MATH LOVE INSTITUTE

Education as a Service (EaaS)

SAMPLE PAPER - SET 6

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. The SI unit of temperature is: **[1]**

(a) Celsius

(b) Fahrenheit

(c) Kelvin

(d) Centigrade

Q2. A solution that has small amount of solute is called: **[1]**

(a) Saturated solution

(b) Unsaturated solution

(c) Supersaturated solution

(d) Dilute solution

Q3. Which of the following correctly represents 360 u? **[1]**

(a) Mass of 1 mole of carbon atoms

(b) Mass of 30 carbon atoms

(c) Mass of 1 carbon atom

(d) Mass of 1 molecule of CO_2

Q4. The K shell can accommodate maximum: **[1]**

(a) 2 electrons

(b) 8 electrons

(c) 18 electrons

(d) 32 electrons

Q5. The organelle without a membrane is: **[1]**

(a) Nucleus

(b) Ribosome

(c) Mitochondria

(d) Chloroplast

Q6. Aerenchyma tissue is found in: **[1]**

(a) Desert plants

(b) Aquatic plants

(c) Xerophytes

(d) Epiphytes

Q7. A car travels from point A to B and returns to A. The displacement is: **[1]**

(a) Twice the distance from A to B

(b) Half the distance from A to B

(c) Zero

(d) Equal to distance from A to B

Q8. The SI unit of momentum is: **[1]**

(a) kg m/s

(b) N s

(c) Both (a) and (b)

(d) kg m/s^2

Q9. Weight of an object on moon is: **[1]**

(a) Equal to its weight on earth

(b) 1/6 of its weight on earth

(c) 6 times its weight on earth

(d) Zero

Q10. 1 kWh equals: **[1]**

(a) 3.6×10^6 J

(b) 3.6×10^5 J

(c) 3.6×10^4 J

(d) 3.6×10^3 J

Q11. The speed of sound is maximum in: **[1]**

(a) Air at 0°C

(b) Air at 20°C

(c) Water

(d) Iron

Q12. During evaporation, the temperature of the liquid: **[1]**

(a) Increases

(b) Decreases

(c) Remains constant

(d) First increases then decreases

Q13. The percentage of nitrogen in air is approximately: **[1]**

(a) 21%

(b) 78%

(c) 0.03%

(d) 1%

Q14. Neutrons were discovered by: **[1]**

(a) J.J. Thomson

(b) Rutherford

(c) James Chadwick

(d) Niels Bohr

Q15. The cell organelle responsible for intracellular transport is: **[1]**

(a) Lysosome

(b) Endoplasmic reticulum

(c) Golgi apparatus

(d) Vacuole

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

Assertion (A): Liquids have fixed volume but no fixed shape.

Reason (R): Intermolecular forces in liquids are weaker than in solids.

(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 atomic mass of chlorine is 35.5 u.

Reason (R): Chlorine has two isotopes with mass numbers 35 and 37.

(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): Chloroplasts are called the kitchen of the cell.

Reason (R): Chloroplasts synthesize food through photosynthesis.

(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 slope of distance-time graph gives speed.

Reason (R): Speed is the rate of change of distance 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): Friction always opposes motion.

Reason (R): Friction acts in the direction opposite to the applied force.

(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. Define: (a) Condensation (b) Sublimation **[2]**

Q22. What is Tyndall effect? Give one example where this effect can be observed. **[2]**

Q23. What do you understand by (a) atomicity and (b) molecular formula? Give one example of each. **[2]**

Q24. What is the significance of semi-permeable membrane in osmosis? Name the process when water moves out of the cell. **[2]**

Q25. A body starts from rest and attains a velocity of 20 m/s in 4 seconds. Calculate its acceleration. **[2]**

Q26. Define: (a) Gravitational force (b) Acceleration due to gravity **[2]**

SECTION C (7 × 3 = 21 Marks)

Q27. (a) Convert 27°C to Kelvin scale. **[3]**

(b) Define latent heat of vaporization.

(c) Why do we feel cool when we perspire?

Q28. (a) What is chromatography? Where is it used? **[3]**

(b) Explain how you would obtain pure water from seawater.

(c) Name the technique used to separate butter from curd.

Q29. How many moles are present in: **[3]**

(a) 46 g of sodium (Na)

(b) 8 g of oxygen (O_2)

(c) 9.033×10^{23} molecules of water

[Given: Atomic masses: Na = 23 u, O = 16 u, Avogadro's number = 6.022×10^{23}]

Q30. OR **[3]**

(a) Define mole. What is Avogadro's constant?

(b) Calculate the number of aluminium ions present in 0.051 g of aluminium oxide (Al_2O_3).

[Given: Atomic mass of Al = 27 u, O = 16 u]

Q31. (a) What are canal rays? Who discovered them? **[3]**

(b) State three properties of canal rays.

(c) How do canal rays differ from cathode rays?

Q32. OR **[3]**

(a) If an atom has 17 protons and 18 neutrons, find its:

(i) Atomic number

(ii) Mass number

(iii) Number of electrons

(b) Write the electronic configuration of this atom.

Q33. (a) What is plasmolysis? **[3]**

(b) Differentiate between hypertonic and hypotonic solutions.

(c) What happens when a plant cell is placed in a hypotonic solution?

Q34. The distance-time graph of three objects A, B, and C is shown below. On the basis of the graph, answer: **[3]**

(a) Which object is moving with maximum speed?

(b) Are all three objects moving with uniform speed?

(c) Which object is stationary?

[Assume: Object A has steepest slope, B has gentle slope, C is horizontal line]

Q35. OR **[3]**

An object is thrown vertically upward with a velocity of 40 m/s. Calculate:

(a) The maximum height reached

(b) The time taken to reach maximum height

(c) The time of flight [Take g = 10 m/s²]

SECTION D (3 × 5 = 15 Marks)

Q36. (a) State the law of conservation of momentum. **[5]**

(b) Derive the law mathematically for an isolated system.

(c) Two objects of masses 100 g and 200 g are moving along the same line in the same direction with velocities of 2 m/s and 1 m/s respectively. They collide and after collision, the first object moves with a velocity of 1.67 m/s. Determine the velocity of the second object.

OR

(a) Derive the relation F = ma using Newton's second law.

(b) Why is it difficult to walk on a slippery road?

(c) A force of 10 N acts on a body of mass 2 kg for 5 seconds. If the body is initially at rest, find:

(i) Velocity acquired by the body

(ii) Change in momentum

Q37. (a) Define potential energy and kinetic energy with formulas. **[5]**

(b) Show that the total mechanical energy of a freely falling body remains constant.

(c) A pendulum bob of mass 50 g is raised to a height of 10 cm and released. What is its kinetic energy when it passes through its mean position? [Take g = 10 m/s²]

OR

(a) What is the difference between potential energy and kinetic energy?

(b) Derive the formula for kinetic energy.

(c) Find the energy in kWh consumed in 10 hours by an electric heater of power 500 W.

Q38. (a) Draw a labeled diagram of a plant cell. **[5]**

(b) List three features that differentiate a plant cell from an animal cell.

(c) Name the cell organelle that:

(i) Controls cell activities

(ii) Helps in packaging of materials

OR

(a) What is tissue? Name the four main types of tissues found in animals.

(b) Differentiate between simple and complex permanent tissues in plants.

(c) Name the tissue present in:

(i) Brain and spinal cord

(ii) Lining of blood vessels

SECTION E (3 × 4 = 12 Marks)

CASE STUDY 1: INTERCONVERSION OF STATES OF MATTER

Matter can change from one state to another by changing temperature or pressure. The change of state from solid to liquid is called melting or fusion, and from liquid to gas is called vaporization or boiling. The reverse processes are called freezing and condensation respectively. Some substances can directly change from solid to gas without becoming liquid, a process called sublimation. Examples include camphor,

naphthalene, and dry ice (solid CO_2). During change of state, temperature remains constant as the heat energy supplied is used to change the state and not to increase the temperature. This heat energy is called latent heat. A student observed that when ice is heated, it melts at 0°C to form water. On further heating, water boils at 100°C to form steam. The temperature remained constant at both 0°C and 100°C despite continuous heating.

(i) What is the name given to the process of conversion of solid directly into gas? [1 mark]

(ii) Why does temperature remain constant during the melting of ice? [1 mark]

OR
Name two substances that undergo sublimation. [1 mark]

(iii) Calculate the heat energy required to melt 2 kg of ice at 0°C. (Latent heat of fusion of ice = 3.34×10^5 J/kg) [2 marks]

CASE STUDY 2: DISCOVERY OF SUBATOMIC PARTICLES

The discovery of subatomic particles led to important advancements in atomic theory. J.J. Thomson discovered electrons in 1897 through cathode ray experiments. He found that cathode rays are streams of negatively charged particles called electrons. Electrons have a mass of 9.1×10^{-31} kg and a charge of -1.6×10^{-19} coulombs. Ernest Rutherford discovered the nucleus and proposed that most of the mass and positive charge of an atom is concentrated in a small central region. Later, James Chadwick discovered neutrons in 1932. Neutrons are neutral particles present in the nucleus along with protons. The mass of a neutron is approximately equal to the mass of a proton (1.67×10^{-27} kg). These discoveries revolutionized our understanding of atomic structure and led to the modern atomic model.

(i) Who discovered electrons and in which year? [1 mark]

(ii) What is the charge on an electron? [1 mark]

OR

Name the scientist who discovered neutrons. [1 mark]

(iii) An atom has 11 protons and 12 neutrons. Calculate:

(a) The number of electrons in the atom

(b) The mass number of the atom [2 marks]

CASE STUDY 3: EQUATIONS OF MOTION

The equations of motion describe the relationship between displacement, velocity, acceleration, and time for uniformly accelerated motion. These three equations are: (1) $v = u + at$, (2) $s = ut + \frac{1}{2}at^2$, and (3) $v^2 = u^2 + 2as$, where u is initial velocity, v is final velocity, a is acceleration, t is time, and s is displacement. These equations are valid only when acceleration is constant. They can be derived using velocity-time graphs. A student performs an experiment by releasing a ball from the top of a building. The ball falls freely under gravity with an acceleration of 10 m/s^2. He notes that the ball takes 4 seconds to reach the ground. Using equations of motion, various parameters of the motion can be calculated.

(i) Write the equation of motion that relates velocity, acceleration, and time. [1 mark]

(ii) Calculate the final velocity of the ball when it reaches the ground. [1 mark]

OR

State the condition under which equations of motion are applicable. [1 mark]

(iii) Calculate the height of the building using the equation $s = ut + \frac{1}{2}at^2$. (Take initial velocity u = 0, g = 10 m/s^2, t = 4 s) [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 6

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	(c)	Q6	(b)	Q11	(d)	Q16	(a)
Q2	(d)	Q7	(c)	Q12	(b)	Q17	(a)
Q3	(b)	Q8	(c)	Q13	(b)	Q18	(a)
Q4	(a)	Q9	(b)	Q14	(c)	Q19	(a)
Q5	(b)	Q10	(a)	Q15	(b)	Q20	(c)

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

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

Q21. Answer:

(a) **Condensation:** The process of conversion of gas into liquid on cooling is called condensation. Example: Formation of water droplets on cold surfaces.

(b) **Sublimation:** The process of conversion of solid directly into gas without passing through the liquid state is called sublimation. Example: Camphor, naphthalene, dry ice.

> **Marking Scheme:** 1 mark for each definition

Q22. Answer:

Tyndall Effect: The phenomenon of scattering of light by colloidal particles is called Tyndall effect. When a beam of light passes through a colloid, the path of light becomes visible due to scattering of light by colloidal particles.

Example: The path of sunlight entering a dark room through a small opening becomes visible due to scattering of light by dust particles in air. It can also be observed when a beam of headlight passes through fog.

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

Q23. Answer:

(a) **Atomicity:** The number of atoms present in one molecule of an element is called its atomicity.
Example: Oxygen (O_2) has atomicity 2 (diatomic), Ozone (O_3) has atomicity 3 (triatomic)

(b) **Molecular Formula:** A formula that shows the actual number of atoms of each element present in one molecule of a compound.
Example: H_2O shows 2 hydrogen atoms and 1 oxygen atom in one water molecule

> **Marking Scheme:** ½ mark for each definition + ½ mark for each example = 2 marks total

Q24. Answer:

Significance of semi-permeable membrane: The semi-permeable membrane is essential for osmosis because it allows only solvent molecules (water) to pass through it but not solute molecules. This selective permeability creates a concentration gradient that drives the movement of water from a region of higher water concentration to lower water concentration.

The process when water moves out of the cell is called **exosmosis**. When a cell loses water and shrinks, the process is called **plasmolysis**.

> **Marking Scheme:** 1 mark for significance + 1 mark for naming the process

Q25. Answer:

Given:
Initial velocity, u = 0 (body starts from rest)
Final velocity, v = 20 m/s
Time, t = 4 seconds

Using the formula: a = (v - u) / t
a = (20 - 0) / 4
a = 20 / 4
a = 5 m/s²

Therefore, the acceleration of the body is 5 m/s².

> **Marking Scheme:** 1 mark for correct formula + 1 mark for correct answer

Q26. Answer:

(a) **Gravitational Force:** The force of attraction between any two objects in the universe is called gravitational force. It is always attractive in nature and acts along the

line joining the centers of the two objects. It depends on the masses of the objects and the distance between them.

(b) **Acceleration due to Gravity (g):** The uniform acceleration produced in a freely falling body due to the gravitational pull of the earth is called acceleration due to gravity. Its value on earth's surface is approximately 9.8 m/s^2 or 10 m/s^2 (for calculations). It is independent of the mass of the falling object.

Marking Scheme: 1 mark for each definition

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

Q27. Answer:

(a) Temperature in Kelvin = Temperature in Celsius + 273
= 27 + 273
= **300 K**

(b) **Latent heat of vaporization:** The amount of heat energy required to convert 1 kg of liquid into gas (vapor) at its boiling point without any change in temperature is called latent heat of vaporization. For water, it is 2.26×10^6 J/kg or 22.6×10^5 J/kg.

(c) We feel cool when we perspire because during evaporation of sweat (perspiration) from our body surface, heat energy is absorbed from our body. This loss of heat energy from the body lowers our body temperature and makes us feel cool.

Marking Scheme: 1 mark for each part (3 marks total)

Q28. Answer:

(a) **Chromatography:** Chromatography is a technique used to separate the components of a mixture based on their different rates of movement through a stationary medium.

The components move at different speeds and get separated.
Uses: It is used in forensic science to detect and identify trace chemicals, in food industry to detect food adulteration, in pharmaceutical industry to separate and purify drugs.

(b) **Distillation method:** Pure water can be obtained from seawater by the process of distillation. Seawater is heated in a distillation flask. Water evaporates leaving behind salt and other impurities. The water vapors are then condensed in a condenser by cooling to obtain pure distilled water. The salt remains in the flask as residue.

(c) **Centrifugation** is the technique used to separate butter from curd. High-speed rotation separates the lighter butter particles from heavier curd.

Marking Scheme: 1 mark for each part (3 marks total)

Q29. Answer:

(a) Atomic mass of sodium (Na) = 23 u = 23 g/mol
Number of moles = Given mass / Atomic mass
= 46 / 23
= **2 moles**

(b) Molecular mass of O_2 = 2 × 16 = 32 u = 32 g/mol
Number of moles = 8 / 32
= **0.25 moles**

(c) Number of moles = Number of molecules / Avogadro's number
= $(9.033 \times 10^{23}) / (6.022 \times 10^{23})$
= **1.5 moles**

Marking Scheme: 1 mark for each calculation (3 marks total)

Q30. Answer (OR):

(a) **Mole:** A mole is the amount of substance that contains as many elementary particles (atoms, molecules, or ions) as there are atoms in exactly 12 g of carbon-12 isotope.
Avogadro's constant: The number of particles in one mole of any substance is constant and equal to 6.022×10^{23} per mole. This is called Avogadro's constant or Avogadro's number.

(b) Molecular mass of $Al_2O_3 = 2 \times 27 + 3 \times 16 = 54 + 48 = 102$ g/mol
Number of moles = 0.051 / 102 = 0.0005 moles
Number of molecules = $0.0005 \times 6.022 \times 10^{23} = 3.011 \times 10^{20}$ molecules
Each Al_2O_3 molecule contains 2 aluminium ions (Al^{3+})
Number of Al^{3+} ions = $2 \times 3.011 \times 10^{20}$
= **6.022×10^{20} aluminium ions**

> **Marking Scheme:** 1 mark for definitions + 2 marks for calculation

Q31. Answer:

(a) **Canal rays:** Canal rays are positively charged radiations consisting of positive ions produced in a discharge tube when high voltage is applied across the electrodes in the presence of gas at low pressure. They were discovered by **Goldstein** in 1886.

(b) **Three properties of canal rays:**
1. They are streams of positively charged particles (positive ions)
2. They travel in straight lines away from the anode
3. Their mass depends on the nature of gas present in the discharge tube
4. They can produce fluorescence in certain materials
(Any three properties)

(c) **Differences between canal rays and cathode rays:**
- Canal rays are positively charged while cathode rays are negatively charged
- Canal rays have mass equal to atoms/ions while cathode rays have very small mass (electrons)
- Canal rays depend on the gas in the tube while cathode rays are same for all gases

Marking Scheme: 1 mark for definition and discoverer + 1 mark for three properties + 1 mark for differences

Q32. Answer (OR):

(a) Given: Number of protons = 17, Number of neutrons = 18

(i) **Atomic number** = Number of protons = **17**

(ii) **Mass number** = Number of protons + Number of neutrons
= 17 + 18 = **35**

(iii) In a neutral atom, number of electrons = number of protons
Number of electrons = 17

(b) Electronic configuration:
K shell = 2 electrons
L shell = 8 electrons
M shell = 7 electrons
Electronic configuration = 2, 8, 7
This is the configuration of Chlorine (Cl).

Marking Scheme: ½ mark each for (i), (ii), (iii) + 1½ marks for electronic configuration

Q33. Answer:

(a) **Plasmolysis:** The shrinking of the cytoplasm away from the cell wall when a plant cell is placed in a hypertonic solution is called plasmolysis. Water moves out of the cell by osmosis, causing the cell to shrink.

(b) **Differences:**
Hypertonic solution: A solution having higher concentration of solutes (lower concentration of water) than the cell sap. Water moves out of the cell when placed in this solution.

Hypotonic solution: A solution having lower concentration of solutes (higher concentration of water) than the cell sap. Water enters the cell when placed in this solution.

(c) When a plant cell is placed in a hypotonic solution, water enters the cell by osmosis (endosmosis). The cell swells and becomes turgid. The cell membrane pushes against the cell wall, creating turgor pressure. The rigid cell wall prevents the cell from bursting.

> **Marking Scheme:** 1 mark for each part (3 marks total)

Q34. Answer:

Based on the distance-time graph:

(a) **Object A** is moving with maximum speed because it has the steepest slope. The steeper the slope of a distance-time graph, the greater the speed.

(b) **Yes**, all three objects are moving with uniform speed because their distance-time graphs are straight lines. A straight line on a distance-time graph indicates uniform (constant) speed.

(c) **Object C** is stationary (not moving) because its graph is a horizontal line parallel to the time axis. This means the distance is not changing with time, indicating zero speed.

> **Marking Scheme:** 1 mark for each answer (3 marks total)

Q35. Answer (OR):

Given: Initial velocity, u = 40 m/s (upward)
Final velocity at maximum height, v = 0
Acceleration, a = -g = -10 m/s² (negative because motion is against gravity)

(a) **Maximum height reached:**
Using: $v^2 = u^2 + 2as$

$0^2 = (40)^2 + 2(-10)s$

$0 = 1600 - 20s$

$20s = 1600$

$s = 1600/20$

s = 80 m

(b) **Time to reach maximum height:**

Using: $v = u + at$

$0 = 40 + (-10)t$

$10t = 40$

$t = 40/10$

t = 4 seconds

(c) **Time of flight:**

Total time of flight = 2 × time to reach maximum height

= 2 × 4

= 8 seconds

> **Marking Scheme:** 1 mark for each calculation (3 marks total)

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

Q36. Answer:

(a) **Law of Conservation of Momentum:** In an isolated system (where no external force acts), the total momentum before collision is equal to the total momentum after collision. In other words, the total momentum of the system remains constant.

(b) **Mathematical Derivation:**

Consider two objects A and B with masses m_1 and m_2

Initial velocities: u_1 and u_2

Final velocities after collision: v_1 and v_2

Time of contact during collision = t

Force on A by B = F_{12} (action)
Force on B by A = F_{21} (reaction)

By Newton's third law: $F_{12} = -F_{21}$

Using F = ma:
$m_1a_1 = -m_2a_2$
$m_1(v_1 - u_1)/t = -m_2(v_2 - u_2)/t$
$m_1v_1 - m_1u_1 = -m_2v_2 + m_2u_2$
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Total initial momentum = Total final momentum

(c) Given:
$m_1 = 100$ g = 0.1 kg, $u_1 = 2$ m/s, $v_1 = 1.67$ m/s
$m_2 = 200$ g = 0.2 kg, $u_2 = 1$ m/s, $v_2 = ?$

Using conservation of momentum:
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$0.1(2) + 0.2(1) = 0.1(1.67) + 0.2(v_2)$
$0.2 + 0.2 = 0.167 + 0.2v_2$
$0.4 = 0.167 + 0.2v_2$
$0.2v_2 = 0.233$
$v_2 = 0.233/0.2$
$v_2 = 1.165$ m/s ≈ 1.17 m/s

> **Marking Scheme:** 1 mark for law + 2 marks for derivation + 2 marks for calculation

Q36. Answer (OR):

(a) **Derivation of F = ma from Newton's second law:**
Newton's second law states that the rate of change of momentum is directly proportional to the applied force and takes place in the direction of the force.

Force ∝ Rate of change of momentum

$F \propto$ (Final momentum - Initial momentum) / Time
$F \propto (mv - mu) / t$
$F \propto m(v - u) / t$
$F \propto ma$ [where $a = (v - u)/t$]
$F = kma$ (k is a proportionality constant)

In SI units, the value of $k = 1$
Therefore, F = ma

(b) It is difficult to walk on a slippery road because there is very little friction between our feet and the slippery surface. When we walk, we push the ground backward with our feet. According to Newton's third law, the ground pushes us forward with an equal force (friction). On a slippery surface, the friction is very low, so the forward push is insufficient, making it difficult to walk or maintain balance.

(c) Given: F = 10 N, m = 2 kg, t = 5 s, u = 0 (initially at rest)

(i) Acceleration: $a = F/m = 10/2 = 5$ m/s²
Velocity acquired: $v = u + at = 0 + 5(5) =$ **25 m/s**

(ii) Change in momentum = Final momentum - Initial momentum
$= mv - mu$
$= m(v - u)$
$= 2(25 - 0)$
= **50 kg m/s**

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

Q37. Answer:

(a) **Potential Energy (PE):** The energy possessed by a body by virtue of its position or configuration is called potential energy.
Formula: PE = mgh
where m = mass, g = acceleration due to gravity, h = height

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

kinetic energy.

Formula: KE = ½mv²

where m = mass, v = velocity

(b) **Proof that total mechanical energy remains constant:**

Consider a body of mass m falling freely from height h.

At point A (height h):

PE = mgh, KE = 0 (v = 0)

Total energy E = mgh + 0 = mgh

At point B (height x from ground):

Distance fallen = h - x

Using $v^2 = u^2 + 2as$: $v^2 = 0 + 2g(h - x) = 2g(h - x)$

KE = ½mv² = ½m × 2g(h - x) = mg(h - x)

PE = mgx

Total energy E = mg(h - x) + mgx = mgh

At point C (ground, x = 0):

PE = 0

Using $v^2 = 2gh$: $v^2 = 2gh$

KE = ½mv² = ½m × 2gh = mgh

Total energy E = 0 + mgh = mgh

Thus, at all points, total mechanical energy = mgh (constant)

(c) Given: m = 50 g = 0.05 kg, h = 10 cm = 0.1 m, g = 10 m/s²

PE at top = mgh = 0.05 × 10 × 0.1 = 0.05 J

By conservation of energy:

KE at mean position = PE at top = 0.05 J

> **Marking Scheme:** 1 mark for definitions with formulas + 2 marks for proof + 2 marks for calculation

Q37. Answer (OR):

(a) **Differences between PE and KE:**

Potential Energy: Energy due to position/configuration, stored energy, depends on height and position

Kinetic Energy: Energy due to motion, energy of moving objects, depends on velocity and mass

(b) **Derivation of KE formula:**

Consider a body of mass m initially at rest (u = 0)

Force F acts on it and it acquires velocity v after displacement s

Work done by force = F × s

Using F = ma and $v^2 = u^2 + 2as$ with u = 0:

$v^2 = 2as$

$s = v^2/2a$

Work done = F × s = ma × $v^2/2a$ = $\frac{1}{2}mv^2$

This work is stored as kinetic energy

Therefore, KE = $\frac{1}{2}mv^2$

(c) Power = 500 W = 0.5 kW

Time = 10 hours

Energy consumed = Power × Time

= 0.5 kW × 10 h

= **5 kWh**

> **Marking Scheme:** 1 mark for difference + 2 marks for derivation + 2 marks for calculation

Q38. Answer:

(a) **Labeled diagram of plant cell:**

[Students should draw a diagram showing: Cell wall, Cell membrane, Cytoplasm, Nucleus (with nucleolus and nuclear membrane), Chloroplast, Large central vacuole, Mitochondria, Endoplasmic Reticulum, Golgi apparatus, Ribosomes]

(b) **Three features that differentiate plant cell from animal cell:**

1. **Cell wall:** Plant cells have a rigid cell wall made of cellulose outside the cell

membrane; animal cells do not have a cell wall

2. **Chloroplasts:** Plant cells contain chloroplasts for photosynthesis; animal cells do not have chloroplasts

3. **Vacuoles:** Plant cells have a large central vacuole that occupies up to 90% of cell volume; animal cells have small and numerous vacuoles

(c) Cell organelles:

(i) **Nucleus** controls all cell activities and contains genetic material (DNA)

(ii) **Golgi apparatus** helps in packaging and dispatching of materials

> **Marking Scheme:** 2 marks for diagram + 1½ marks for three differences + 1½ marks for naming organelles

Q38. Answer (OR):

(a) **Tissue:** A group of cells that are similar in structure and function and work together to perform a specific function is called a tissue.

Four main types of animal tissues:

1. **Epithelial tissue** - Protective covering and lining
2. **Connective tissue** - Connects and supports different tissues
3. **Muscular tissue** - Movement and locomotion
4. **Nervous tissue** - Control and coordination

(b) **Differences:**

Simple Permanent Tissue:

- Made of only one type of cells
- All cells are similar in structure and function
- Examples: Parenchyma, Collenchyma, Sclerenchyma

Complex Permanent Tissue:

- Made of more than one type of cells
- Different types of cells work together as a unit
- Examples: Xylem, Phloem

(c) Tissues:

(i) **Nervous tissue** is present in brain and spinal cord

(ii) **Squamous epithelium** forms the lining of blood vessels

> **Marking Scheme:** 1 mark for definition of tissue + 1 mark for four types + 2 marks for differentiation + 1 mark for naming tissues

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

CASE STUDY 1 - ANSWERS:

(i) The process of conversion of solid directly into gas is called **Sublimation**.

> Marks: 1

(ii) Temperature remains constant during the melting of ice because the heat energy supplied is used to overcome the strong intermolecular forces of attraction between ice particles to change the state from solid to liquid. This energy is used for breaking bonds and not for increasing the kinetic energy of particles. Hence, temperature does not rise during melting.

> Marks: 1

OR: Two substances that undergo sublimation are:
1. **Camphor**
2. **Naphthalene**
(Other acceptable answers: Ammonium chloride, Iodine, Dry ice/solid CO_2)

> Marks: 1

(iii) Given:
Mass of ice, m = 2 kg
Latent heat of fusion, L = 3.34×10^5 J/kg

Heat energy required = m × L

= 2 × 3.34 × 10^5

= 6.68 × 10^5 J

= **668,000 J or 6.68 × 10^5 J**

> Marks: 2 (1 mark for formula + 1 mark for calculation)

CASE STUDY 2 - ANSWERS:

(i) J.J. Thomson discovered electrons in **1897**.

> Marks: 1

(ii) The charge on an electron is **-1.6 × 10^{-19} coulombs** or **-1** (unit negative charge).

> Marks: 1

OR: James Chadwick discovered neutrons in 1932.

> Marks: 1

(iii) Given:

Number of protons = 11

Number of neutrons = 12

(a) In a neutral atom, number of electrons = number of protons

Number of electrons = 11

(b) Mass number = Number of protons + Number of neutrons

= 11 + 12

= **23**

(This is the sodium atom, Na-23)

> Marks: 2 (1 mark for each calculation)

CASE STUDY 3 - ANSWERS:

(i) The equation of motion that relates velocity, acceleration, and time is:

$v = u + at$

where v = final velocity, u = initial velocity, a = acceleration, t = time

> Marks: 1

(ii) Given:

Initial velocity, u = 0 (ball is released from rest)

Acceleration, a = g = 10 m/s^2

Time, t = 4 seconds

Using: $v = u + at$

$v = 0 + 10 \times 4$

$v =$ **40 m/s**

> Marks: 1

OR: The equations of motion are applicable only when the **acceleration is uniform (constant)** throughout the motion. They cannot be applied when acceleration is variable or non-uniform.

> Marks: 1

(iii) Given: u = 0, g = 10 m/s^2, t = 4 s

Using the equation: $s = ut + \frac{1}{2}at^2$

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

$s = 0 + 5 \times 16$

$s = 80$ m

Height of building = 80 m

> Marks: 2 (1 mark for correct formula + 1 mark for correct calculation)

📚 END OF COMPLETE ANSWER KEY 📚

Total Marks: 80

All sections answered with detailed step-by-step solutions

Comprehensive coverage of CBSE Class 9 Science Syllabus 2025-26

Practice regularly for excellent exam preparation!

Study Tips for Success:

✓ Solve all numerical problems with proper units and steps

✓ Draw neat, labeled diagrams with pencil

✓ Learn all definitions, laws, and formulas accurately

✓ Practice derivations multiple times until perfect

✓ Revise NCERT textbook thoroughly - all topics

✓ Time management is crucial - practice with timer

✓ Attempt easier questions first in the exam

✓ Write neatly and underline important points

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