium (19)

Q15. The cell wall of plant cells is made up of: **[1]**

(a) Protein

(b) Cellulose

(c) Chitin

(d) Lipid

Q16. ASSERTION-REASON TYPE QUESTIONS **[1]**

Assertion (A): Evaporation causes cooling.

Reason (R): Particles of liquid absorb energy from surroundings during evaporation.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

Q17. ASSERTION-REASON TYPE QUESTIONS **[1]**

Assertion (A): The mass number is the sum of protons and neutrons in an atom.

Reason (R): Electrons do not contribute to the mass of an atom.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

Q18. ASSERTION-REASON TYPE QUESTIONS **[1]**

Assertion (A): Mitochondria are called powerhouse of the cell.

Reason (R): Mitochondria produce energy in the form of ATP through respiration.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

Q19. ASSERTION-REASON TYPE QUESTIONS **[1]**

Assertion (A): The velocity-time graph of a body moving with uniform velocity is a straight line parallel to the time axis.

Reason (R): In uniform motion, velocity remains constant with time.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

Q20. ASSERTION-REASON TYPE QUESTIONS **[1]**

Assertion (A): It is easier to push an empty box than a box full of books.

Reason (R): Inertia of an object is directly proportional to its mass.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

SECTION B (6 × 2 = 12 Marks)

Q21. Explain why solids have a fixed shape while liquids and gases take the shape of their container. **[2]**

Q22. What is the difference between a physical change and a chemical change? Give one example of each. **[2]**

Q23. Define isotopes. Why do isotopes have the same chemical properties? **[2]**

Q24. Name the organelle that is responsible for storing food, waste products, and other materials in the cell. Explain its role in plant and animal cells. **[2]**

Q25. Distinguish between distance and displacement with the help of an example. **[2]**

Q26. State the universal law of gravitation. Write the formula and define each term. **[2]**

SECTION C (7 × 3 = 21 Marks)

Q27. (a) Define melting point and boiling point. **[3]**

(b) Convert the following temperature to Celsius scale: 500 K

(c) Why does steam cause more severe burns than boiling water at the same temperature?

Q28. Explain the process of crystallization with an example. How is it different from evaporation? **[3]**

Q29. Calculate the number of moles in: **[3]**

(a) 52 g of helium (atomic mass of He = 4 u)

(b) 12.044×10^{23} atoms of helium

Q30. OR **[3]**

(a) Define molar mass. What is its unit?

(b) Calculate the molar mass of H_2SO_4.

(c) How many molecules are present in 98 g of H_2SO_4?

[Given: Atomic masses: H = 1 u, S = 32 u, O = 16 u]

Q31. (a) State Rutherford's model of atom. **[3]**

(b) Why was Thomson's model of atom rejected?

(c) Name the subatomic particle which has negligible mass.

Q32. OR **[3]**

(a) How are electrons distributed in different shells of an atom?

(b) Draw the electronic configuration of argon (atomic number = 18).

(c) Why is the outermost shell of an atom also called the valence shell?

Q33. (a) What is meant by diffusion? **[3]**

(b) Name the process by which Amoeba obtains its food.

(c) Why do plant cells have a cell wall in addition to a cell membrane?

Q34. A train starting from rest attains a velocity of 90 km/h in 5 minutes. Assuming that the acceleration is uniform, find: **[3]**

(a) The acceleration in m/s^2

(b) The distance travelled by the train in this time

Q35. OR **[3]**

A car travels at a speed of 54 km/h for the first half time and at a speed of 36 km/h for the second half time. Calculate:

(a) The average speed of the car

(b) If the total time of journey is 4 hours, what is the total distance covered?

SECTION D (3 × 5 = 15 Marks)

Q36. (a) State Newton's three laws of motion. **[5]**

(b) A cricket ball of mass 150 g is moving with a velocity of 12 m/s and is hit by a bat so that the ball is turned back with a velocity of 20 m/s. Calculate:

(i) Initial momentum of the ball

(ii) Final momentum of the ball

(iii) Change in momentum

(iv) If the ball remains in contact with the bat for 0.01 s, what is the force exerted by the bat on the ball?

OR

(a) What is meant by thrust and pressure? State their SI units.

(b) Derive the relation: Pressure = $h\rho g$

(c) A rectangular block of dimensions 5 cm × 4 cm × 2 cm weighs 200 g. Calculate the maximum and minimum pressure that can be exerted by this block on a surface.

[Take g = 10 m/s^2]

Q37. (a) Define kinetic energy and potential energy. Give one example of each. **[5]**

(b) State and prove the law of conservation of energy.

(c) A body of mass 2 kg is dropped from a height of 10 m. Calculate:

(i) The potential energy at the top

(ii) The kinetic energy just before it touches the ground

(iii) The speed with which it hits the ground

[Take g = 10 m/s²]

OR

(a) Define echo. Write two conditions necessary for hearing an echo.

(b) A man standing in front of a cliff fires a gun. He hears the echo after 3 seconds. If the velocity of sound is 340 m/s, calculate the distance of the cliff from the man.

(c) What is ultrasound? Give two applications of ultrasound.

Q38. (a) Draw a well-labeled diagram of a prokaryotic cell and a eukaryotic cell. **[5]**

(b) State three differences between prokaryotic and eukaryotic cells.

(c) Why are lysosomes known as suicide bags of the cell?

OR

(a) Draw a neat labeled diagram showing different types of simple permanent tissues in plants.

(b) Differentiate between parenchyma, collenchyma, and sclerenchyma tissues.

(c) Name the tissue that transports water and minerals in plants.

SECTION E (3 × 4 = 12 Marks)

CASE STUDY 1: SEPARATION OF MIXTURES IN DAILY LIFE

In our daily life, we come across various mixtures that need to be separated. For example, tea leaves are separated from prepared tea using a strainer which works on the principle of filtration. Salt is obtained from seawater by the process of evaporation. A mixture of salt and ammonium chloride can be separated by sublimation as ammonium

chloride sublimes on heating. Centrifugation is used to separate cream from milk. The choice of separation technique depends on the type of mixture and the properties of its components. Understanding these separation techniques is essential in industries, laboratories, and households.

(i) Which method is used to separate a mixture of salt and ammonium chloride? [1 mark]

(ii) Name the process by which salt is obtained from seawater. [1 mark]

OR
Why is centrifugation preferred over filtration for separating cream from milk? [1 mark]

(iii) A student has a mixture of iron filings, sand, and common salt. Describe step-by-step how this mixture can be separated into its components. [2 marks]

CASE STUDY 2: BOHR'S MODEL OF ATOM

Niels Bohr proposed a model of the atom in 1913. According to Bohr's model, electrons revolve around the nucleus in fixed circular paths called orbits or shells. Each shell has a fixed energy level and is designated as K, L, M, N, etc., or by numbers 1, 2, 3, 4, etc. The maximum number of electrons that can be accommodated in a shell is given by the formula $2n^2$, where n is the shell number. Electrons can move from one energy level to another by absorbing or emitting energy. When an electron jumps from a higher energy level to a lower energy level, it emits energy in the form of light. This model successfully explained the stability of atoms and the line spectrum of hydrogen.

(i) What is the maximum number of electrons that can be accommodated in the M shell? [1 mark]

(ii) Name the shells in which the electrons of a sodium atom (atomic number 11) are distributed. [1 mark]

OR

What happens when an electron jumps from a higher energy level to a lower energy level? [1 mark]

(iii) An element has electronic configuration 2, 8, 5. Write its atomic number, valency, and the period and group to which it belongs in the periodic table. [2 marks]

CASE STUDY 3: MOTION UNDER GRAVITY

When objects fall towards the earth under the effect of gravitational force alone, we say that the objects are in free fall. During free fall, the acceleration of the object is equal to the acceleration due to gravity (g = 9.8 m/s²). The velocity of a freely falling object increases at a constant rate. The equations of motion are applicable to objects in free fall. If we throw an object vertically upward, it moves upward initially with decreasing velocity, becomes zero at the highest point, and then starts falling downward with increasing velocity. A student performed an experiment by dropping a ball from the top of a building. He observed that the ball took 4 seconds to reach the ground.

(i) What is the velocity of the ball just before it hits the ground? [1 mark]

(ii) Calculate the height of the building. (Take g = 10 m/s²) [1 mark]

OR

What is the velocity of a freely falling object at the highest point when thrown vertically upward? [1 mark]

(iii) A stone is thrown vertically upward with an initial velocity of 30 m/s. Calculate the maximum height reached by the stone and the time taken to reach that height. (Take g = 10 m/s²) [2 marks]

*** END OF QUESTION PAPER ***

Total Marks: 80

All the Best!

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🔑 DETAILED ANSWER KEY 🔑

CBSE CLASS 9 SCIENCE - SAMPLE PAPER 4

Complete Step-by-Step Solutions with Marking Scheme

Prepared by Expert Faculty of Math Love Institute

SECTION A - ANSWERS (20 × 1 = 20 Marks)

OBJECTIVE TYPE QUESTIONS - ANSWERS:

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
Q1	(a)	Q6	(b)	Q11	(d)	Q16	(a)
Q2	(b)	Q7	(b)	Q12	(a)	Q17	(a)
Q3	(a)	Q8	(a)	Q13	(b)	Q18	(a)
Q4	(c)	Q9	(b)	Q14	(c)	Q19	(a)
Q5	(a)	Q10	(b)	Q15	(b)	Q20	(a)

Marking Scheme: 1 mark for each correct answer. No negative marking.

SECTION B - ANSWERS (6 × 2 = 12 Marks)

Q21. Answer:

Solids have a fixed shape because the particles in solids are closely packed and have strong intermolecular forces of attraction. The particles can only vibrate at their fixed positions and cannot move freely. Liquids and gases take the shape of their container because their particles have weaker intermolecular forces and can move more freely. In liquids, particles slide over each other, while in gases, particles move randomly in all directions.

> **Marking Scheme:** 1 mark for explanation about solids + 1 mark for explanation about liquids and gases

Q22. Answer:

Physical Change: A change in which no new substance is formed and the chemical composition remains the same. The change is usually reversible.
Example: Melting of ice into water

Chemical Change: A change in which one or more new substances with different chemical composition are formed. The change is usually irreversible.
Example: Burning of paper

> **Marking Scheme:** ½ mark for definition of physical change + ½ mark for example + ½ mark for definition of chemical change + ½ mark for example

Q23. Answer:

Isotopes: Isotopes are atoms of the same element having the same atomic number but different mass numbers.

Isotopes have the same chemical properties because they have the same number of electrons in their atoms and the same electronic configuration. Chemical properties depend on the number and arrangement of electrons, not on the number of neutrons.

> **Marking Scheme:** 1 mark for definition + 1 mark for explanation

Q24. Answer:

The organelle responsible for storing food, waste products, and other materials is the **vacuole**.

In plant cells: Vacuoles are large and occupy up to 90% of the cell volume. They store water, minerals, and waste products and maintain turgor pressure.
In animal cells: Vacuoles are small and numerous. They mainly store waste products and excess water temporarily.

> **Marking Scheme:** ½ mark for naming vacuole + ¾ mark for role in plant cells + ¾ mark for role in animal cells

Q25. Answer:

Distance: The total path length covered by an object is called distance. It is a scalar quantity.
Displacement: The shortest distance between the initial and final position of an object in a particular direction is called displacement. It is a vector quantity.

Example: If a person walks 3 km east and then 4 km north, the total distance covered is 7 km, but the displacement is 5 km in the north-east direction.

> **Marking Scheme:** ½ mark for distance + ½ mark for displacement + 1 mark for example

Q26. Answer:

Universal Law of Gravitation: Every object in the universe attracts every other object with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

Formula: $F = G \times (m_1 \times m_2) / r^2$
Where:
F = Gravitational force between two objects

G = Universal gravitational constant (6.67×10^{-11} N m^2 kg^{-2})
m_1 and m_2 = Masses of the two objects
r = Distance between the centers of the two objects

Marking Scheme: 1 mark for statement + ½ mark for formula + ½ mark for defining terms

SECTION C - ANSWERS (7 × 3 = 21 Marks)

Q27. Answer:

(a) **Melting Point:** The temperature at which a solid changes into liquid at atmospheric pressure is called melting point.
Boiling Point: The temperature at which a liquid changes into gas at atmospheric pressure is called boiling point.

(b) Temperature in Celsius = Temperature in Kelvin - 273
= 500 - 273 = 227°C

(c) Steam causes more severe burns than boiling water because steam has more heat energy than boiling water at the same temperature. Steam possesses the additional latent heat of vaporization (2260 kJ/kg). When steam comes in contact with skin, it condenses and releases this large amount of latent heat, causing more severe burns.

Marking Scheme: ½ + ½ mark for definitions + 1 mark for conversion + 1 mark for explanation of steam burns

Q28. Answer:

Crystallization: Crystallization is the process of obtaining pure solid substances in the form of crystals from their hot saturated solutions by cooling them slowly.

Process: A saturated solution of a substance (like copper sulphate) is prepared by

dissolving it in hot water. The solution is filtered to remove impurities. The clear solution is then allowed to cool slowly. As the solution cools, crystals of the pure substance separate out.

Difference from Evaporation:
- In crystallization, crystals of pure solid are obtained, while in evaporation, the solid may contain impurities
- Crystallization is used for substances that decompose or get charred on heating, while evaporation can be used for heat-stable substances
- Crystallization involves controlled slow cooling, while evaporation involves heating

Marking Scheme: 1 mark for definition + 1 mark for process/example + 1 mark for difference

Q29. Answer:

(a) Number of moles = Given mass / Atomic mass
= 52 g / 4 g mol^{-1}
= 13 moles

(b) Number of moles = Number of atoms / Avogadro's number
= $(12.044 \times 10^{23}) / (6.022 \times 10^{23})$
= 2 moles

Marking Scheme: 1½ marks for part (a) + 1½ marks for part (b)

Q30. Answer: (OR Question)

(a) **Molar mass:** The mass of one mole of a substance expressed in grams is called molar mass. Its unit is g/mol or g mol^{-1}.

(b) Molar mass of H_2SO_4 = $(2 \times 1) + (1 \times 32) + (4 \times 16)$
= 2 + 32 + 64
= 98 g/mol

(c) Number of moles in 98 g H_2SO_4 = 98/98 = 1 mole
Number of molecules = Number of moles × Avogadro's number
= 1 × 6.022 × 10^{23}
= 6.022 × 10^{23} molecules

> **Marking Scheme:** 1 mark for definition + 1 mark for molar mass calculation + 1 mark for molecules calculation

Q31. Answer:

(a) **Rutherford's Model:** According to Rutherford's model, an atom consists of a small, dense, positively charged nucleus at the center containing protons and neutrons. The electrons revolve around the nucleus in circular orbits. Most of the space in an atom is empty.

(b) Thomson's model was rejected because it could not explain:
- The results of Rutherford's alpha particle scattering experiment
- The stability of the atom
- The presence of nucleus in the atom

(c) **Electron** is the subatomic particle which has negligible mass (approximately 1/1836 times the mass of a proton).

> **Marking Scheme:** 1 mark for Rutherford's model + 1 mark for limitations + 1 mark for naming electron

Q32. Answer: (OR Question)

(a) Electrons are distributed in different shells according to the following rules:
- The maximum number of electrons in a shell is given by $2n^2$, where n is the shell number
- The outermost shell cannot have more than 8 electrons
- Shells are filled in a stepwise manner: K, L, M, N
- Electrons are first filled in the inner shells before filling the outer shells

(b) Electronic configuration of Argon (18):
K shell = 2 electrons
L shell = 8 electrons
M shell = 8 electrons
Configuration: 2, 8, 8

(c) The outermost shell is called the valence shell because it contains the valence electrons which determine the chemical properties and reactivity of the atom. These electrons participate in chemical bonding.

> **Marking Scheme:** 1 mark for distribution rules + 1 mark for electronic configuration + 1 mark for explanation of valence shell

Q33. Answer:

(a) **Diffusion:** The spontaneous mixing of particles of two or more substances due to their random motion is called diffusion. It occurs from a region of higher concentration to a region of lower concentration.

(b) Amoeba obtains its food by the process of **endocytosis** (or phagocytosis). The cell membrane engulfs the food particle to form a food vacuole inside the cell.

(c) Plant cells have a cell wall in addition to cell membrane because:
- Cell wall provides structural support and rigidity to the plant cell
- It protects the cell from mechanical damage
- It prevents the cell from bursting when water enters by osmosis
- It gives a definite shape to the cell

> **Marking Scheme:** 1 mark for diffusion + 1 mark for naming endocytosis + 1 mark for functions of cell wall

Q34. Answer:

(a) Initial velocity, u = 0 (train starts from rest)
Final velocity, v = 90 km/h = 90 × (5/18) = 25 m/s

Time, t = 5 minutes = 5 × 60 = 300 s

Using: v = u + at

25 = 0 + a × 300

a = 25/300

a = 0.083 m/s² or 1/12 m/s²

(b) Using: s = ut + ½at²

s = 0 × 300 + ½ × (1/12) × (300)²

s = ½ × (1/12) × 90000

s = 3750 m

Distance travelled = 3750 m or 3.75 km

> **Marking Scheme:** 1½ marks for acceleration + 1½ marks for distance

Q35. Answer: (OR Question)

(a) Speed in first half time = 54 km/h

Speed in second half time = 36 km/h

Average speed = $(v_1 + v_2) / 2$

= (54 + 36) / 2

= 90 / 2

= 45 km/h

(b) Total time = 4 hours

Total distance = Average speed × Time

= 45 × 4

= 180 km

> **Marking Scheme:** 1½ marks for average speed + 1½ marks for total distance

SECTION D - ANSWERS (3 × 5 = 15 Marks)

Q36. Answer:

(a) **Newton's Three Laws of Motion:**
First Law: An object remains in a state of rest or of uniform motion in a straight line unless compelled to change that state by an applied force.
Second Law: The rate of change of momentum of an object is proportional to the applied force and takes place in the direction of the force.
Third Law: For every action, there is an equal and opposite reaction.

(b) Mass of ball, m = 150 g = 0.15 kg
Initial velocity, u = 12 m/s
Final velocity, v = -20 m/s (opposite direction)
Time of contact, t = 0.01 s

(i) Initial momentum = mu = 0.15 × 12 = **1.8 kg m/s**

(ii) Final momentum = mv = 0.15 × (-20) = **-3.0 kg m/s**

(iii) Change in momentum = Final momentum - Initial momentum
= -3.0 - 1.8
= **-4.8 kg m/s**
(Magnitude = 4.8 kg m/s)

(iv) Force = Change in momentum / Time
= 4.8 / 0.01
= **480 N**

> **Marking Scheme:** 1 mark for three laws + 1 mark each for four parts = 5 marks

Q36. Answer: (OR Question)

(a) **Thrust:** The perpendicular force acting on a surface is called thrust. SI unit: Newton (N)
Pressure: The thrust acting per unit area is called pressure. SI unit: Pascal (Pa) or N/m^2

(b) **Derivation of Pressure = hρg:**

Consider a liquid column of height h, cross-sectional area A, and density ρ.

Volume of liquid column = A × h

Mass of liquid column = Volume × Density = A × h × ρ

Weight of liquid column (Thrust) = Mass × g = A × h × ρ × g

Pressure = Thrust / Area = (A × h × ρ × g) / A

Pressure = h × ρ × g

(c) Dimensions: 5 cm × 4 cm × 2 cm

Weight = 200 g = 0.2 kg

Force (Weight) = mg = 0.2 × 10 = 2 N

Three possible areas:

$A_1 = 5 \times 4 = 20\ cm^2 = 20 \times 10^{-4}\ m^2$

$A_2 = 5 \times 2 = 10\ cm^2 = 10 \times 10^{-4}\ m^2$

$A_3 = 4 \times 2 = 8\ cm^2 = 8 \times 10^{-4}\ m^2$

Maximum pressure (minimum area) = $F/A_3 = 2/(8 \times 10^{-4})$ = **2500 Pa**

Minimum pressure (maximum area) = $F/A_1 = 2/(20 \times 10^{-4})$ = **1000 Pa**

> **Marking Scheme:** 1 mark for definitions + 2 marks for derivation + 2 marks for pressure calculations

Q37. Answer:

(a) **Kinetic Energy:** The energy possessed by a body by virtue of its motion is called kinetic energy.

Example: A moving car, flying bird

Potential Energy: The energy possessed by a body by virtue of its position or configuration is called potential energy.

Example: Water stored in a tank, stretched spring

(b) **Law of Conservation of Energy:** Energy can neither be created nor destroyed; it can only be transformed from one form to another. The total energy of an isolated system remains constant.

Proof: Consider a body of mass m at height h. Let it fall freely under gravity.

At point A (height h): PE = mgh, KE = 0, Total Energy = mgh
At point B (height x): PE = mgx, KE = ½mv² = mg(h-x), Total Energy = mgh
At point C (ground): PE = 0, KE = mgh, Total Energy = mgh
Thus, total mechanical energy remains constant throughout the fall.

(c) Mass, m = 2 kg; Height, h = 10 m; g = 10 m/s²

(i) Potential energy at top = mgh = 2 × 10 × 10 = **200 J**

(ii) By conservation of energy:
KE at ground = PE at top = **200 J**

(iii) KE = ½mv²
200 = ½ × 2 × v²
v² = 200
v = √200 = 14.14 m/s or **10√2 m/s**

> **Marking Scheme:** 1 mark for definitions + 2 marks for law and proof + 2 marks for calculations

Q37. Answer: (OR Question)

(a) **Echo:** Echo is the phenomenon of hearing the reflected sound. When sound waves strike a hard surface, they get reflected and if the reflected sound reaches our ears, we hear an echo.

Conditions for hearing echo:
1. The minimum distance between the source of sound and the reflecting surface should be 17.2 m
2. The time interval between the original sound and the reflected sound should be at least 0.1 second

(b) Time taken to hear echo = 3 seconds
Velocity of sound = 340 m/s

Total distance travelled by sound = Velocity × Time
= 340 × 3 = 1020 m

Distance of cliff from man = Total distance / 2
= 1020 / 2
= **510 m**

(c) **Ultrasound:** Sound waves having frequency greater than 20,000 Hz (20 kHz) are called ultrasound. Humans cannot hear ultrasound.

Applications:
1. In medical field for scanning and imaging (ultrasound scan, echocardiography)
2. For detecting cracks and flaws in metal blocks
3. For cleaning difficult-to-reach parts of objects
4. In SONAR for detecting depth of sea and locating underwater objects

> **Marking Scheme:** 1½ marks for echo and conditions + 2 marks for distance calculation + 1½ marks for ultrasound and applications

Q38. Answer:

(a) **Diagrams:** [Students should draw well-labeled diagrams showing:]
Prokaryotic Cell: Cell wall, cell membrane, cytoplasm, nucleoid (nuclear region), ribosomes, plasmid
Eukaryotic Cell: Cell membrane, cytoplasm, nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, ribosomes, lysosomes

(b) **Differences between Prokaryotic and Eukaryotic Cells:**
1. **Nucleus:** Prokaryotic cells have no well-defined nucleus (nucleoid region), while eukaryotic cells have a well-defined nucleus with nuclear membrane
2. **Size:** Prokaryotic cells are smaller (0.1-5.0 μm), while eukaryotic cells are larger (5-100 μm)
3. **Organelles:** Prokaryotic cells lack membrane-bound organelles (mitochondria, ER, Golgi apparatus), while eukaryotic cells have membrane-bound organelles

(c) Lysosomes are known as suicide bags because they contain powerful digestive enzymes that can break down all organic material. During cellular damage or when the cell dies, the lysosome membrane ruptures and releases these enzymes into the

cytoplasm, which then digest the cell's own components. This self-destruction of the cell is why lysosomes are called suicide bags.

> **Marking Scheme:** 2 marks for diagrams + 1½ marks for differences + 1½ marks for lysosomes explanation

Q38. Answer: (OR Question)

(a) **Diagram:** [Students should draw a diagram showing:]
Three types of simple permanent tissues: Parenchyma, Collenchyma, and Sclerenchyma with proper labels

(b) **Differences:**

Parenchyma	**Collenchyma**	**Sclerenchyma**
Cells are thin-walled	Cells have thickened corners	Cells have thick lignified walls
Cells are living	Cells are living	Cells are dead
Provides support and stores food	Provides mechanical support and flexibility	Provides mechanical strength
Found in soft parts of plant	Found in leaf stalks and stems	Found in hard parts like stem, veins of leaves

(c) **Xylem** is the tissue that transports water and minerals from roots to all parts of the plant. It consists of tracheids, vessels, xylem parenchyma, and xylem fibers.

> **Marking Scheme:** 1 mark for diagram + 3 marks for differences + 1 mark for naming xylem

SECTION E - ANSWERS (3 × 4 = 12 Marks)

CASE STUDY 1 - ANSWERS:

(i) Sublimation is used to separate a mixture of salt and ammonium chloride. Ammonium chloride sublimes on heating and can be collected separately, leaving salt behind.

> Marks: 1

(ii) Salt is obtained from seawater by the process of evaporation. Seawater is allowed to stand in shallow pits, and the water evaporates due to heat from the sun, leaving behind salt.

> Marks: 1

OR

Centrifugation is preferred over filtration for separating cream from milk because cream particles are very small and light, and they do not settle down easily. Centrifugation uses high-speed rotation to separate lighter cream from heavier milk, which is faster and more efficient than filtration.

> Marks: 1

(iii) Step-by-step separation:

Step 1: Use a magnet to separate iron filings from the mixture. Iron filings being magnetic will be attracted to the magnet.

Step 2: Add water to the remaining mixture of sand and salt. Salt will dissolve in water while sand will not.

Step 3: Filter the mixture. Sand will remain on the filter paper as residue.

Step 4: Evaporate the filtrate to obtain salt crystals.

> Marks: 2 (½ mark for each correct step)

CASE STUDY 2 - ANSWERS:

(i) Maximum number of electrons in M shell = $2n^2 = 2 \times 3^2 = 2 \times 9 =$ **18 electrons**

> Marks: 1

(ii) Sodium (atomic number 11) has electronic configuration 2, 8, 1.
Electrons are distributed in **K, L, and M shells**.

> Marks: 1

OR
When an electron jumps from a higher energy level to a lower energy level, it emits energy in the form of electromagnetic radiation (light). This released energy corresponds to the difference between the two energy levels.

> Marks: 1

(iii) Electronic configuration: 2, 8, 5
Atomic number: Total number of electrons = 2 + 8 + 5 = **15**
Valency: Number of valence electrons = 5
To achieve stable configuration, it needs 3 more electrons.
Therefore, valency = **3**
Period: Number of shells = 3, so it belongs to **Period 3**
Group: Valence electrons = 5, so it belongs to **Group 15**

> Marks: 2 (½ mark each for atomic number, valency, period, and group)

CASE STUDY 3 - ANSWERS:

(i) Initial velocity, u = 0 (dropped from rest)
Time, t = 4 seconds
Acceleration, a = g = 10 m/s²

Using: v = u + at
v = 0 + 10 × 4
v = **40 m/s**

> Marks: 1

(ii) Using: $s = ut + \frac{1}{2}at^2$

$s = 0 \times 4 + \frac{1}{2} \times 10 \times (4)^2$

$s = 0 + 5 \times 16$

$s = \mathbf{80\ m}$

> Marks: 1

OR

The velocity of a freely falling object at the highest point when thrown vertically upward is **zero**. At the highest point, the object momentarily comes to rest before starting to fall back down.

> Marks: 1

(iii) Initial velocity, $u = 30$ m/s

Final velocity at highest point, $v = 0$

Acceleration, $a = -g = -10$ m/s² (negative because motion is against gravity)

Maximum height:

Using: $v^2 = u^2 + 2as$

$0^2 = (30)^2 + 2 \times (-10) \times s$

$0 = 900 - 20s$

$20s = 900$

$s = \mathbf{45\ m}$

Time to reach maximum height:

Using: $v = u + at$

$0 = 30 + (-10) \times t$

$10t = 30$

$t = \mathbf{3\ seconds}$

> Marks: 2 (1 mark for height + 1 mark for time)

📚 END OF ANSWER KEY 📚

Total Marks: 80

This comprehensive sample paper follows strict CBSE guidelines and includes above-average difficulty questions for excellent exam preparation.

Practice regularly and revise all NCERT concepts thoroughly.

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