MATH LOVE INSTITUTE

CBSE Class 9 Science (Code: 086)

Sample Paper 1 - Home Exam 2025-26 with Complete Solutions

Based on Latest CBSE Syllabus & Exam Pattern 2025-26

Maximum Marks	80 (Theory)
Time Allowed	3 Hours
Class	IX (Nine)
Subject	Science (086)

📋 GENERAL INSTRUCTIONS:

1. This question paper contains **38 questions** divided into **Five Sections A, B, C, D and E**.
2. **Section A**: 20 MCQs of 1 mark each (20 marks)
3. **Section B**: 5 Very Short Answer Type questions of 2 marks each (10 marks)
4. **Section C**: 6 Short Answer Type questions of 3 marks each (18 marks)
5. **Section D**: 4 Long Answer Type questions of 5 marks each (20 marks)
6. **Section E**: 3 Case Study Based questions of 4 marks each (12 marks)
7. All questions are **compulsory**. However, internal choices have been provided in some questions.
8. Draw neat and labelled diagrams wherever required.
9. Use of calculators is **NOT** permitted.

SECTION A - MULTIPLE CHOICE QUESTIONS (1 × 20 = 20 Marks)

Q1. Which of the following is NOT a characteristic of particles of matter? **[1]**

(a) Particles of matter have spaces between them

(b) Particles of matter are continuously moving

(c) Particles of matter do not attract each other

(d) Particles of matter are very small in size

Q2. The process of changing a solid directly into gas without passing through the liquid state is called: **[1]**

(a) Evaporation

(b) Condensation

(c) Sublimation

(d) Freezing

Q3. Which of the following is a heterogeneous mixture? **[1]**

(a) Salt solution

(b) Sugar solution

(c) Tincture of iodine

(d) Soil

Q4. The law of conservation of mass was given by: **[1]**

(a) Dalton

(b) Lavoisier

(c) Proust

(d) Rutherford

Q5. The molecular mass of water (H_2O) is: **[1]**

(a) 16 u

(b) 17 u

(c) 18 u

(d) 20 u

Q6. Which sub-atomic particle was discovered by J.J. Thomson? **[1]**

(a) Proton

(b) Electron

(c) Neutron

(d) Nucleus

Q7. An element has atomic number 12 and mass number 24. The number of neutrons in its atom is: **[1]**

(a) 12

(b) 24

(c) 36

(d) 6

Q8. Which of the following is NOT a function of the cell membrane? **[1]**

(a) It provides shape to the cell

(b) It controls the movement of substances in and out of the cell

(c) It carries out photosynthesis

(d) It protects the cell from the external environment

Q9. Which tissue is responsible for the growth of plants? **[1]**

(a) Parenchyma

(b) Collenchyma

(c) Sclerenchyma

(d) Meristematic tissue

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

(a) km/h

(b) m/s

(c) cm/s

(d) m/min

Q11. A body is said to be in uniform motion if it covers: **[1]**

(a) Equal distances in equal intervals of time

(b) Unequal distances in equal intervals of time

(c) Equal distances in unequal intervals of time

(d) None of the above

Q12. According to Newton's first law of motion, a body at rest will remain at rest unless acted upon by: **[1]**

(a) Gravity

(b) Friction

(c) An unbalanced external force

(d) A balanced force

Q13. The SI unit of force is: **[1]**

(a) Dyne

(b) Newton

(c) Joule

(d) Watt

Q14. The value of acceleration due to gravity (g) on the surface of the earth is approximately: **[1]**

(a) 6.8 m/s^2

(b) 9.8 m/s^2

(c) 10.8 m/s^2

(d) 12.8 m/s^2

Q15. An object is floating in a liquid. The buoyant force acting on it is: **[1]**

(a) Greater than the weight of the object

(b) Less than the weight of the object

(c) Equal to the weight of the object

(d) Zero

Q16. The SI unit of work is: **[1]**

(a) Newton

(b) Watt

(c) Joule

(d) Pascal

Q17. Sound cannot travel through: **[1]**

(a) Solids

(b) Liquids

(c) Gases

(d) Vacuum

Q18. The speed of sound is maximum in: **[1]**

(a) Air

(b) Water

(c) Steel

(d) Vacuum

Q19. **Assertion (A):** Camphor disappears without leaving any solid residue when left in the open. **[1]**

Reason (R): Camphor undergoes sublimation and directly changes from solid to gas.

(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 (A):** The mass of an object is the same on the earth and on the moon. **[1]**

Reason (R): Mass is a measure of the inertia of a body and does not depend on gravity.

(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 - VERY SHORT ANSWER TYPE QUESTIONS (2 × 5 = 10 Marks)

Q21. Why does the temperature of a substance remain constant during a change of state even though heat is being supplied continuously? **[2]**

Q22. Calculate the number of moles and the number of molecules in 36 g of water (H_2O). [Given: Avogadro's number = 6.022×10^{23}] **[2]**

Q23. Differentiate between prokaryotic cells and eukaryotic cells. (Any two differences) **[2]**

Q24. A car travels 30 km in the first hour, 40 km in the second hour, and 50 km in the third hour. Calculate the average speed of the car. **[2]**

Q25. What is the difference between mass and weight? Give the SI unit of each. **[2]**

SECTION C - SHORT ANSWER TYPE QUESTIONS (3 × 6 = 18 Marks)

Q26. (a) What is Tyndall effect? In which type of mixture is it observed? **[3]**

(b) Classify the following into elements, compounds and mixtures: Air, Iron, Water, Salt solution, Carbon dioxide.

Q27. Write the distribution of electrons in the atoms of: (i) Sodium (Na, Z = 11), (ii) Chlorine (Cl, Z = 17), and (iii) Calcium (Ca, Z = 20). Also write their valency. **[3]**

Q28. Draw a neat labelled diagram of a plant cell. Mention any three differences between a plant cell and an animal cell. **[3]**

OR

What are the functions of the following cell organelles? (i) Mitochondria, (ii) Endoplasmic Reticulum, (iii) Golgi Apparatus.

Q29. Derive the equation: $v^2 = u^2 + 2as$, where the symbols have their usual meaning. **[3]**

Q30. A force of 5 N gives a mass m_1 an acceleration of 10 m/s² and a mass m_2 an acceleration of 20 m/s². What acceleration would it give if both the masses were tied together? **[3]**

Q31. (a) State Archimedes' Principle. **[3]**

(b) A body weighs 50 N in air and 40 N when fully immersed in water. Calculate:

(i) the loss in weight of the body in water.

(ii) the buoyant force acting on the body.

SECTION D - LONG ANSWER TYPE QUESTIONS (5 × 4 = 20 Marks)

Q32. (a) What is the difference between an atom and a molecule? **[5]**

(b) Define: (i) Atomic mass unit (ii) Molecular mass (iii) Mole

(c) Calculate the formula unit mass of $CaCO_3$. [Given: Ca = 40 u, C = 12 u, O = 16 u]

OR

(a) State the Law of Constant Proportions with an example.

(b) What are isotopes and isobars? Give one example of each.

(c) Write the chemical formulae of: (i) Aluminium oxide, (ii) Calcium hydroxide, (iii) Sodium carbonate.

Q33. (a) What are the different types of permanent tissues in plants? Explain any two with their functions. **[5]**

(b) Draw a neat labelled diagram of a neuron (nerve cell).

Q34. (a) State Newton's second law of motion and derive the relationship F = ma. **[5]**

(b) A bullet of mass 20 g is fired from a rifle of mass 4 kg with an initial velocity of 35 m/s. Calculate the initial recoil velocity of the rifle.

OR

(a) State the universal law of gravitation and write its mathematical expression.

(b) Calculate the force of gravitation between two objects of masses 50 kg and 100 kg kept at a distance of 2 m apart. [Given: $G = 6.67 \times 10^{-11}$ N m²/kg²]

Q35. (a) What is an echo? State the conditions necessary to hear an echo. **[5]**

(b) The speed of sound in air is 344 m/s. Calculate the minimum distance required to hear an echo. [Take time gap = 0.1 s]

(c) Explain one practical application of the reflection of sound.

SECTION E - CASE STUDY BASED QUESTIONS (4 × 3 = 12 Marks)

Q36. **[4]**

CASE STUDY 1: Rutherford's Gold Foil Experiment

In 1911, Ernest Rutherford performed a famous experiment in which he bombarded a thin gold foil with fast-moving alpha (α) particles. He observed that most of the α-particles passed straight through the foil, some were deflected by small angles, and a very few (about 1 in 20,000) bounced back. Based on these observations, Rutherford proposed a new model of the atom.

Based on the above information, answer the following questions:

(i) What did Rutherford conclude from the observation that most α-particles passed through the gold foil without any deflection? **[1 mark]**

(ii) Why were some α-particles deflected at large angles? **[1 mark]**

(iii) State any two limitations of Rutherford's model of the atom. **[2 marks]**

Q37. **[4]**

CASE STUDY 2: Motion of a Car on a Straight Road

Ravi observed a car moving on a straight road. The car starts from rest and reaches a velocity of 20 m/s in 10 seconds. After that, it moves with this uniform velocity for 20 seconds. Then the driver applies brakes and the car comes to rest in 5 seconds.

Based on the above information, answer the following questions:

(i) What is the acceleration of the car in the first 10 seconds? **[1 mark]**

(ii) What is the total distance covered by the car in the entire journey? **[2 marks]**

(iii) What is the retardation (deceleration) of the car when brakes are applied? **[1 mark]**

Q38. **[4]**

CASE STUDY 3: Improvement in Food Resources

India is an agricultural country where farming is the primary occupation for the majority of its population. To meet the growing demand for food, scientists have developed various methods to improve crop production. These include the use of high-yielding variety (HYV) seeds, modern irrigation techniques, and proper use of manures and fertilizers. Additionally, crop protection from pests and diseases is essential for a good yield.

Based on the above information, answer the following questions:

(i) What are the advantages of using manure over fertilizers? (Any one) **[1 mark]**

(ii) What is the difference between manure and fertilizer? **[2 marks]**

(iii) What is organic farming? **[1 mark]**

📚 END OF QUESTION PAPER 📚

Total Marks: 80

Section A: 20 marks | Section B: 10 marks | Section C: 18 marks

Section D: 20 marks | Section E: 12 marks

Based on CBSE Class 9 Science Syllabus 2025-26
Most Expected Questions for Home Exams

🎯 DETAILED SOLUTIONS WITH STEP-BY-STEP EXPLANATIONS

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

Q1. Answer: (c) Particles of matter do not attract each other

Explanation: This statement is false. Particles of matter attract each other with an intermolecular force of attraction. The other three are correct characteristics of particles of matter.

Q2. Answer: (c) Sublimation

Explanation: Sublimation is the process in which a solid directly converts into gas on heating without passing through the liquid state. Examples: camphor, naphthalene balls, dry ice (solid CO_2).

Q3. Answer: (d) Soil

Explanation: Soil is a heterogeneous mixture because its components (sand, clay, gravel, organic matter) are not uniformly distributed and can be seen separately. Salt solution, sugar solution, and tincture of iodine are all homogeneous mixtures.

Q4. Answer: (b) Lavoisier

Explanation: The law of conservation of mass was given by Antoine Lavoisier in 1789. It states that mass can neither be created nor destroyed in a chemical reaction. The total mass of reactants is equal to the total mass of products.

Q5. Answer: (c) 18 u

Solution:
Molecular mass of H_2O = 2 × (Atomic mass of H) + 1 × (Atomic mass of O)
= 2 × 1 + 1 × 16 = 2 + 16 = 18 u

Q6. Answer: (b) Electron

Explanation: J.J. Thomson discovered the electron in 1897 through his cathode ray experiment. Protons were discovered by Goldstein, and neutrons were discovered by Chadwick.

Q7. Answer: (a) 12

Solution:
Number of neutrons = Mass number − Atomic number
= 24 − 12 = 12

Q8. Answer: (c) It carries out photosynthesis

Explanation: Photosynthesis is carried out by chloroplasts (plastids), not by the cell membrane. The cell membrane provides shape, controls the movement of substances, and protects the cell.

Q9. Answer: (d) Meristematic tissue

Explanation: Meristematic tissue is responsible for the growth of plants. The cells of this tissue are actively dividing and have the ability to differentiate into other types of tissues.

Q10. Answer: (b) m/s

Explanation: The SI unit of speed (and velocity) is metre per second (m/s). km/h is also commonly used but it is not the SI unit.

Q11. Answer: (a) Equal distances in equal intervals of time

Explanation: A body is said to be in uniform motion when it covers equal distances in equal intervals of time, however small the intervals may be. If the distances are unequal in equal time intervals, the motion is non-uniform.

Q12. Answer: (c) An unbalanced external force

Explanation: Newton's first law (Law of Inertia) states that a body continues in its state of rest or of uniform motion in a straight line unless acted upon by an unbalanced external force.

Q13. Answer: (b) Newton

Explanation: The SI unit of force is Newton (N). 1 Newton is the force that produces an acceleration of 1 m/s^2 in a body of mass 1 kg. (1 N = 1 kg × 1 m/s^2)

Q14. Answer: (b) 9.8 m/s^2

Explanation: The acceleration due to gravity (g) on the surface of the earth is approximately 9.8 m/s^2 (often taken as 10 m/s^2 for ease of calculation).

Q15. Answer: (c) Equal to the weight of the object

Explanation: When an object floats, it is in equilibrium. The buoyant force acting on it is exactly equal to the weight of the object. If the buoyant force were greater, the object would rise; if less, it would sink.

Q16. Answer: (c) Joule

Explanation: The SI unit of work is Joule (J). Work = Force × Displacement. 1 Joule = 1 Newton × 1 metre. Newton is the unit of force, Watt is the unit of power, and Pascal is the unit of pressure.

Q17. Answer: (d) Vacuum

Explanation: Sound is a mechanical wave and requires a material medium (solid, liquid, or gas) for propagation. It cannot travel through vacuum because there are no particles to transmit the vibrations.

Q18. Answer: (c) Steel

Explanation: The speed of sound is maximum in solids (like steel), followed by liquids (like water), and minimum in gases (like air). Sound cannot travel through vacuum at all. Speed in steel ≈ 5960 m/s, in water ≈ 1500 m/s, in air ≈ 344 m/s.

Q19. Answer: (a) Both A and R are true and R is the correct explanation of A

Explanation: Camphor undergoes sublimation — it directly changes from solid to gaseous state without passing through the liquid state. This is why it disappears without leaving any residue. Thus, R correctly explains A.

Q20. Answer: (a) Both A and R are true and R is the correct explanation of A

Explanation: Mass is a measure of the amount of matter (inertia) and remains the same everywhere. Weight (W = mg) depends on gravity and changes from place to place. Since the moon's gravity is 1/6th of earth's, weight changes but mass remains the same. R correctly explains A.

SECTION B - SOLUTIONS (2 × 5 = 10 Marks)

Q21. Solution:

> **Marking Scheme:** 1 mark for concept of latent heat + 1 mark for explanation

During a change of state, the temperature of a substance remains constant because the heat supplied is used up in changing the state of the substance (i.e., overcoming the forces of attraction between the particles) rather than increasing the kinetic energy of the particles. **[1 mark]**

This heat energy that is absorbed without showing any rise in temperature is called **latent heat**. For example, at 0°C (melting point of ice), the heat energy supplied is used to overcome the intermolecular forces holding the ice molecules in a fixed position, converting ice into water without any change in temperature. **[1 mark]**

Q22. Solution:

> **Marking Scheme:** 1 mark for number of moles + 1 mark for number of molecules

Given: Mass of water = 36 g
Molecular mass of H_2O = 2(1) + 16 = 18 g/mol

Number of moles:
Number of moles = Given mass / Molecular mass
= 36 / 18
= 2 moles [1 mark]

Number of molecules:
Number of molecules = Number of moles × Avogadro's number
= $2 \times 6.022 \times 10^{23}$
= 12.044×10^{23} molecules = 1.2044×10^{24} molecules [1 mark]

Q23. Solution:

Marking Scheme: 1 mark for each correct difference (any two)

Feature	Prokaryotic Cell	Eukaryotic Cell
Nucleus	No well-defined nucleus; nuclear material is not enclosed by a nuclear membrane.	Well-defined nucleus enclosed by a nuclear membrane.
Membrane-bound organelles	Absent (e.g., no mitochondria, ER, Golgi body).	Present (e.g., mitochondria, ER, Golgi body, etc.).

Examples — Prokaryotic: Bacteria, Blue-green algae; Eukaryotic: Plant and Animal cells.

Q24. Solution:

Marking Scheme: 1 mark for total distance and time + 1 mark for calculation

Given:
Distance in 1st hour = 30 km
Distance in 2nd hour = 40 km
Distance in 3rd hour = 50 km

Total distance = 30 + 40 + 50 = 120 km **[½ mark]**
Total time = 1 + 1 + 1 = 3 hours **[½ mark]**

Average speed = Total distance / Total time
= 120 / 3
= 40 km/h [1 mark]

Q25. Solution:

Marking Scheme: 1 mark for differences + 1 mark for SI units

Property	Mass	Weight
Definition	Amount of matter contained in a body.	Force with which the earth attracts a body (W = mg).
Nature	It is a scalar quantity. It remains constant everywhere.	It is a vector quantity. It changes from place to place.
SI Unit	**Kilogram (kg)**	**Newton (N)**

SECTION C - SOLUTIONS (3 × 6 = 18 Marks)

Q26. Solution:

> **Marking Scheme:** 1 mark for Tyndall effect + 1 mark for type + 1 mark for classification

(a) Tyndall Effect:
The scattering of a beam of light by the particles of a colloid when light passes through it is called the Tyndall effect. The path of light becomes visible due to the scattering of light by the colloidal particles. **[1 mark]**

It is observed in **colloidal solutions** (e.g., milk, fog, smoke). It is not observed in true solutions because the particles are too small to scatter light. **[1 mark]**

(b) Classification: [1 mark]
• **Elements:** Iron
• **Compounds:** Water (H_2O), Carbon dioxide (CO_2)
• **Mixtures:** Air, Salt solution

Q27. Solution:

> **Marking Scheme:** 1 mark for each correct electronic configuration and valency

(i) Sodium (Na), Z = 11:
Electronic configuration: 2, 8, 1
Valency = 1 (it can lose 1 electron from its outermost shell) **[1 mark]**

(ii) Chlorine (Cl), Z = 17:
Electronic configuration: 2, 8, 7
Valency = 1 (it can gain 1 electron to complete its octet, i.e., 8 − 7 = 1) **[1 mark]**

(iii) Calcium (Ca), Z = 20:
Electronic configuration: 2, 8, 8, 2
Valency = 2 (it can lose 2 electrons from its outermost shell) **[1 mark]**

Q28. Solution:

> **Marking Scheme:** 1 mark for diagram + 1 mark for labels + 1 mark for three differences

Diagram of a Plant Cell:
[Students should draw a rectangular-shaped cell with the following parts labelled: Cell wall, Cell membrane, Nucleus, Vacuole (large central), Chloroplast, Mitochondria, Endoplasmic Reticulum, Golgi apparatus, Cytoplasm] **[1 mark for diagram + 1 mark for correct labels]**

Three differences between Plant Cell and Animal Cell: [1 mark]

Feature	**Plant Cell**	**Animal Cell**
Cell wall	Present (made of cellulose)	Absent
Chloroplasts	Present	Absent
Vacuoles	Large central vacuole	Small or absent

OR

Functions of Cell Organelles:

(i) Mitochondria: Known as the "powerhouse of the cell." They carry out cellular respiration (aerobic respiration) and produce energy in the form of ATP (adenosine

triphosphate). They have their own DNA and ribosomes. **[1 mark]**

(ii) Endoplasmic Reticulum (ER): It is of two types — Smooth ER (SER) and Rough ER (RER). RER has ribosomes on its surface and helps in protein synthesis. SER helps in the manufacture of fats (lipids). ER also serves as a transport channel for materials within the cell. **[1 mark]**

(iii) Golgi Apparatus: It functions as the packaging and dispatching unit of the cell. It receives materials from the ER, modifies and packages them into vesicles, and dispatches them to various targets inside and outside the cell. It is also involved in the formation of lysosomes. **[1 mark]**

Q29. Solution:

> **Marking Scheme:** 1 mark for defining symbols + 1 mark for derivation steps + 1 mark for final result

Derivation of $v^2 = u^2 + 2as$:

We know the first two equations of motion:

$v = u + at$ ...(i) **[½ mark]**

$s = ut + \frac{1}{2}at^2$ ...(ii) **[½ mark]**

From equation (i): $t = (v - u)/a$ ...(iii)

Substituting (iii) in (ii): **[1 mark]**

$s = u \times (v - u)/a + \frac{1}{2} \times a \times [(v - u)/a]^2$

$s = u(v - u)/a + \frac{1}{2} \times a \times (v - u)^2/a^2$

$s = u(v - u)/a + (v - u)^2/2a$

Multiplying both sides by 2a:

$2as = 2u(v - u) + (v - u)^2$

$2as = 2uv - 2u^2 + v^2 - 2uv + u^2$

$2as = v^2 - u^2$

$\therefore v^2 = u^2 + 2as$ [1 mark]

Where: u = initial velocity, v = final velocity, a = acceleration, s = displacement.

Q30. Solution:

> **Marking Scheme:** 1 mark for finding m_1 + 1 mark for finding m_2 + 1 mark for final acceleration

Given: F = 5 N, $a_1 = 10\ m/s^2$, $a_2 = 20\ m/s^2$

Finding m_1:

$F = m_1 \times a_1$

$5 = m_1 \times 10$

$m_1 = 0.5$ kg [1 mark]

Finding m_2:

$F = m_2 \times a_2$

$5 = m_2 \times 20$

$m_2 = 0.25$ kg [1 mark]

Acceleration when both masses are tied together:

Total mass = $m_1 + m_2 = 0.5 + 0.25 = 0.75$ kg

$F = (m_1 + m_2) \times a$

$5 = 0.75 \times a$

$a = 5/0.75$

$a = 6.67\ m/s^2$ (approximately) [1 mark]

Q31. Solution:

> **Marking Scheme:** 1 mark for stating the principle + 1 mark for loss in weight + 1 mark for buoyant force

(a) Archimedes' Principle:

When a body is immersed fully or partially in a fluid, it experiences an upward force (buoyant force) that is equal to the weight of the fluid displaced by the body.

[1 mark]

(b) Given:
Weight of body in air = 50 N
Weight of body in water = 40 N

(i) Loss in weight:
Loss in weight = Weight in air − Weight in water
= 50 − 40
= 10 N [1 mark]

(ii) Buoyant force:
According to Archimedes' Principle, the buoyant force is equal to the loss in weight of the body when immersed in the fluid.
Buoyant force = 10 N [1 mark]

SECTION D - SOLUTIONS (5 × 4 = 20 Marks)

Q32. Solution:

> **Marking Scheme:** 1 mark for atom vs molecule + 1 mark each for 3 definitions + 1 mark for formula unit mass calculation

(a) Difference between Atom and Molecule: [1 mark]
An **atom** is the smallest particle of an element that can take part in a chemical reaction (e.g., Na, O, H). A **molecule** is the smallest particle of an element or compound that can exist independently and retains all the properties of that substance (e.g., O_2, H_2O, NaCl).

(b) Definitions:

(i) Atomic Mass Unit (amu or u): One atomic mass unit is defined as exactly 1/12th the mass of one atom of carbon-12. It is used to express atomic and molecular masses. 1 u = 1.66×10^{-24} g. **[1 mark]**

(ii) Molecular Mass: The molecular mass of a substance is the sum of the atomic masses of all the atoms present in one molecule of that substance. For example, molecular mass of H_2O = 2(1) + 16 = 18 u. **[1 mark]**

(iii) Mole: A mole is the amount of substance that contains as many particles (atoms, molecules, or ions) as there are atoms in exactly 12 g of carbon-12. This number is called Avogadro's number ($N_A = 6.022 \times 10^{23}$). **[1 mark]**

(c) Formula Unit Mass of $CaCO_3$: [1 mark]

$CaCO_3 = Ca + C + 3 \times O$

$= 40 + 12 + 3 \times 16$

$= 40 + 12 + 48$

= 100 u

OR

(a) Law of Constant Proportions (Law of Definite Proportions): [1 mark]

This law was given by Joseph Proust. It states that in a chemical substance, the elements are always present in definite proportions by mass.

Example: In water (H_2O), the ratio of hydrogen to oxygen by mass is always 1:8, regardless of the source of water (river, well, sea, or laboratory).

(b) Isotopes and Isobars: [2 marks]

Isotopes: Atoms of the same element that have the same atomic number but different mass numbers are called isotopes. They have different numbers of neutrons.

Example: Hydrogen has three isotopes — Protium (^1H), Deuterium (^2H), and Tritium (^3H).

Isobars: Atoms of different elements that have the same mass number but different atomic numbers are called isobars.

Example: Calcium (^{40}Ca, Z=20) and Argon (^{40}Ar, Z=18).

(c) Chemical Formulae: [2 marks]

(i) Aluminium oxide: **Al_2O_3**

(ii) Calcium hydroxide: **$Ca(OH)_2$**
(iii) Sodium carbonate: **Na_2CO_3**

Q33. Solution:

> **Marking Scheme:** 2 marks for types and explanation of two tissues + 2 marks for functions + 1 mark for diagram

(a) Types of Permanent Tissues in Plants:
Permanent tissues are of two types:
(i) **Simple permanent tissues** — Parenchyma, Collenchyma, Sclerenchyma
(ii) **Complex permanent tissues** — Xylem and Phloem **[1 mark]**

1. Parenchyma: [1 mark]
These are the most common type of simple permanent tissue. The cells are living, thin-walled, loosely packed with large intercellular spaces. They are generally found in the cortex and pith of stems and roots.
Function: They store food, provide support and also help in gaseous exchange. When they contain chlorophyll, they are called chlorenchyma and perform photosynthesis.

2. Sclerenchyma: [1 mark]
The cells are dead, thick-walled (due to deposition of lignin), and have no intercellular spaces. They are found in the hard outer covering of seeds, in veins of leaves, and in coconut husk.
Function: They provide strength, rigidity, and mechanical support to the plant body. They make the plant hard and stiff.

(b) Diagram of a Neuron (Nerve Cell): [2 marks]
[Students should draw a neat labelled diagram of a neuron showing the following parts:]
• **Cell body (Cyton):** Contains nucleus and cytoplasm
• **Dendrites:** Short branched projections that receive nerve impulses
• **Axon:** Long, thin fibre that transmits impulses away from the cell body

• **Myelin sheath:** Insulating layer around the axon
• **Nerve endings (Axon terminals):** Terminal branches at the end of axon

Q34. Solution:

> **Marking Scheme:** 2 marks for stating law and derivation + 1 mark for defining terms + 2 marks for numerical

(a) Newton's Second Law of Motion: [1 mark]
The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction in which the force acts.

Derivation of F = ma: [2 marks]
Let a body of mass m be moving with initial velocity u. Let a force F be applied on it for time t, and the velocity changes to v.

Initial momentum = mu
Final momentum = mv
Change in momentum = mv − mu = m(v − u)
Time taken = t

Rate of change of momentum = m(v − u)/t

According to Newton's Second Law:
$F \propto m(v - u)/t$
$F \propto ma \quad [\because a = (v - u)/t]$
F = kma

Where k is a constant of proportionality. In SI units, k = 1.
∴ **F = ma**

(b) Numerical: [2 marks]
Given: Mass of bullet (m_1) = 20 g = 0.02 kg
Mass of rifle (m_2) = 4 kg
Velocity of bullet (v_1) = 35 m/s

Initial velocity of bullet = Initial velocity of rifle = 0 (both at rest)

By the law of conservation of momentum:
Total momentum before firing = Total momentum after firing
$0 = m_1v_1 + m_2v_2$
$0 = (0.02)(35) + (4)(v_2)$
$0 = 0.7 + 4v_2$
$4v_2 = -0.7$
$v_2 = -0.7/4$
$v_2 = -0.175$ m/s

The negative sign indicates that the rifle recoils in the opposite direction to the bullet.
Recoil velocity of the rifle = 0.175 m/s (in the backward direction)

OR

(a) Universal Law of Gravitation: [2 marks]
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 centres.

Mathematical Expression:
$F = G \times (m_1 \times m_2) / d^2$

Where:
F = Gravitational force between the two objects
m_1 and m_2 = Masses of the two objects
d = Distance between the centres of the two objects
G = Universal gravitational constant = 6.67×10^{-11} N m^2/kg^2

(b) Numerical: [3 marks]
Given: $m_1 = 50$ kg, $m_2 = 100$ kg, d = 2 m, G = 6.67×10^{-11} N m^2/kg^2

$F = G \times (m_1 \times m_2) / d^2$
$F = 6.67 \times 10^{-11} \times (50 \times 100) / (2)^2$
$F = 6.67 \times 10^{-11} \times 5000 / 4$

$F = 6.67 \times 10^{-11} \times 1250$

$F = 8337.5 \times 10^{-11}$

$F = 8.34 \times 10^{-8}$ N

Q35. Solution:

> **Marking Scheme:** 1 mark for echo definition + 1 mark for conditions + 1 mark for numerical + 1 mark for formula + 1 mark for application

(a) Echo: [1 mark]

An echo is the repetition of a sound caused by the reflection of sound waves from a hard surface (such as a wall, cliff, or building) back to the listener.

Conditions necessary to hear an echo: [1 mark]

(i) The minimum distance between the source of sound and the reflecting surface should be 17.2 m (at 20°C in air).

(ii) The time interval between the original sound and the reflected sound should be at least 0.1 second.

(iii) The reflecting surface should be large and hard (e.g., a building, cliff, or wall).

(b) Numerical — Minimum distance to hear an echo: [2 marks]

Given: Speed of sound in air (v) = 344 m/s, Time gap (t) = 0.1 s

The sound has to travel to the reflecting surface and back.

Total distance = $v \times t = 344 \times 0.1 = 34.4$ m

Since sound travels to the wall and back:

Minimum distance (d) = Total distance / 2

= 34.4 / 2

d = 17.2 m

(c) Practical application of reflection of sound: [1 mark]

Stethoscope: A stethoscope works on the principle of multiple reflection of sound. The sound of the patient's heartbeat reaches the doctor's ears through multiple

reflections of sound waves within the rubber tube of the stethoscope. This amplifies the sound and helps in diagnosis.

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

Q36. Solution: CASE STUDY 1 - Rutherford's Gold Foil Experiment

Marking Scheme: 1 + 1 + 2 = 4 marks

(i) Since most of the α-particles passed through the gold foil without any deflection, Rutherford concluded that **most of the space inside the atom is empty**. **[1 mark]**

(ii) Some α-particles were deflected at large angles because they came close to or hit the **positively charged nucleus** of the atom. Since the nucleus is positively charged and α-particles are also positively charged, they were repelled (deflected) due to electrostatic repulsion. **[1 mark]**

(iii) Two limitations of Rutherford's model: [2 marks]
Limitation 1: According to electromagnetic theory, a charged particle (electron) revolving around another charged particle (nucleus) should continuously emit radiation and lose energy. This would cause the electron to spiral inward and eventually collapse into the nucleus. But atoms are stable, which Rutherford's model could not explain. **[1 mark]**

Limitation 2: Rutherford's model did not explain the distribution of electrons around the nucleus. It did not say anything about the arrangement of electrons in different orbits or energy levels. **[1 mark]**

Q37. Solution: CASE STUDY 2 - Motion of a Car

Marking Scheme: 1 + 2 + 1 = 4 marks

(i) Acceleration in the first 10 seconds: [1 mark]

u = 0 m/s (starts from rest), v = 20 m/s, t = 10 s

$a = (v - u)/t = (20 - 0)/10$

$a = 2\ m/s^2$

(ii) Total distance covered: [2 marks]

Phase 1 (0 to 10 s): Accelerating

$s_1 = ut + \frac{1}{2}at^2 = 0(10) + \frac{1}{2}(2)(10)^2 = 0 + 100 = 100$ m

Phase 2 (10 s to 30 s): Uniform velocity = 20 m/s, time = 20 s

$s_2 = v \times t = 20 \times 20 = 400$ m

Phase 3 (30 s to 35 s): Decelerating

u = 20 m/s, v = 0 m/s, t = 5 s

$s_3 = (u + v)/2 \times t = (20 + 0)/2 \times 5 = 10 \times 5 = 50$ m

Total distance = $s_1 + s_2 + s_3 = 100 + 400 + 50 = 550$ m

(iii) Retardation (deceleration): [1 mark]

u = 20 m/s, v = 0 m/s, t = 5 s

$a = (v - u)/t = (0 - 20)/5$

$a = -4\ m/s^2$

Retardation = $4\ m/s^2$ (magnitude)

Q38. Solution: CASE STUDY 3 - Improvement in Food Resources

> **Marking Scheme:** 1 + 2 + 1 = 4 marks

(i) Advantage of using manure over fertilizers (Any one): [1 mark]

Manure improves the soil structure (texture) by increasing the water-holding capacity and aeration of the soil. It enriches the soil with organic matter and nutrients and does not cause water pollution (unlike chemical fertilizers).

(ii) Difference between Manure and Fertilizer: [2 marks]

Feature	Manure	Fertilizer
Source	It is a natural substance obtained by the decomposition of animal excreta and plant waste.	It is a man-made (synthetic) substance prepared in factories.
Nutrient content	It provides humus and many nutrients but in small quantities.	It provides specific nutrients (N, P, K) in large quantities.
Effect on soil	It improves soil texture and water-holding capacity.	Excessive use can damage soil fertility and cause water pollution.

(iii) Organic Farming: [1 mark]

Organic farming is a farming system that uses biological methods of pest control, organic manures, and minimal or no chemical inputs (fertilizers, pesticides, herbicides). It aims to produce food that is healthy, sustainable, and environment-friendly. It integrates the use of bio-fertilizers, crop rotation, composting, and biological pest control methods.

✅ END OF SOLUTIONS ✅

All solutions strictly based on CBSE Class 9 Science Syllabus 2025-26

Comprehensive step-by-step explanations with marking schemes

Key Topics Covered:

• Matter in Our Surroundings (States of Matter, Change of State, Sublimation)
• Is Matter Around Us Pure (Mixtures, Elements, Compounds, Tyndall Effect)
• Atoms and Molecules (Atomic Mass, Molecular Mass, Mole Concept)
• Structure of the Atom (Sub-atomic Particles, Rutherford's Model, Isotopes & Isobars)
• The Fundamental Unit of Life (Cell Organelles, Prokaryotic & Eukaryotic Cells)
• Tissues (Plant & Animal Tissues, Neuron)
• Motion (Equations of Motion, Distance-Time, Velocity-Time)
• Force and Laws of Motion (Newton's Laws, Conservation of Momentum)
• Gravitation (Universal Law, Buoyancy, Archimedes' Principle)

• Work and Energy (Work, Kinetic & Potential Energy)

• Sound (Echo, Reflection, Speed of Sound)

• Improvement in Food Resources (Manure, Fertilizer, Organic Farming)

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