TALLENTEX Chemistry

Sample Paper – 6

Duration: 23 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of **TALLENTEX** entrance.
- Each correct answer carries **+4 marks**. There is **a penalty of** -1 **mark** for incorrect answers. Unattempted questions carry no penalty.
- Only **one** option is correct. Choose carefully.
- Syllabus: **NCERT Class 8 and Class 9 Chemistry**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. A pressure cooker cooks food faster than an open vessel because the increased pressure inside the cooker

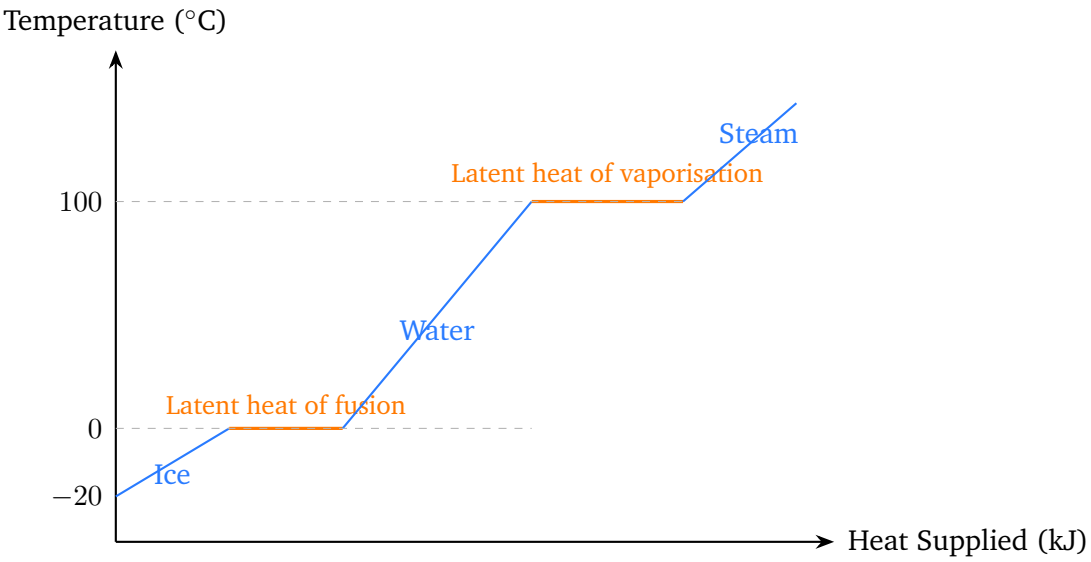
(A) decreases the boiling point of water

(B) increases the latent heat of vaporisation

(C) raises the boiling point of water above $100\,^\circ\text{C}$

(D) decomposes food particles more rapidly without heat

Q2. The graph below shows the temperature of a sample of water as heat is supplied at a constant rate starting from ice at $-20\,^\circ\text{C}$. Which of the following statements about the graph is **correct**?



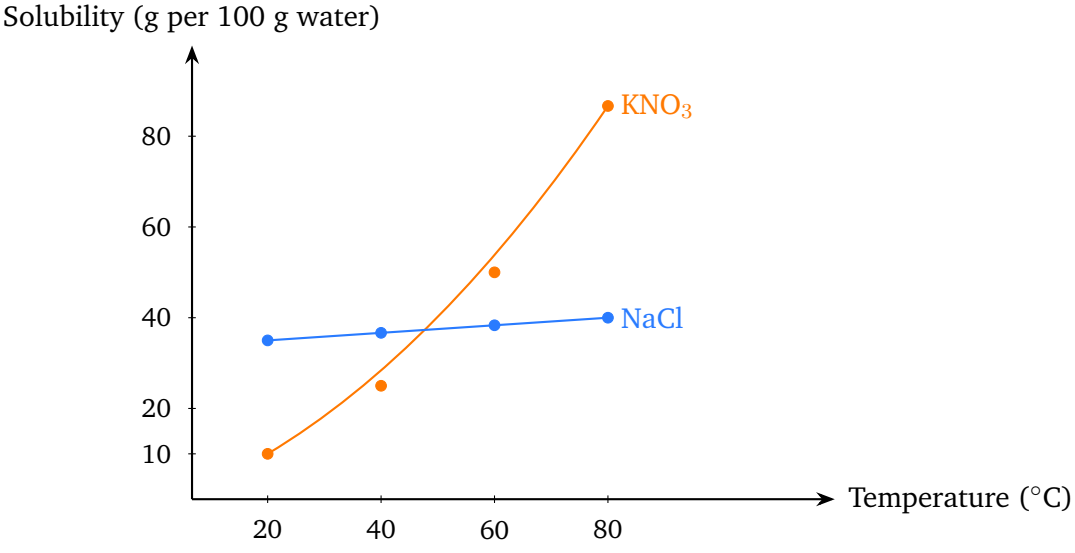
(A) The temperature rises continuously without any flat portions throughout the heating process.

(B) The flat region at $0\,^{\circ}\text{C}$ represents the latent heat of vaporisation of ice.

(C) The slope of the rising section for steam is less steep than that for ice, indicating steam has a lower specific heat.

(D) The two flat (horizontal) regions represent phase changes where temperature remains constant despite continued heat supply.

Q3. The graph below shows the solubility of two salts with increasing temperature. Which statement is **correct** based on the graph?



(A) The solubility of KNO_3 increases much more steeply with temperature compared to NaCl.

(B) Both KNO_3 and NaCl show equal increase in solubility with temperature.

(C) The solubility of NaCl decreases as temperature increases.

(D) At all temperatures, NaCl is more soluble than KNO_3.

Q4. A student places a spot of black ink near the bottom of a strip of filter paper and dips the strip (below the ink spot) into water. After some time, the ink separates into several coloured bands. The technique used and the property exploited are, respectively:

(A) Distillation; difference in boiling points

(B) Paper chromatography; different rates of movement (adsorption) of components

(C) Sublimation; difference in volatility

(D) Filtration; difference in particle size

Q5. Carbon forms two oxides: carbon monoxide (CO) and carbon dioxide (CO_2). The masses of oxygen that combine with a fixed mass of carbon (12 g) in CO and CO_2 are 16 g and 32 g respectively. This illustrates:

(A) Law of Conservation of Mass

(B) Law of Definite Proportions

(C) Avogadro's Law

(D) Law of Multiple Proportions

Q6. Calculate the formula unit mass of magnesium chloride ($MgCl_2$). [Atomic masses: Mg = 24 u, Cl = 35.5 u]

(A) 59.5 u

(B) 71.0 u

(C) 95.0 u

(D) 119.0 u

Q7. Iron(II) sulphate is a compound used as a source of iron in supplements. The correct chemical formula of iron(II) sulphate is:

(A) $FeSO_4$

(B) $Fe_2(SO_4)_3$

(C) Fe_2SO_4

(D) $Fe(SO_4)_2$

Q8. The experiment that provided evidence for the existence of positively charged particles in atoms, ultimately leading to the identification of the **proton**, involved:

(A) Cathode ray tube experiment — rays deflected towards positive plate

(B) Canal ray (anode ray) experiment — positively charged rays passing through holes in cathode

(C) Gold foil experiment — most alpha particles passing straight through

(D) Millikan's oil drop experiment — measuring charge on electron

Q9. According to the Bohr–Bury scheme, the maximum number of electrons that can be accommodated in the **second shell** (L shell) of an atom is:

(A) 2

(B) 4

(C) 6

(D) 8

Q10. In Rutherford's alpha particle scattering experiment, a thin gold foil was bombarded with alpha particles. What happened to the **majority** of the alpha particles?

(A) They passed straight through the gold foil without deflection.

(B) They were deflected at large angles (greater than $90°$).

(C) They bounced straight back towards the source.

(D) They were absorbed by the gold atoms and stopped.

Q11. Rusting of iron is an example of a chemical change. Which combination of conditions is **necessary** for iron to rust?

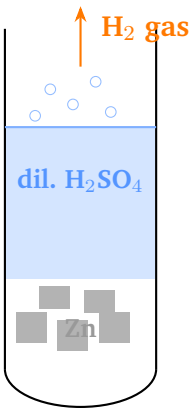
(A) Presence of oxygen alone (no water needed)

(B) Presence of water alone (no oxygen needed)

(C) Presence of both water (moisture) and oxygen

(D) Presence of carbon dioxide and nitrogen only

Q12. The diagram below shows the reaction of zinc pieces with dilute sulphuric acid. Which gas is produced, and what is its correct chemical formula?



(A) Hydrogen gas, H_2 — colourless, odourless, burns with a pop sound

(B) Oxygen gas, O_2 — colourless, supports combustion

(C) Sulphur dioxide, SO_2 — pungent, colourless gas

(D) Hydrogen sulphide, H_2S — colourless gas with rotten egg smell

Q13. When fuels burn in a **limited supply of air (oxygen)**, incomplete combustion occurs. Which of the following is the main poisonous gas produced during incomplete combustion of fuels like LPG or coal?

(A) Carbon dioxide (CO_2)

(B) Carbon monoxide (CO)

(C) Sulphur dioxide (SO_2)

(D) Nitrogen dioxide (NO_2)

Q14. During the electrolysis of dilute sulphuric acid (which effectively electrolyses water), electrodes are connected to a battery. Which gas is collected at the **cathode** (negative electrode), and in what volume ratio does it compare to the gas collected at the anode?

(A) Oxygen is collected at the cathode; ratio of O_2:H_2 = 2:1

(B) Hydrogen is collected at the cathode; equal volumes of both gases are produced

(C) Sulphur dioxide is collected at the cathode; ratio depends on concentration

(D) Hydrogen is collected at the cathode; volume ratio H_2:O_2 = 2:1

Q15. Polyethylene terephthalate (PET) is a type of synthetic polymer widely used to make bottles for cold drinks and water. PET belongs to which category of synthetic material, and which property makes it suitable for making transparent bottles?

(A) Nylon; high tensile strength and ability to be drawn into thin fibres

(B) Bakelite; thermosetting nature that makes it hard and rigid

(C) Polyester (a thermoplastic); can be moulded into transparent shapes and is light, strong, and resistant to moisture

(D) Rayon; semi-synthetic nature that allows it to absorb dyes easily

Detailed Solutions

Q1.

Solution

Concept: The boiling point of a liquid depends on the pressure above its surface. Increasing pressure raises the boiling point; decreasing pressure lowers it.

Step 1 — Boiling and pressure: A liquid boils when its vapour pressure equals the surrounding (atmospheric) pressure. If external pressure is increased, the liquid must be heated to a higher temperature before its vapour pressure can match the external pressure.

Step 2 — Pressure cooker mechanism: A pressure cooker is a sealed vessel. As steam builds up inside, the pressure rises significantly above atmospheric. This raises the boiling point of water well above $100\,^\circ$C (commonly to about $120\,^\circ$C), enabling food to cook at a higher temperature and therefore much faster.

Why other options are wrong:

- (A): Increased pressure *raises*, not decreases, the boiling point.
- (B): Latent heat of vaporisation is a property of water and does not significantly change with pressure in this context; it is not the reason food cooks faster.
- (D): Pressure does not decompose food without heat; the higher temperature achieved under pressure is responsible.

Answer: (C) Go Back to Q 1

Q2.

Solution

Concept: When a substance undergoes a phase change (melting or boiling), it absorbs latent heat without any rise in temperature. The temperature vs. heat-supplied graph therefore shows flat (horizontal) regions at the phase-change temperatures.

Step 1 — Identify the flat regions: The graph shows two flat segments: one at $0\,^\circ$C (melting of ice) and one at $100\,^\circ$C (boiling of water). During these flat regions, all the supplied heat is used to overcome intermolecular forces and change the state of matter, not to raise the temperature.

Step 2 — Evaluate each option: Option (D) correctly states that the two horizontal regions represent phase changes where temperature stays constant despite

heat being supplied. This matches the concept of latent heat perfectly.

Why other options are wrong:

- (A): The graph clearly shows flat portions (phase changes), not a continuous rise.
- (B): The flat region at $0\,^\circ$C represents the latent heat of *fusion* (melting), not vaporisation.
- (C): Steam has a *higher* specific heat capacity than ice, so its slope is less steep, but the statement about steam having "lower specific heat" is contradicted by data — the slopes of rising sections depend on specific heat, and steam's section is less steep (higher specific heat), not lower. This makes (C) self-contradictory as stated.

Answer: (D) Go Back to Q 2

Q3.

Solution

Concept: Solubility of most solid solutes in water increases with temperature. However, the rate of increase differs. KNO_3 shows a steep rise while NaCl shows almost no change with temperature.

Step 1 — Reading the graph: The KNO_3 curve rises steeply (from about 13 g at $20\,^\circ$C to over 160 g at $80\,^\circ$C per 100 g water). The NaCl curve is nearly flat (from about 36 g at $20\,^\circ$C to about 38 g at $80\,^\circ$C).

Step 2 — Correct statement: Option (A) correctly identifies that the solubility of KNO_3 increases much more steeply with temperature compared to NaCl, which is directly evident from the graph.

Why other options are wrong:

- (B): The two salts do *not* show equal increase; KNO_3 rises far more steeply.
- (C): NaCl's solubility does *not* decrease; it remains nearly constant (slightly increases).
- (D): At low temperatures (near $20\,^\circ$C), NaCl is more soluble than KNO_3, but at higher temperatures KNO_3 becomes more soluble. So the statement "at *all* temperatures NaCl is more soluble" is false.

Answer: (A) Go Back to Q 3

Q4.

Solution

Concept: Paper chromatography is a separation technique used to separate mixtures of dissolved substances (like dyes) based on differences in their rates of movement through a stationary phase (filter paper) as a mobile phase (solvent/water) moves through it.

Step 1 — Identify the technique: The description — spot of ink on filter paper, dipped in water, components separating into coloured bands — perfectly describes **paper chromatography**.

Step 2 — Principle: Different components of the ink mixture have different degrees of attraction (adsorption) to the paper and different solubility in water. The more soluble and less adsorbed component moves faster, leading to separation of bands.

Why other options are wrong:

- (A): Distillation separates based on boiling points; it uses heat and vapour condensation, not paper.
- (C): Sublimation exploits a solid directly converting to gas; it does not produce coloured bands on paper.
- (D): Filtration separates insoluble solids from liquids based on particle size; ink dyes are all dissolved.

Answer: (B) Go Back to Q 4

Q5.

Solution

Concept: The Law of Multiple Proportions states that when two elements combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element are in a simple whole-number ratio.

Step 1 — Apply to CO and CO_2: Fixed mass of carbon = 12 g.

- In CO: 12 g C combines with 16 g O.
- In CO_2: 12 g C combines with 32 g O.

Ratio of masses of oxygen $= 16 : 32 = 1 : 2$, a simple whole-number ratio. This is a textbook illustration of the Law of Multiple Proportions.

Step 2 — Identify the law: This is the Law of Multiple Proportions (Dalton, 1803).

Why other options are wrong:

- (A): Law of Conservation of Mass deals with total mass being unchanged in a reaction, not ratios of combining masses.
- (B): Law of Definite Proportions (Proust) states that a given compound always has the same ratio of elements; it applies to one compound, not the comparison between two.
- (C): Avogadro's Law relates equal volumes of gases at the same temperature and pressure containing equal numbers of molecules.

Answer: (D) Go Back to Q 5

Q6.

Solution

Concept: The formula unit mass of an ionic compound is the sum of the atomic masses of all atoms in one formula unit.

Step 1 — Count atoms in $MgCl_2$:

- 1 Mg atom: $1 \times 24 = 24$ u
- 2 Cl atoms: $2 \times 35.5 = 71$ u

Step 2 — Sum:

$$\text{Formula unit mass of } MgCl_2 = 24 + 71 = \mathbf{95.0} \text{ u}$$

Why other options are wrong:

- (A): 59.5 u would be $24 + 35.5$ (only one Cl atom counted — error in formula).
- (B): 71 u is just 2×35.5 (only chlorine counted, Mg ignored).
- (D): 119 u would result from $24 + 2 \times 47.5$, an incorrect atomic mass for Cl.

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept: Chemical formulae are derived by balancing the valencies of the constituent ions. Iron(II) means Fe has valency 2 (Fe^{2+}). Sulphate ion is SO_4^{2-} (valency 2).

Step 1 — Balance valencies:

$$Fe^{2+} + SO_4^{2-} \longrightarrow FeSO_4$$

Since both ions have equal valency (2), one of each is needed. Formula = $FeSO_4$.

Step 2 — Confirm: Iron(II) sulphate = $FeSO_4$. This is also known as ferrous sulphate and is commonly used in iron-deficiency anaemia treatment.

Why other options are wrong:

- (B): $Fe_2(SO_4)_3$ is iron(III) sulphate (ferric sulphate), where Fe has valency 3.
- (C): Fe_2SO_4 is incorrect — it would imply each Fe has valency 1, which is not iron(II).
- (D): $Fe(SO_4)_2$ would imply Fe has valency 4, which is not iron(II).

Answer: (A) Go Back to Q 7

Q8.

Solution

Concept: The proton was discovered through experiments with canal rays (also called anode rays or positive rays), which were observed in discharge tubes with perforated cathodes.

Step 1 — Canal ray experiment: When high voltage is applied to a gas in a discharge tube with a perforated cathode, streams of positively charged particles pass through the holes in the cathode moving in the direction opposite to cathode rays. These were called canal rays.

Step 2 — Discovery of proton: The lightest canal ray particle, obtained when hydrogen gas was used, was identified as the proton. E. Goldstein is credited with discovering canal rays; the proton itself was named by Rutherford.

Why other options are wrong:

- (A): The cathode ray experiment led to the discovery of the *electron* (J.J. Thomson). Cathode rays are negatively charged.

- (C): Rutherford's gold foil (alpha particle scattering) experiment led to the discovery of the *nucleus*, not the proton.
- (D): Millikan's oil drop experiment measured the charge (and hence mass) of the *electron*, not positive particles.

Answer: (B) Go Back to Q 8

Q9.

Solution

Concept: According to the Bohr–Bury scheme, the maximum number of electrons that can be accommodated in the n-th shell is given by $2n^2$.

Step 1 — Identify shell number: The second shell is the L shell, so $n = 2$.

Step 2 — Apply formula:

$$\text{Maximum electrons in L shell} = 2n^2 = 2 \times (2)^2 = 2 \times 4 = \mathbf{8}$$

Verification: The K shell ($n = 1$) holds $2 \times 1 = 2$ electrons. The L shell ($n = 2$) holds 8 electrons. This is consistent with the electronic configurations of elements like Neon $(2, 8)$ and Sodium $(2, 8, 1)$.

Why other options are wrong:

- (A): 2 is the maximum for the K shell ($n = 1$), not L shell.
- (B): 4 has no basis in the $2n^2$ formula for the L shell.
- (C): 6 is not a result of $2n^2$ for any principal quantum number in the Bohr–Bury scheme.

Answer: (D) Go Back to Q 9

Q10.

Solution

Concept: Rutherford's alpha particle scattering experiment (1909–1911) bombarded a thin gold foil with fast-moving alpha particles (positively charged helium nuclei) and observed their deflection on a fluorescent screen.

Step 1 — Key observations:

- **Most** ($> 99\%$) alpha particles passed straight through the foil without de-

flection.

- A small number were deflected at various angles.
- Very few (about 1 in 20,000) bounced back.

Step 2 — Conclusion: The fact that most particles passed through undeflected showed that atoms are mostly empty space. The dense, positive nucleus occupies only a tiny central region.

Why other options are wrong:

- (B): Only a *small* fraction was deflected at large angles; not the majority.
- (C): Very few (1 in ∼20,000) bounced back; this was the crucial observation pointing to the nucleus but it was not what most particles did.
- (D): Alpha particles were not absorbed; most passed straight through.

Answer: (A) Go Back to Q 10

Q11.

Solution

Concept: Rusting of iron is a chemical change (corrosion) where iron reacts with oxygen in the presence of moisture (water) to form hydrated iron(III) oxide (rust), $Fe_2O_3 \cdot xH_2O$.

Step 1 — Chemical reaction for rusting:

$$4\,Fe + 3\,O_2 + x\,H_2O \longrightarrow 2\,Fe_2O_3 \cdot x\,H_2O$$

Both oxygen *and* water are required. This has been confirmed experimentally: iron kept in dry air (oxygen, no moisture) does not rust, and iron kept in boiled (oxygen-free) water also does not rust.

Step 2 — Necessary conditions: Both moisture (water) AND oxygen must be present simultaneously for rusting to occur.

Why other options are wrong:

- (A): Oxygen alone (completely dry conditions) does not cause rusting. Experimental evidence: iron in a test tube of dry air does not rust.
- (B): Water alone (with no dissolved oxygen) does not cause rusting. Experimental evidence: iron in boiled, oil-sealed water does not rust.
- (D): Carbon dioxide and nitrogen are not the primary agents of rusting; CO_2

can slightly accelerate it, but these two alone do not cause rusting.

Answer: (C) Go Back to Q 11

Q12.

Solution

Concept: Zinc is an active metal that reacts with dilute acids (like dilute sulphuric acid) to produce a salt and hydrogen gas. This is a displacement reaction.

Step 1 — Chemical equation:

$$Zn_{(s)} + H_2SO_{4\,(aq)} \longrightarrow ZnSO_{4\,(aq)} + H_{2\,(g)} \uparrow$$

Step 2 — Properties of H_2: Hydrogen gas is colourless, odourless, lighter than air, and burns with a distinctive pop or squeaky pop sound when a burning splint is brought near a test tube of H_2. This pop test is the standard laboratory test for hydrogen.

Step 3 — Confirm from diagram: The diagram shows zinc pieces at the bottom, dilute H_2SO_4 above, and bubbles of gas rising upward — confirming H_2 gas production.

Why other options are wrong:

- (B): O_2 is produced by decomposition of hydrogen peroxide or electrolysis of water, not by Zn + H_2SO_4.
- (C): SO_2 is produced when metals react with hot concentrated H_2SO_4, not dilute H_2SO_4.
- (D): H_2S is produced when metals react with dilute HCl after sulphide ores, not with dilute H_2SO_4.

Answer: (A) Go Back to Q 12

Q13.

Solution

Concept: Combustion requires adequate oxygen. When fuel burns in limited oxygen (insufficient air supply), **incomplete combustion** occurs, producing carbon monoxide (CO) instead of carbon dioxide (CO_2).

Step 1 — Complete vs. incomplete combustion:

- Complete combustion (excess O_2): $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (clean blue flame)
- Incomplete combustion (limited O_2): $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$ (yellow/sooty flame)

Step 2 — Danger of CO: Carbon monoxide is a colourless, odourless, and highly poisonous gas. It binds to haemoglobin in blood about 200 times more strongly than oxygen, preventing oxygen transport and causing carbon monoxide poisoning (potentially fatal). This is why rooms with burning coal stoves must be well-ventilated.

Why other options are wrong:

- (A): CO_2 is the product of *complete* combustion; it is not poisonous at normal concentrations (though it is a greenhouse gas).
- (C): SO_2 is produced when sulphur-containing fuels (like coal with high sulphur content) burn; it is not the "main" product of incomplete combustion of LPG.
- (D): NO_2 is formed at very high temperatures (such as in engines), not during typical incomplete combustion of LPG or coal.

Answer: (B) Go Back to Q 13

Q14.

Solution

Concept: Electrolysis of water (using dilute H_2SO_4 as electrolyte) decomposes water into hydrogen and oxygen gases at the electrodes. The cathode is the negative electrode; the anode is the positive electrode.

Step 1 — Half-reactions:

- At cathode (reduction): $2H^+ + 2e^- \rightarrow H_2 \uparrow$
- At anode (oxidation): $2H_2O \rightarrow O_2 \uparrow + 4H^+ + 4e^-$

Step 2 — Overall reaction:

$$2H_2O \xrightarrow{\text{electrolysis}} 2H_2 + O_2$$

Volume ratio: $H_2 : O_2 = 2 : 1$. Hydrogen is collected at the cathode and oxygen at the anode.

Step 3 — Identify correct option: Option (D) correctly states that hydrogen is collected at the cathode and the volume ratio H_2:O_2 = 2:1.

Why other options are wrong:

- (A): Oxygen is produced at the *anode*, not the cathode. The ratio stated is also inverted.
- (B): The gases are *not* produced in equal volumes; hydrogen is produced at twice the volume of oxygen.
- (C): Sulphur dioxide is not produced in the electrolysis of dilute H_2SO_4.

Answer: (D) Go Back to Q 14

Q15.

Solution

Concept: Polyethylene terephthalate (PET) is a thermoplastic polyester. Thermoplastics can be repeatedly softened on heating and hardened on cooling, making them suitable for moulding into various shapes.

Step 1 — Classification of PET: PET is a **polyester** (a condensation polymer of ethylene glycol and terephthalic acid). It is a **thermoplastic**, meaning it can be moulded and remoulded. This distinguishes it from thermosetting plastics like Bakelite, which cannot be resoftened.

Step 2 — Properties making PET suitable for bottles:

- Transparent and clear (allows content visibility)
- Lightweight yet strong
- Resistant to moisture and chemicals
- Can be moulded into desired shapes under heat and pressure
- Food-safe for cold beverages

Step 3 — Confirm option (C): Option (C) correctly identifies PET as a polyester (thermoplastic) and cites transparency, light weight, strength, and moisture resistance as the key properties.

Why other options are wrong:

- (A): Nylon is a polyamide; it is used for fibres, ropes, and fabrics — not primarily for transparent bottles.

- (B): Bakelite is a *thermosetting* plastic that is hard and brittle; it cannot be moulded into transparent flexible bottles.
- (D): Rayon is a semi-synthetic fibre made from cellulose; it is a textile material, not used for making bottles.

Answer: (C) **Go Back to Q 15**

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	D	3	A	4	B	5	D
6	C	7	A	8	B	9	D	10	A
11	C	12	A	13	B	14	D	15	C