TALLENTEX Chemistry

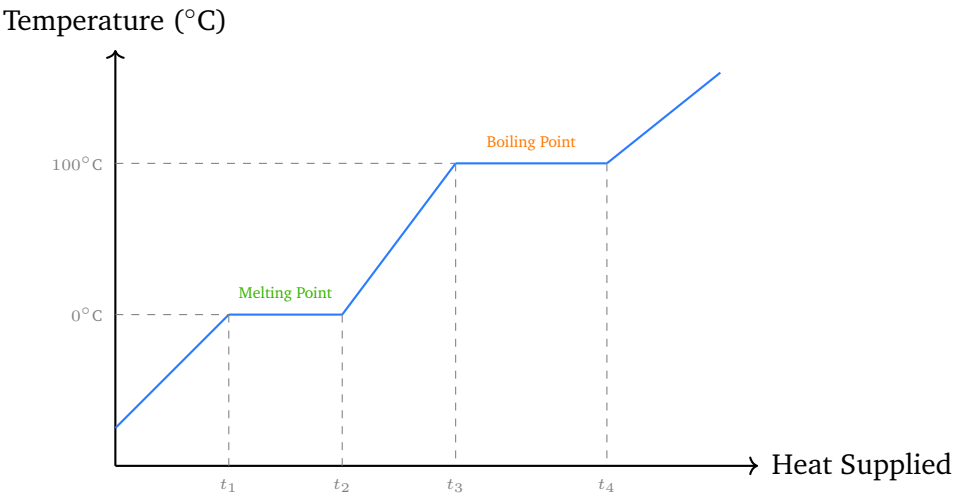
Sample Paper – 3

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.

Q.1. A student heats a block of ice steadily at a constant rate and records the temperature every minute. The heating curve she plots is shown below.



Which statement **correctly** explains what happens during the flat portion of the heating curve at 0°C?

(A) The temperature stops rising because the heat supply pauses momentarily.

(B) The heat supplied is used to break intermolecular forces during melting, so temperature does not rise.

(C) Ice absorbs heat and its temperature increases rapidly to 100°C.

(D) The flat portion shows that latent heat is released by ice to the surroundings.

Answer: (B)

Q.2. Priya dissolves equal masses of sugar separately in a cup of cold water (10°C) and a cup of hot water (70°C), without stirring. She observes that sugar dissolves much faster in hot water. Which of the following **best** explains this observation?

(A) At higher temperature, the kinetic energy of particles increases, so diffusion is faster.

(B) Hot water has a lower density, making it easier for sugar to float to the surface.

(C) Sugar molecules become smaller at higher temperatures, fitting between water molecules more easily.

(D) Cold water has more dissolved oxygen, which blocks sugar from diffusing.

Answer: (A)

Q.3. A student dissolves 10 g of common salt (NaCl) in 90 g of water to prepare a saline solution. What is the **mass by mass percentage** of NaCl in this solution?

(A) 9%

(B) 11.1%

(C) 0.1%

(D) 10%

Answer: (D)

Q.4. A forensic scientist needs to separate the different coloured dyes present in a sample of blue ink without using heat. Which of the following separation techniques is **most appropriate**, and on what principle does it work?

(A) Distillation — components are separated based on their different boiling points.

(B) Filtration — components are separated based on particle size.

(C) Chromatography — components are separated based on differential adsorption on a stationary phase.

(D) Evaporation — the solvent is removed leaving the dye behind.

Answer: (C)

Q.5. Which of the following is the **correct IUPAC chemical symbol** for the element *Sodium*?

(A) Na

(B) S

(C) So

(D) Sd

Answer: (A)

Q.6. A gas jar contains 0.5 mol of carbon dioxide (CO_2) at standard conditions. How many **molecules** of CO_2 does the jar contain? (Take Avogadro's number $N_A = 6.022 \times 10^{23}$)

(A) 6.022×10^{23}

(B) 3.011×10^{23}

(C) 1.204×10^{24}

(D) 6.022×10^{22}

Answer: (B)

Q.7. The chemical formula of aluminium chloride is $AlCl_3$. Given that the valency of chlorine is 1, what is the **valency of aluminium** in this compound?

(A) 1

(B) 2

(C) 3

(D) 4

Answer: (C)

Q.8. J.J. Thomson proposed an early model of the atom after discovering the electron. Which of the following **correctly describes** Thomson's model of the atom?

(A) The atom has a tiny, dense, positively charged nucleus at its centre with electrons orbiting around it.

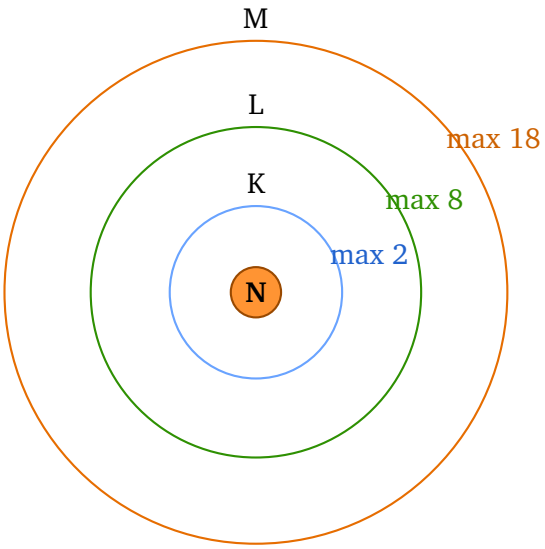
(B) Electrons revolve around the nucleus in fixed circular paths called orbits or shells.

(C) The atom is mostly empty space; the nucleus occupies the central region and contains both protons and neutrons.

(D) The atom is a sphere of uniform positive charge with electrons embedded in it like raisins in a pudding.

Answer: (D)

Q.9. According to the $2n^2$ rule for the maximum number of electrons in an orbit, what is the **maximum number of electrons** that can occupy the third orbit (M-shell, $n = 3$) of an atom?



(A) 18

(B) 8

(C) 32

(D) 2

Answer: (A)

Q.10. Archaeologists excavate an ancient wooden artefact and wish to determine its age. A scientist suggests using **carbon dating**. Which of the following statements about the isotope used in carbon dating is **correct**?

(A) Carbon-12 is radioactive and decays slowly in dead organic matter, allowing age estimation.

(B) Carbon-14 is a radioactive isotope of carbon that decays at a known rate, enabling dating of organic specimens.

(C) Carbon-13 emits alpha particles and is used to date inorganic rocks.

(D) All isotopes of carbon are radioactive and are used equally in dating techniques.

Answer: (B)

Q.11. A student tests two unknown solid elements P and Q in a laboratory. Element P conducts electricity and can be beaten into a thin sheet. Element

Q does not conduct electricity and shatters when hammered. Based on these observations, which statement is **correct**?

(A) Both P and Q are metals because they are solid at room temperature.

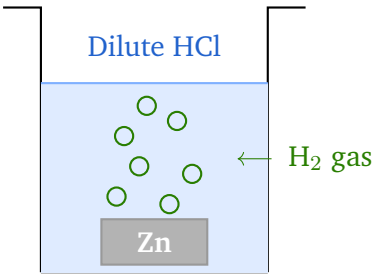
(B) Element Q is a metal because all metals are brittle.

(C) Element P is a metal and element Q is a non-metal; non-metals are generally brittle and poor conductors.

(D) Element Q is a non-metal only if it is a gas at room temperature.

Answer: (C)

Q.12. When zinc granules are added to dilute hydrochloric acid in a beaker, a vigorous reaction is observed as shown below. Identify the **correct products** of this reaction.



(A) Zinc oxide and water

(B) Zinc hydroxide and chlorine gas

(C) Zinc chloride and oxygen gas

(D) Zinc chloride and hydrogen gas

Answer: (D)

Q.13. Which of the following substances is the **best example of spontaneous combustion**, catching fire in air at ordinary room temperature without any external ignition source?

(A) White phosphorus

(B) Coal

(C) Kerosene

(D) Magnesium ribbon

Answer: (A)

Q.14. In the electrolytic refining of copper, two electrodes are placed in a copper sulphate solution and current is passed through it. Which of the following correctly identifies the **anode** and **cathode**, and what happens during the process?

(A) Pure copper acts as the anode; impure copper acts as the cathode; copper dissolves from the cathode.

(B) Impure copper acts as the anode; pure copper acts as the cathode; copper deposits on the cathode.

(C) Both electrodes are made of impure copper; copper deposits on both equally.

(D) Pure copper acts as the anode; copper dissolves from it and impurities collect at the cathode.

Answer: (B)

Q.15. Petroleum is refined by fractional distillation to separate it into useful fractions. Which of the following shows the **correct order of increasing boiling point** of petroleum fractions?

(A) Diesel $<$ Kerosene $<$ Petrol $<$ Petroleum gas $<$ Fuel oil

(B) Fuel oil $<$ Diesel $<$ Kerosene $<$ Petrol $<$ Petroleum gas

(C) Petroleum gas $<$ Petrol $<$ Kerosene $<$ Diesel $<$ Fuel oil

(D) Petrol $<$ Petroleum gas $<$ Diesel $<$ Kerosene $<$ Fuel oil

Answer: (C)

Detailed Solutions

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Q.1.

Solution

Concept: Latent heat is the heat energy absorbed or released during a change of state at constant temperature.

Step 1: During melting (at 0°C), the heat supplied does not raise the temperature; instead it is used to overcome the intermolecular forces holding water molecules in a rigid lattice in ice.

Step 2: This energy goes into potential energy of the system, not kinetic energy, so the thermometer reading stays flat.

Why other options are wrong:

- (A) The heat supply is continuous and does not pause.
- (C) Temperature does not increase during the flat portion.
- (D) Latent heat is *absorbed* by ice, not released to surroundings, during melting.

Final Answer: **(B)** Heat supplied is used to break intermolecular bonds during melting — temperature does not rise.

Q.2.

Solution

Concept: Diffusion is the spontaneous movement of particles from a region of higher concentration to lower concentration. Its rate depends on the kinetic energy of particles.

Step 1: Temperature is a measure of the average kinetic energy of particles. At 70°C, both sugar and water molecules move faster than at 10°C.

Step 2: Faster-moving water molecules collide more frequently with sugar particles, breaking them away from the crystal surface more rapidly, increasing the rate of diffusion and dissolution.

Why other options are wrong:

- (B) Lower density of hot water is irrelevant to the mechanism of diffusion.
- (C) Sugar molecules do not change size with temperature.

- (D) Dissolved oxygen has no bearing on sugar dissolution.

Final Answer: **(A)** Increased kinetic energy at higher temperature accelerates diffusion of sugar molecules.

Q.3.

Solution

Concept: Mass by mass percentage (w/w%) $= \dfrac{\text{mass of solute}}{\text{mass of solution}} \times 100$

Step 1: Mass of solute (NaCl) $= 10\,\text{g}$; Mass of solvent (water) $= 90\,\text{g}$.
Mass of solution $= 10 + 90 = 100\,\text{g}$.

Step 2: $w/w\% = \dfrac{10}{100} \times 100 = 10\%$

Why other options are wrong:

- (A) 9% would result if only the mass of solvent were used in the denominator.
- (B) 11.1% arises from the incorrect formula $\frac{10}{90} \times 100$.
- (C) 0.1% is obtained from a gross computational error.

Final Answer: **(D)** The mass by mass percentage of NaCl is $\mathbf{10\%}$.

Q.4.

Solution

Concept: Chromatography separates components of a mixture by exploiting differences in how strongly each component is adsorbed onto a stationary phase as a mobile phase moves through it.

Step 1: The dyes in ink have different affinities for the stationary phase (e.g. paper or silica). Components that adsorb more strongly travel slower; those that adsorb less travel faster, causing separation.

Step 2: No heating is required, making chromatography ideal for separating heat-sensitive dyes.

Why other options are wrong:

- (A) Distillation separates liquids based on boiling points — unsuitable for dye mixtures.
- (B) Filtration separates insoluble solids from liquids — all dyes are dissolved.

- (D) Evaporation removes solvent but does not separate the dyes from each other.

Final Answer: **(C)** Chromatography, based on differential adsorption, is the correct technique.

Q.5.

Solution

Concept: IUPAC chemical symbols are internationally agreed abbreviations for elements, often derived from their Latin names.

Step 1: Sodium derives its symbol from its Latin name *Natrium*. The IUPAC symbol is **Na** (capital N, lowercase a).

Step 2: "S" is the symbol for Sulphur, "So" and "Sd" are not valid IUPAC symbols for any element.

Why other options are wrong:

- (B) S is the symbol for Sulphur, not Sodium.
- (C) "So" is not a recognised IUPAC symbol.
- (D) "Sd" is not a recognised IUPAC symbol.

Final Answer: **(A)** The correct IUPAC symbol for Sodium is **Na**.

Q.6.

Solution

Concept: One mole of any substance contains $N_A = 6.022 \times 10^{23}$ particles (Avogadro's number).

Step 1: Number of molecules $=$ number of moles $\times N_A$

Step 2: $= 0.5 \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$ molecules

Why other options are wrong:

- (A) 6.022×10^{23} is the number for 1 full mole, not 0.5 mol.
- (C) 1.204×10^{24} corresponds to 2 mol.
- (D) 6.022×10^{22} corresponds to 0.1 mol.

Final Answer: **(B)** 0.5 mol of CO_2 contains $\mathbf{3.011 \times 10^{23}}$ molecules.

Q.7.

Solution

Concept: Valency is the combining capacity of an element. In a neutral compound, the total valency of all atoms must balance.

Step 1: In $AlCl_3$, there are 3 chlorine atoms each with valency 1, giving a total combining capacity of $3 \times 1 = 3$ on the chlorine side.

Step 2: To balance, one aluminium atom must have valency $= 3$.

Why other options are wrong:

- (A) If Al had valency 1, the formula would be AlCl, not $AlCl_3$.
- (B) Valency 2 would give the formula $AlCl_2$.
- (D) Valency 4 would give $AlCl_4$, which is not the formula given.

Final Answer: (C) The valency of aluminium in $AlCl_3$ is **3**.

Q.8.

Solution

Concept: Thomson's model (1904), also called the "plum pudding model", described the atom before the nucleus was discovered.

Step 1: Thomson proposed that the atom is a sphere of diffuse, uniform, positive charge in which electrons are embedded at various positions — like raisins (plums) embedded in a pudding.

Step 2: This model explained why atoms are electrically neutral overall (positive and negative charges balance) but could not explain the results of Rutherford's scattering experiment.

Why other options are wrong:

- (A) Describes Rutherford's nuclear model, not Thomson's.
- (B) Describes Bohr's model with fixed orbits.
- (C) Also describes post-Rutherford/Bohr understanding, not Thomson's model.

Final Answer: (D) Thomson's model: atom is a sphere of positive charge with electrons embedded in it.

Q.9.

Solution

Concept: The maximum number of electrons that can be accommodated in the nth orbit is given by the formula $2n^2$.

Step 1: For the third orbit, $n = 3$.
Maximum electrons $= 2 \times (3)^2 = 2 \times 9 = 18$.

Step 2: This is the M-shell. As shown in the diagram, K-shell (max 2), L-shell (max 8), M-shell (max 18).

Why other options are wrong:

- (B) 8 is the maximum for the second orbit ($n = 2$): $2 \times 4 = 8$.
- (C) 32 is the maximum for the fourth orbit ($n = 4$): $2 \times 16 = 32$.
- (D) 2 is the maximum for the first orbit ($n = 1$): $2 \times 1 = 2$.

Final Answer: **(A)** The maximum number of electrons in the third orbit (M-shell) is 18.

Q.10.

Solution

Concept: Isotopes are atoms of the same element with the same number of protons but different numbers of neutrons. Some isotopes are radioactive.

Step 1: Carbon has three naturally occurring isotopes: C-12, C-13, and C-14. Of these, only **Carbon-14** (^{14}C) is radioactive.

Step 2: Living organisms continuously absorb C-14 through the food chain. After death, C-14 decays at a known rate (half-life $\approx$ 5730 years). By measuring the remaining C-14, scientists can estimate the age of organic specimens (carbon dating).

Why other options are wrong:

- (A) C-12 is stable and non-radioactive; it cannot be used for carbon dating.
- (C) C-13 is also stable and does not emit alpha particles in the context of carbon dating.
- (D) C-12 and C-13 are stable isotopes, not radioactive.

Final Answer: **(B)** Carbon-14 is the radioactive isotope used in carbon dating.

Q.11.

Solution

Concept: Metals are generally lustrous, malleable, ductile, and good conductors of heat and electricity. Non-metals are generally brittle and poor conductors (with some exceptions like diamond).

Step 1: Element P conducts electricity and can be beaten into a thin sheet (malleable) — these are characteristic properties of metals.

Step 2: Element Q does not conduct electricity and shatters when hammered (brittle) — these are characteristic properties of non-metals.

Why other options are wrong:

- (A) Being solid at room temperature is not a defining property of metals (many non-metals are solids too, e.g. sulphur, carbon).
- (B) Brittleness is a property of non-metals, not metals.
- (D) Non-metals can be solid, liquid, or gas at room temperature.

Final Answer: (C) P is a metal; Q is a non-metal — non-metals are generally brittle and poor conductors.

Q.12.

Solution

Concept: Active metals like zinc react with dilute acids to produce a salt and hydrogen gas. The general reaction is: Metal + Dilute acid $\rightarrow$ Salt + Hydrogen gas.

Step 1: The balanced chemical equation is:

$$\mathrm{Zn} + 2\,\mathrm{HCl} \longrightarrow \mathrm{ZnCl_2} + \mathrm{H_2} \uparrow$$

Step 2: Zinc chloride ($\mathrm{ZnCl_2}$) dissolves in the solution and hydrogen gas ($\mathrm{H_2}$) is evolved as bubbles, as seen in the diagram.

Why other options are wrong:

- (A) Zinc oxide forms when zinc burns in air, not when it reacts with HCl.
- (B) Zinc hydroxide would form if zinc reacted with water, not with HCl; chlorine gas is not produced.
- (C) Oxygen gas is not produced in this reaction.

Final Answer: **(D)** The products are zinc chloride ($ZnCl_2$) and hydrogen gas (H_2).

Q.13.

Solution

Concept: Spontaneous combustion occurs when a substance ignites by itself in air at room temperature without any external ignition source, because its ignition temperature is at or below room temperature.

Step 1: White phosphorus has a very low ignition temperature (around 30°C to 35°C), which is close to room temperature. It therefore catches fire spontaneously when exposed to air.

Step 2: For this reason, white phosphorus is stored under water to prevent it from contacting air and igniting.

Why other options are wrong:

- (B) Coal requires a significant external heat source (high ignition temperature) to combust.
- (C) Kerosene needs an external flame; it does not ignite spontaneously at room temperature.
- (D) Magnesium ribbon requires a strong external flame to ignite.

Final Answer: **(A)** White phosphorus undergoes spontaneous combustion in air at room temperature.

Q.14.

Solution

Concept: Electrolytic refining purifies metals using electrolysis. The impure metal is made the anode and the pure metal is the cathode; both are immersed in a solution of the metal's salt.

Step 1: In copper refining, the impure copper block is connected as the **anode**. When current passes, copper atoms from the impure block dissolve into the copper sulphate solution as Cu^{2+} ions.

Step 2: At the **cathode** (pure copper), Cu^{2+} ions from the solution are reduced and deposit as pure copper. Impurities from the anode either stay in solution or fall to the bottom as anode mud.

Why other options are wrong:

- (A) It is the *impure* copper that is the anode, not pure copper.
- (C) Only the cathode grows; the anode dissolves.
- (D) Pure copper is the cathode, not the anode; impurities collect at the bottom (anode mud), not at the cathode.

Final Answer: (B) Impure copper = anode; pure copper = cathode; copper deposits on cathode.

Q.15.

Solution

Concept: In fractional distillation of petroleum, fractions are collected at different temperature ranges (boiling points). Lighter fractions (smaller molecules) have lower boiling points and are collected at the top of the fractionating column; heavier fractions have higher boiling points and are collected lower down.

Step 1: Petroleum gas (LPG) has the smallest molecules and the lowest boiling point ($< 40^\circ$C). Petrol (gasoline) boils in the range 40–75°C. Kerosene: 150–275°C. Diesel: 250–350°C. Fuel oil (heavy oil) has the highest boiling point.

Step 2: Correct order of increasing boiling point: Petroleum gas $<$ Petrol $<$ Kerosene $<$ Diesel $<$ Fuel oil.

Why other options are wrong:

- (A) Incorrect; places diesel and kerosene before petrol and petroleum gas.
- (B) This is the reverse (decreasing) order.
- (D) Incorrectly places petrol before petroleum gas and mixes up the order of other fractions.

Final Answer: (C) Petroleum gas $<$ Petrol $<$ Kerosene $<$ Diesel $<$ Fuel oil.

Answer Key

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

All questions are original and based on NCERT Class 8 & 9 Chemistry. Marking scheme: +4 per correct answer, -1 per incorrect answer.