TALLENTEX Chemistry

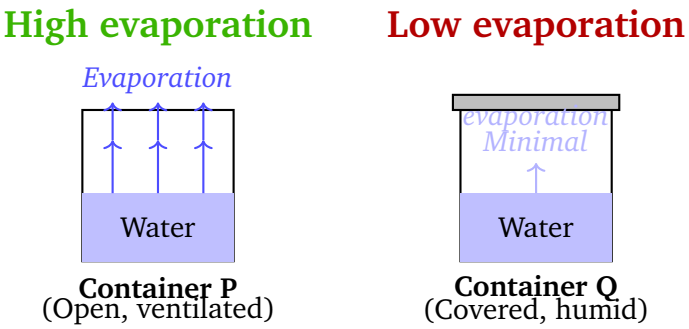
Sample Paper – 4

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. Riya places equal amounts of water in two identical containers under the same temperature. Container P is left open in a well-ventilated room, while Container Q is tightly covered and kept in a humid bathroom. After two hours, which observation is most likely, and which factor is responsible for the difference?



(A) Container P will show less evaporation because it is open to the air

(B) Container Q will show more evaporation due to the enclosed warm air

(C) Both containers will show the same level of evaporation regardless of conditions

(D) Container P will show more evaporation; high humidity in Container Q **decreases** the rate of evaporation

Q2. A student prepares three mixtures: Mixture X by dissolving common salt in water, Mixture Y by shaking chalk powder in water, and Mixture Z by mixing a few drops of milk in water. On the basis of particle size, which of the following correctly classifies these mixtures?

(A) X is a suspension, Y is a solution, Z is a colloid

(B) X is a colloid, Y is a suspension, Z is a solution

(C) X is a solution, Z is a colloid, and Y is a suspension

(D) X is a solution, Y is a colloid, and Z is a suspension

Q3. Priya adds spoonful after spoonful of sugar to a glass of water at room temperature, stirring well each time. After some point, she notices that no matter how vigorously she stirs, a layer of sugar collects at the bottom and does not dissolve. The solution at this stage is best described as:

(A) An unsaturated solution, because more solute can still be dissolved if heated

(B) A saturated solution, because it cannot dissolve any more solute at that temperature

(C) A supersaturated solution, because excess solute is present

(D) A dilute solution, because the amount of solute is large relative to the solvent

Q4. A laboratory technician is given a heterogeneous mixture of iron filings and powdered sulfur. She wants to separate only the iron filings in their original form without using any liquid. Which method and reasoning is correct?

(A) Pass a magnet over the mixture; iron filings are attracted to the magnet while sulfur is non-magnetic and remains behind

(B) Heat the mixture strongly; iron melts first and can be poured away from the sulfur

(C) Dissolve the mixture in water; sulfur dissolves while iron filings settle and can be filtered

(D) Use a centrifuge; the denser iron sinks to the bottom while sulfur floats

Q5. In an experiment, 10 g of calcium carbonate ($CaCO_3$) is heated in a closed container. It decomposes to give calcium oxide (CaO) and carbon dioxide (CO_2) gas. If 5.6 g of CaO is formed, what is the mass of CO_2 produced, and which fundamental law does this illustrate?

(A) 3.4 g of CO_2; Law of Definite Proportions

(B) 5.6 g of CO_2; Law of Multiple Proportions

(C) 6.4 g of CO_2; Law of Conservation of Energy

(D) 4.4 g of CO_2; Law of Conservation of Mass

Q6. A student is asked to calculate the mass of 3 moles of water (H_2O) molecules. Given that the molar mass of water is 18 g/mol, what is the correct mass?

(A) 18 g

(B) 36 g

(C) 54 g

(D) 72 g

Q7. Calcium phosphate is an ionic compound formed from calcium ions (Ca^{2+}) and phosphate ions (PO_4^{3-}). Using the criss-cross method to balance the charges, what is the correct chemical formula of calcium phosphate?

(A) $Ca_2(PO_4)_3$

(B) $Ca_3(PO_4)_2$

(C) $Ca(PO_4)_2$

(D) Ca_2PO_4

Q8. In 1932, James Chadwick performed an experiment to discover a new subatomic particle. He bombarded a thin sheet of beryllium metal with a beam of fast-moving alpha particles. The radiation emitted could knock out protons from a paraffin wax target. Which particle did Chadwick discover, and what are its key properties?

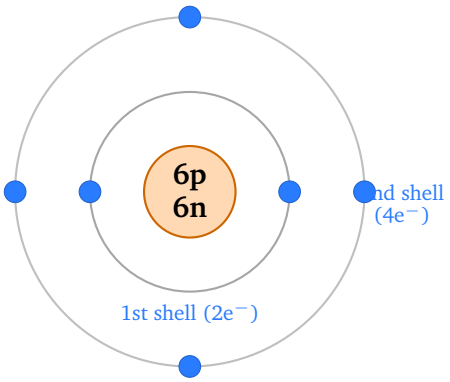
(A) The neutron; it carries no electric charge and has a mass approximately equal to 1 amu

(B) The proton; it carries a positive charge and was emitted directly from the beryllium nucleus

(C) The electron; it was freed from the outer shell of beryllium atoms by the alpha particles

(D) The positron; a positively charged particle with the same mass as an electron

Q9. The diagram below represents the structure of a carbon atom. Study the diagram carefully. Which statement correctly uses information from the diagram to define atomic number?



Carbon (C)

(A) The atomic number equals the total number of electrons plus neutrons in the nucleus

(B) The atomic number is the sum of protons and neutrons; for carbon it is 12

(C) The atomic number equals the number of neutrons; for carbon it is 6

(D) The atomic number equals the number of protons (or electrons in a neutral atom); for carbon it is 6

Q10. Hydrogen is unique in having three naturally occurring isotopes. A chemistry teacher asks students to match each isotope of hydrogen with its correct description. Which set of matches is entirely correct?

(A) Protium: 1 proton, 1 neutron; Deuterium: 1 proton, 2 neutrons; Tritium: 1 proton, 0 neutrons

(B) Protium: 1 proton, 1 neutron; Deuterium: 1 proton, 0 neutrons; Tritium: 1 proton, 2 neutrons

(C) Protium: 1 proton, 0 neutrons; Deuterium: 1 proton, 1 neutron; Tritium: 1 proton, 2 neutrons

(D) Protium: 0 protons, 1 neutron; Deuterium: 1 proton, 1 neutron; Tritium: 2 protons, 1 neutron

Q11. A manufacturer needs a metal material that is harder than pure copper and more resistant to corrosion for making musical instruments. A metallurgist recommends using an alloy instead of pure copper. Which alloy is recommended, and what is its composition?

(A) Bronze, an alloy of copper and tin (Sn)

(B) Brass, an alloy of copper (Cu) and zinc (Zn)

(C) Stainless steel, an alloy of iron (Fe) and chromium (Cr)

(D) Duralumin, an alloy of aluminium (Al) and copper (Cu)

Q12. In a school chemistry experiment, a student adds excess dilute sulphuric acid (H_2SO_4) to black copper oxide (CuO) powder in a beaker and stirs the mixture. The black powder gradually disappears and the solution turns blue. What are the products of this reaction?

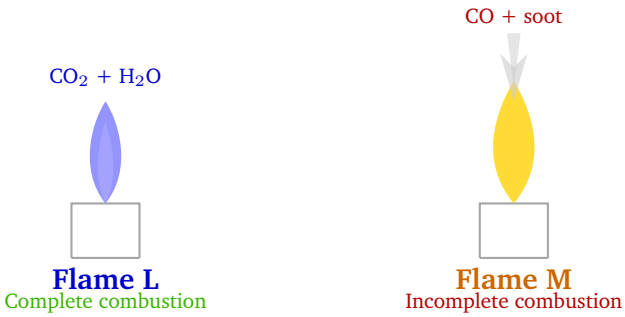
(A) Copper sulphate ($CuSO_4$) and water (H_2O); the blue colour is due to the copper sulphate solution

(B) Copper sulphide (CuS) and hydrogen (H_2) gas; hydrogen causes bubbling

(C) Copper (Cu) metal and sulphurous acid (H_2SO_3); the metal deposits on the glass

(D) Copper carbonate ($CuCO_3$) and water; the solution turns green

Q13. The diagram below compares two flames produced when methane (natural gas) burns. Flame L burns with a clear blue colour, while Flame M burns with a yellow, sooty appearance. Which statement correctly explains the chemistry behind this observation?



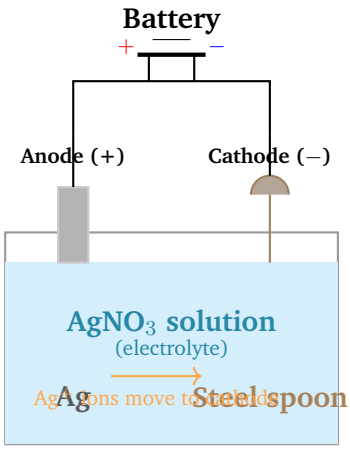
(A) Flame L is incomplete combustion because blue flames are cooler; Flame M is complete combustion

(B) Both flames represent complete combustion; the colour difference is only due to the type of burner used

(C) Flame L shows complete combustion (sufficient oxygen) producing CO_2 and H_2O; Flame M shows incomplete combustion (insufficient oxygen) producing CO and soot

(D) Flame M is safer because yellow flames release more heat energy per unit of fuel

Q14. A cutlery factory wants to coat ordinary steel spoons with a thin layer of silver to improve their appearance and resistance to tarnishing. The diagram below shows the electroplating setup used. Identify the correct role of each component in the circuit.



(A) The steel spoon is the anode; silver ions from the electrolyte deposit on it when connected to the positive terminal

(B) The silver rod is the cathode; it gains mass as silver from the electrolyte deposits on it

(C) The $AgNO_3$ solution acts as the power source that drives current through the circuit

(D) The steel spoon is the cathode; Ag^+ ions from the electrolyte are reduced and deposit silver on it; the silver anode dissolves to replenish Ag^+ ions

Q15. A school craft teacher gives students two types of plastic objects to investigate: Object P is made of PVC and Object Q is made of Bakelite. When both are carefully heated with a heat gun, Object P softens and can be remoulded into a new shape, while Object Q remains hard and does not change shape. What property of these plastics explains this difference?

(A) Both PVC and Bakelite are thermoplastics; the difference is due to the thickness of the objects

(B) PVC is a thermoplastic that softens on heating and can be remoulded; Bakelite is a thermosetting plastic that, once set, cannot be remoulded by heating

(C) Bakelite is a thermoplastic and PVC is a thermosetting plastic; the teacher has mislabelled the objects

(D) Both are thermosetting plastics; PVC softens only because it was manufactured at a higher temperature

Detailed Solutions

Q1.

Solution

Concept: The rate of evaporation depends on several factors. Increasing surface area, temperature, and wind speed all *increase* the rate of evaporation. However, increasing humidity *decreases* it because the air above the liquid is already saturated with water vapour, reducing the tendency of liquid molecules to escape.

Step 1 – Container P (open, ventilated): Wind removes water vapour from above the surface, keeping humidity low. Evaporation proceeds rapidly.

Step 2 – Container Q (covered, humid bathroom): The cover traps water vapour inside; the humid bathroom air is already moisture-laden. The high humidity means the air can absorb very little additional vapour, so evaporation is strongly suppressed.

Why other options are wrong:

- (A) Incorrect — an open container increases, not decreases, evaporation.
- (B) Incorrect — the enclosed humid container shows *less*, not more, evaporation.
- (C) Incorrect — the conditions are clearly different and will produce different rates.

Final Answer: (D) — Container P evaporates faster; the high humidity inside Container Q decreases the rate of evaporation.

Answer: (D)

Q2.

Solution

Concept: Mixtures are classified by particle size: solutions have particles $< 1\,\text{nm}$, colloids have particles between 1 and $1000\,\text{nm}$, and suspensions have particles $> 1000\,\text{nm}$.

Step 1 – Classify each mixture:

- Mixture X (salt in water): NaCl dissociates into ions of size $< 1\,\text{nm} \Rightarrow$ **solution**.
- Mixture Y (chalk powder in water): chalk particles are large ($> 1000\,\text{nm}$), settle on standing $\Rightarrow$ **suspension**.

- Mixture Z (milk in water): milk is an emulsion with fat globules in the colloidal range (1–1000 nm) $\Rightarrow$ **colloid**.

Step 2 – Match to options: X = solution, Y = suspension, Z = colloid $\Rightarrow$ option (C).

Why other options are wrong:

- (A) Swaps X and Y incorrectly.
- (B) Misidentifies salt solution as a colloid.
- (D) Swaps Y (suspension) and Z (colloid).

Final Answer: (C) — X is a solution, Z is a colloid, Y is a suspension.

Answer: (C)

Q3.

Solution

Concept: A **saturated solution** is one that holds the maximum amount of solute dissolved in it at a given temperature. Any additional solute added simply collects undissolved at the bottom.

Step 1: As Priya adds sugar, it dissolves at first because the solution is unsaturated (capacity remains).

Step 2: Once the maximum solubility is reached, no further sugar dissolves. The undissolved sugar at the bottom confirms saturation at that temperature.

Why other options are wrong:

- (A) An unsaturated solution still has capacity to dissolve more solute — this is the *initial* stage, not the final.
- (C) A supersaturated solution holds *more* than the normal maximum, achieved by careful cooling; simply adding excess does not produce supersaturation.
- (D) "Dilute" refers to a low concentration — the opposite of what is described.

Final Answer: (B) — The solution is saturated because no more solute can dissolve at that temperature.

Answer: (B)

Q4.

Solution

Concept: Magnetic separation exploits the difference in magnetic properties. Iron is ferromagnetic (strongly attracted to magnets) while sulfur is non-magnetic. A magnet passed over the mixture pulls out iron filings, leaving sulfur behind.

Step 1: The technician sweeps a bar magnet over the mixture. Iron filings cling to the magnet.

Step 2: Sulfur, being non-magnetic, is not attracted and stays in the dish.

Why other options are wrong:

- (B) Heating would cause sulfur to burn and react with iron, forming iron sulphide — a compound, not a separation.
- (C) Neither iron filings nor sulfur dissolve readily in water at room temperature; filtration would not give pure iron.
- (D) Centrifugation requires a liquid medium and would not work for a dry solid mixture.

Final Answer: (A) — Magnetic separation using a magnet separates iron filings from non-magnetic sulfur.

Answer: (A)

Q5.

Solution

Concept: The **Law of Conservation of Mass** (Lavoisier, 1789): in a chemical reaction, the total mass of reactants equals the total mass of products. Matter is neither created nor destroyed.

Step 1 – Set up the equation:

$$CaCO_3 \rightarrow CaO + CO_2$$

Mass of reactant $= 10$ g | Mass of CaO produced $= 5.6$ g

Step 2 – Apply conservation of mass:

$$m(CO_2) = 10\,\text{g} - 5.6\,\text{g} = 4.4\,\text{g}$$

Why other options are wrong:

- (A) 3.4 g is arithmetic error; and Law of Definite Proportions governs composition, not this experiment's outcome.
- (B) 5.6 g would mean CaO and CO_2 have the same mass, which is incorrect here.
- (C) 6.4 g exceeds total reactant mass — impossible under conservation.

Final Answer: (D) — 4.4 g of CO_2 is produced; this illustrates the Law of Conservation of Mass.

Answer: (D)

Q6.

Solution

Concept: The mole concept relates number of moles to mass via molar mass:

$$\text{Mass} = \text{Number of moles} \times \text{Molar mass}$$

Step 1 – Identify values: Number of moles = 3 mol; Molar mass of H_2O = 18 g/mol.

Step 2 – Calculate:

$$\text{Mass} = 3 \times 18 = 54\,\text{g}$$

Why other options are wrong:

- (A) 18 g = mass of only 1 mole of water.
- (B) 36 g = mass of 2 moles of water.
- (D) 72 g = mass of 4 moles of water.

Final Answer: (C) — The mass of 3 mol of water is 54 g.

Answer: (C)

Q7.

Solution

Concept: The **criss-cross method** for writing ionic formulae: swap the magnitudes of the charges of the two ions and use them as subscripts.

Step 1 – Identify ions and charges:

- Calcium ion: Ca^{2+} (charge magnitude = 2)
- Phosphate ion: PO_4^{3-} (charge magnitude = 3)

Step 2 – Apply criss-cross: Subscript of Ca = 3; Subscript of PO_4 = 2.

$$\text{Formula} = Ca_3(PO_4)_2$$

Verification: charge balance: $3 \times (+2) + 2 \times (-3) = +6 - 6 = 0$ ✓

Why other options are wrong:

- (A) $Ca_2(PO_4)_3$: charge = $+4 - 9 \neq 0$.
- (C) $Ca(PO_4)_2$: charge = $+2 - 6 \neq 0$.
- (D) Ca_2PO_4: charge = $+4 - 3 \neq 0$.

Final Answer: (B) — The formula of calcium phosphate is $Ca_3(PO_4)_2$.

Answer: (B)

Q8.

Solution

Concept: James Chadwick (1932) discovered the **neutron** by bombarding beryllium with alpha particles (α-particles). The reaction is:

$$^{9}_{4}\text{Be} + ^{4}_{2}\text{He} \rightarrow ^{12}_{6}\text{C} + ^{1}_{0}\text{n}$$

The emitted neutral radiation (neutrons) knocked protons out of paraffin wax.

Step 1 – Key properties of neutron:

- No electric charge (neutral)
- Mass ≈ 1 amu (similar to proton)
- Located in the nucleus

Step 2 – Why it had to be a new particle: The radiation was not deflected by electric or magnetic fields (proving it was neutral) yet had enough mass to displace protons (distinguishing it from massless gamma rays).

Why other options are wrong:

- (B) Protons were already known; they were knocked *out* of paraffin by the new particle.

- (C) Electrons are far too light to displace protons and have negative charge.
- (D) Positrons were discovered by Anderson in cosmic ray studies, not Chadwick's experiment.

Final Answer: (A) — Chadwick discovered the neutron: no charge, mass ≈ 1 amu.

Answer: (A)

Q9.

Solution

Concept: The **atomic number** (Z) of an element is defined as the number of protons in the nucleus of an atom. In a neutral atom, the number of electrons equals the number of protons.

Step 1 – Read the diagram: The nucleus shows 6 protons (6p) and 6 neutrons (6n). There are 2 electrons in the first shell and 4 in the second (total electrons = 6).

Step 2 – Apply definition: Atomic number = number of protons = 6 (and also equals number of electrons in a neutral atom = 6). This matches option (D).

Why other options are wrong:

- (A) Atomic number $\neq$ electrons + neutrons; that would give $6+6=12$ (which is the mass number, not atomic number).
- (B) Sum of protons and neutrons gives mass number (12), not atomic number.
- (C) Atomic number is protons, not neutrons. If it equalled neutrons, all isotopes would have different atomic numbers, which is incorrect.

Final Answer: (D) — Atomic number = number of protons = number of electrons (neutral atom) = 6 for carbon.

Answer: (D)

Q10.

Solution

Concept: **Isotopes** are atoms of the same element with the same atomic number (same protons) but different mass numbers (different neutrons). All three isotopes of hydrogen have 1 proton.

Step 1 – Determine neutrons for each isotope:

- Protium ($^1_1$H): mass number = 1, protons = 1 $\Rightarrow$ neutrons = $1 - 1 = \mathbf{0}$
- Deuterium ($^2_1$H): mass number = 2, protons = 1 $\Rightarrow$ neutrons = $2 - 1 = \mathbf{1}$
- Tritium ($^3_1$H): mass number = 3, protons = 1 $\Rightarrow$ neutrons = $3 - 1 = \mathbf{2}$

Step 2: Match to option (C): Protium (0 neutrons), Deuterium (1 neutron), Tritium (2 neutrons). ✓

Why other options are wrong:

- (A) Gives protium 1 neutron and tritium 0 neutrons — reversed.
- (B) Swaps protium and deuterium neutron counts.
- (D) Assigns 0 protons to protium — impossible for hydrogen.

Final Answer: (C) — Protium: 0 neutrons; Deuterium: 1 neutron; Tritium: 2 neutrons.

Answer: (C)

Q11.

Solution

Concept: An **alloy** is a homogeneous mixture of two or more metals (or a metal and a non-metal) fused together. Alloys generally have better properties (hardness, corrosion resistance) than their constituent pure metals.

Step 1 – Identify brass: Brass is an alloy of **copper (Cu) and zinc (Zn)**. It is harder than pure copper, has a golden appearance, and is widely used for musical instruments (trumpets, trombones), coins, and decorative items.

Step 2 – Match the requirement: The manufacturer needs something harder than copper with better corrosion resistance $\Rightarrow$ brass (Cu + Zn).

Why other options are wrong:

- (A) Bronze (Cu + Sn) is used for statues and bells, not typically musical wind instruments.
- (C) Stainless steel (Fe + Cr) is iron-based, not copper-based.
- (D) Duralumin (Al + Cu) is used in aircraft, not musical instruments.

Final Answer: (B) — Brass, an alloy of copper (Cu) and zinc (Zn), is the recommended material.

Answer: (B)

Q12.

Solution

Concept: Metal oxides are basic in nature. They react with acids (acid-base neutralisation) to form a **salt** and **water**. This is a typical property of metals.

Step 1 – Write the reaction:

$$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$$

Step 2 – Identify products: Copper sulphate ($CuSO_4$) is a blue salt; its aqueous solution turns the solution blue. Water is also produced.

Step 3 – Verify observation: The black CuO dissolves (consumed in the reaction) and the blue $CuSO_4$ solution forms, consistent with what the student observes.

Why other options are wrong:

- (B) Copper sulphide and hydrogen are not products of CuO + H_2SO_4.
- (C) Copper metal does not form; there is no reduction occurring.
- (D) Copper carbonate would only form if a carbonate were involved, not CuO.

Final Answer: (A) — Products are copper sulphate ($CuSO_4$) and water (H_2O); the blue colour is due to $CuSO_4$.

Answer: (A)

Q13.

Solution

Concept: Combustion of a fuel can be **complete** (sufficient oxygen) or **incomplete** (insufficient oxygen).

Step 1 – Complete combustion (Flame L, blue):

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

All carbon is fully oxidised to CO_2. The flame appears blue and produces maximum heat.

Step 2 – Incomplete combustion (Flame M, yellow/sooty):

$$2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$$

Insufficient O_2 means carbon is only partially oxidised, producing toxic carbon

monoxide (CO) and unburnt carbon particles (soot). The flame is yellow and smoky.

Why other options are wrong:

- (A) Completely reverses the classification; blue flames are *hotter* and indicate complete combustion.
- (B) The two flames clearly have different combustion types.
- (D) Yellow flames actually release *less* heat (incomplete combustion is less efficient) and produce harmful CO.

Final Answer: (C) — Flame L is complete combustion ($CO_2 + H_2O$); Flame M is incomplete combustion (CO + soot).

Answer: (C)

Q14.

Solution

Concept: Electroplating uses electrolysis to deposit a layer of one metal onto another. The object to be coated is the **cathode** (negative terminal), and the plating metal is the **anode** (positive terminal), dissolved in a suitable electrolyte.

Step 1 – Role of each component:

- **Steel spoon (cathode, $-$):** Connected to the negative terminal. Ag^+ ions from solution are attracted here, gain electrons, and deposit as silver metal: $Ag^+ + e^- \rightarrow Ag$.
- **Silver rod (anode, $+$):** Connected to the positive terminal. Silver atoms lose electrons and dissolve into solution as Ag^+: $Ag \rightarrow Ag^+ + e^-$. This replenishes Ag^+ ions in the electrolyte.
- **$AgNO_3$ solution (electrolyte):** Provides Ag^+ ions that carry the current and deposit on the cathode.

Step 2 – Net result: Silver is transferred from the anode rod to the steel spoon (cathode), coating it with a thin silver layer.

Why other options are wrong:

- (A) The spoon is the cathode (negative), not the anode.
- (B) The silver rod is the anode; it *loses* mass, not gains.
- (C) The electrolyte carries ions but does not supply electrical energy — the battery does.

Final Answer: (D) — Steel spoon = cathode; Ag^+ ions deposit on it; silver anode dissolves to maintain ion concentration.

Answer: (D)

Q15.

Solution

Concept: Synthetic plastics are classified by their behaviour on heating:

- **Thermoplastics** (e.g., PVC, polythene): soften on heating and can be re-moulded repeatedly. Their polymer chains are not cross-linked.
- **Thermosetting plastics** (e.g., Bakelite, melamine): once set by heat and pressure during manufacture, they are permanently hard. Heating does *not* soften them because they have extensive cross-linked networks.

Step 1 – Object P (PVC): PVC is a thermoplastic. It softens when heated because the polymer chains can slide past each other. It can be remoulded.

Step 2 – Object Q (Bakelite): Bakelite is a thermosetting plastic. Its three-dimensional cross-linked network makes it permanently rigid; heating only chars or decomposes it, not softens it.

Why other options are wrong:

- (A) Not both are thermoplastics; Bakelite is thermosetting.
- (C) The classifications are correct in the question; the teacher has not mislabelled.
- (D) Neither is a thermosetting plastic in option (D)'s framing — PVC is definitively thermoplastic.

Final Answer: (B) — PVC is thermoplastic (remouldable); Bakelite is thermosetting (cannot be remoulded once set).

Answer: (B)

Answer Key

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
D	C	B	A	D	C	B	A	D	C	
Q11	**Q12**	**Q13**	**Q14**	**Q15**						
B	A	C	D	B						