TALLENTEX Chemistry

Sample Paper – 7

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. Which of the following correctly describes the **plasma state** of matter?

(A) A state in which particles have negligible kinetic energy and are held rigidly in fixed positions

(B) A high-energy state consisting of ionised gas containing free electrons and positively charged ions, found in the sun and neon lights

(C) A state in which liquid particles are arranged in a regular, ordered pattern

(D) A gaseous state with very low temperature and pressure in which particles do not interact

Q2. When the temperature of a substance is increased, which of the following statements about its particles is **correct**?

(A) The mass of each particle increases

(B) The number of particles in the substance increases

(C) The kinetic energy of the particles increases, causing them to move faster

(D) The intermolecular forces between particles become stronger

Q3. Which of the following pairs correctly classifies mixtures as **homogeneous** and **heterogeneous**?

(A) Salt water (homogeneous) and sugar solution (heterogeneous)

(B) Sand in water (homogeneous) and vinegar (heterogeneous)

(C) Air (heterogeneous) and muddy water (homogeneous)

(D) Vinegar (homogeneous) and sand in water (heterogeneous)

Q4. Which separation technique is **most appropriate** to obtain pure water from a mixture of water and ink?

(A) Simple distillation, because water evaporates and can be condensed, leaving the ink behind

(B) Filtration, because ink particles are too large to pass through filter paper

(C) Chromatography, because ink contains coloured components that travel at different speeds

(D) Evaporation, because both water and ink will evaporate together

Q5. According to **Gay-Lussac's Law of Gaseous Volumes**, when hydrogen gas reacts with oxygen gas to form water vapour, what is the ratio of volumes of hydrogen to oxygen to water vapour?

(A) 1 : 1 : 1

(B) 2 : 1 : 2

(C) 1 : 2 : 2

(D) 2 : 2 : 1

Q6. Calculate the **formula unit mass** of calcium carbonate ($CaCO_3$).
[Given: Ca = 40 u, C = 12 u, O = 16 u]

(A) 56 u

(B) 84 u

(C) 96 u

(D) 100 u

Q7. Using the **criss-cross method**, what is the correct chemical formula of **iron(III) chloride**?
[Valency of $Fe^{3+} = 3$; $Cl^- = 1$]

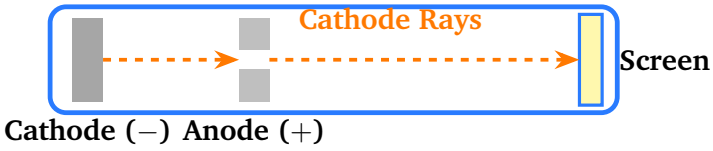
(A) FeCI

(B) Fe_2Cl_3

(C) $FeCl_3$

(D) Fe_3Cl

Q8. The diagram below represents a **cathode ray tube** experiment. Study the diagram and identify the **correct** conclusion drawn from this experiment.



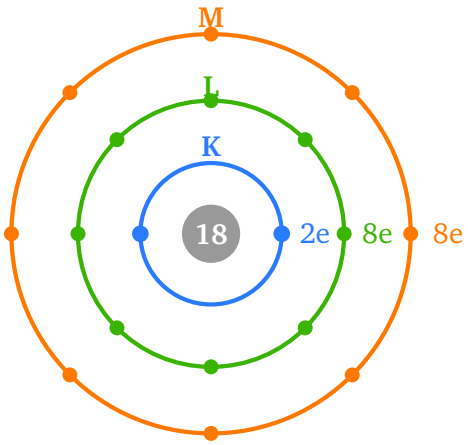
(A) Cathode rays are streams of negatively charged particles (electrons) that travel from cathode to anode, discovered by J.J. Thomson

(B) Cathode rays are streams of positively charged particles travelling from anode to cathode

(C) Cathode rays are electromagnetic radiation similar to visible light

(D) Cathode rays proved that the atom is indivisible and has no internal structure

Q9. The shell diagram below represents an atom with atomic number $Z = 18$. Which element is this, and what is its **electronic configuration**?



(A) Chlorine; 2, 8, 7

(B) Argon; 2, 8, 8

(C) Calcium; 2, 8, 8, 2

(D) Sulphur; 2, 8, 6

Q10. Which of the following statements correctly distinguishes between **atomic mass** and **mass number**?

(A) Mass number is the weighted average of all naturally occurring isotopes; atomic mass is always a whole number

(B) Atomic mass and mass number are identical for all elements

(C) Mass number counts only protons; atomic mass counts only neutrons

(D) Mass number is the total number of protons and neutrons in the nucleus; atomic mass is the average mass of an atom relative to $\frac{1}{12}$th the mass of a carbon-12 atom

Q11. The school bell produces a ringing sound when struck. This property of metals is known as:

(A) Sonority

(B) Ductility

(C) Malleability

(D) Conductivity

Q12. Which of the following is a **non-metal** that is an **exception** to the general rule that non-metals do not conduct electricity?

(A) Sulphur

(B) Phosphorus

(C) Graphite

(D) Iodine

Q13. Which of the following fuels has the **highest calorific value** (energy produced per kilogram of fuel)?

(A) Wood ($\approx 17{,}000\,\text{kJ/kg}$)

(B) Coal ($\approx 25{,}000\,\text{kJ/kg}$)

(C) LPG ($\approx 55{,}000\,\text{kJ/kg}$)

(D) Hydrogen ($\approx 1{,}50{,}000\,\text{kJ/kg}$)

Q14. A student tests two solutions — salt water (NaCl solution) and sugar water ($C_{12}H_{22}O_{11}$ solution) — using a simple **tester with a bulb and battery**. What will be the observation?

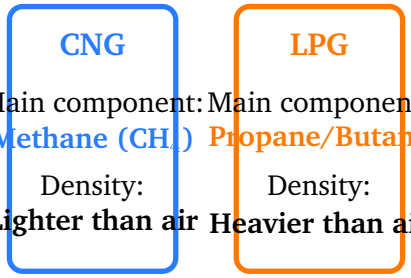
(A) The bulb glows brightly for sugar solution and does not glow for salt solution

(B) The bulb glows for salt solution but does not glow for sugar solution

(C) The bulb glows equally brightly for both solutions

(D) The bulb does not glow for either solution

Q15. The diagram below compares **CNG** and **LPG** as fuels. Based on the diagram and your knowledge, which statement is **correct**?



(A) CNG (compressed natural gas, mainly methane) is considered a cleaner fuel than LPG because it produces less pollution; being lighter than air, it disperses safely if it leaks

(B) LPG is a cleaner fuel than CNG because propane has a higher calorific value than methane

(C) CNG is heavier than air, making it more dangerous than LPG in case of a leak

(D) Both CNG and LPG have identical chemical compositions and calorific values

Detailed Solutions

Q1.

Solution

Concept: Matter exists in four states: solid, liquid, gas, and plasma. Plasma is the fourth state of matter, consisting of ionised gas with free electrons and positively charged ions.

Step 1 — Identify plasma: When a gas is heated to extremely high temperatures or subjected to strong electric fields, its atoms lose electrons and become ions. This mixture of free electrons and positive ions is called **plasma**.

Step 2 — Real-life examples: The sun and other stars are made mostly of plasma. Neon lights and fluorescent lamps work by creating plasma inside the tube. Lightning is also a plasma.

Why other options are wrong:

- (A): This describes a solid, where particles have low kinetic energy and are held in fixed positions.
- (B): **Correct.** Plasma is ionised gas with free electrons and positive ions, found in the sun and neon lights.
- (C): Describing liquid particles arranged in regular ordered patterns is incorrect for plasma; that describes a solid or crystalline solid.
- (D): A gaseous state with very low temperature is simply a gas (or a Bose-Einstein condensate at extremely low temperatures), not plasma.

Answer: (B) Go Back to Q 1

Q2.

Solution

Concept: Temperature is a measure of the average kinetic energy of the particles of a substance. Higher temperature means particles have greater kinetic energy and move faster.

Step 1 — Kinetic theory and temperature: According to the kinetic theory of matter, particles in a substance are always in motion. When we heat a substance, we supply energy to its particles.

Step 2 — Effect of heating: The supplied energy converts to kinetic energy of the particles, making them move faster. This increased kinetic energy is what

we measure as higher temperature. It does not change the mass or number of particles, nor does it strengthen intermolecular forces (it actually weakens them, enabling changes of state).

Why other options are wrong:

- (A): The mass of individual particles does not change with temperature.
- (B): The number of particles in a closed system remains constant regardless of temperature.
- (C): **Correct.** Kinetic energy of particles increases with temperature.
- (D): Increasing temperature actually weakens intermolecular forces (not strengthens them), which is why solids melt and liquids boil on heating.

Answer: (C) Go Back to Q 2

Q3.

Solution

Concept: A **homogeneous mixture** has uniform composition throughout (e.g., solutions). A **heterogeneous mixture** has non-uniform composition and visible distinct phases (e.g., suspensions).

Step 1 — Classify each substance:

- Vinegar (acetic acid dissolved in water) — uniform throughout — **homogeneous**
- Sand in water — sand settles, two distinct phases visible — **heterogeneous**
- Salt water — uniform solution — **homogeneous**
- Air — uniform mixture of gases — **homogeneous**

Step 2 — Match the correct option: Option (D) correctly identifies vinegar as homogeneous and sand in water as heterogeneous.

Why other options are wrong:

- (A): Sugar solution is also homogeneous, not heterogeneous.
- (B): Sand in water is heterogeneous (not homogeneous); vinegar is homogeneous (not heterogeneous).
- (C): Air is homogeneous (not heterogeneous); muddy water is heterogeneous (not homogeneous).

- (D): **Correct.** Vinegar is homogeneous; sand in water is heterogeneous.

Answer: (D) Go Back to Q 3

Q4.

Solution

Concept: Simple distillation is used to separate a volatile liquid from a non-volatile dissolved substance. The liquid is evaporated by heating and then condensed by cooling, leaving the dissolved substance behind.

Step 1 — Analyse the mixture: Ink is a mixture of water and coloured dye/pigment. Water is volatile (low boiling point); the dye is non-volatile.

Step 2 — Choose the technique: When the ink mixture is heated, water evaporates and rises as vapour. On cooling, the vapour condenses back to pure liquid water. The dye remains in the flask. This is simple distillation.

Why other options are wrong:

- (A): **Correct.** Simple distillation separates water from the dissolved dye in ink.
- (B): Filtration separates insoluble solids from liquids. Ink dye is dissolved, so filtration will not remove it.
- (C): Chromatography would separate the different dye pigments from each other, not purify the water.
- (D): Evaporation would remove the water by evaporation into air, but the water vapour is lost — we cannot collect pure water this way.

Answer: (A) Go Back to Q 4

Q5.

Solution

Concept: Gay-Lussac's Law of Gaseous Volumes states that gases combine in simple whole-number ratios of volumes (at the same temperature and pressure). Avogadro's law confirms equal volumes contain equal numbers of molecules.

Step 1 — Write the balanced equation:

$$2\,H_2(g) + O_2(g) \longrightarrow 2\,H_2O(g)$$

Step 2 — Read off the volume ratio: The coefficients give the volume ratio directly:

$$H_2 : O_2 : H_2O = 2 : 1 : 2$$

Why other options are wrong:

- (A): 1 : 1 : 1 is incorrect; oxygen is half the volume of hydrogen.
- (B): **Correct.** The ratio is 2 : 1 : 2 from the balanced equation.
- (C): 1 : 2 : 2 reverses the ratio of hydrogen and oxygen.
- (D): 2 : 2 : 1 is wrong; equal volumes of H_2 and O_2 do not match the equation.

Answer: (B) Go Back to Q 5

Q6.

Solution

Concept: The **formula unit mass** (or molar mass) of a compound is calculated by adding the atomic masses of all atoms present in one formula unit.

Step 1 — Identify atoms in $CaCO_3$: One Ca, one C, and three O atoms.

Step 2 — Add atomic masses:

$$Ca + C + 3 \times O = 40 + 12 + (3 \times 16) = 40 + 12 + 48 = \mathbf{100\,u}$$

Why other options are wrong:

- (A): 56 u corresponds to CaO (40 + 16), not $CaCO_3$.
- (B): 84 u would result if only two oxygens were counted: $40 + 12 + 32 = 84$.
- (C): 96 u has no straightforward correspondence to $CaCO_3$.
- (D): **Correct.** $40 + 12 + 48 = 100$ u is the formula unit mass of $CaCO_3$.

Answer: (D) Go Back to Q 6

Q7.

Solution

Concept: The **criss-cross method** involves swapping the valencies of the ions to get the subscripts in the chemical formula.

Step 1 — Write valencies:

- Iron(III) ion: Fe^{3+} (valency = 3)
- Chloride ion: Cl^{-} (valency = 1)

Step 2 — Apply criss-cross: The valency of Fe (3) becomes the subscript of Cl, and the valency of Cl (1) becomes the subscript of Fe:

$$Fe_1Cl_3 \longrightarrow \mathbf{FeCl_3}$$

(A subscript of 1 is not written.)

Why other options are wrong:

- (A): FeCI (or $FeCl_1$) would require valency of Fe to be 1, which is Fe(I), not Fe(III).
- (B): Fe_2Cl_3 applies to iron(III) oxide-type counting — not correct for chloride with these valencies.
- (C): **Correct.** $FeCl_3$ from the criss-cross of Fe^{3+} and Cl^{-}.
- (D): Fe_3Cl reverses the subscripts, which is incorrect.

Answer: (C) Go Back to Q 7

Q8.

Solution

Concept: J.J. Thomson's cathode ray tube experiment (1897) demonstrated that cathode rays are streams of negatively charged particles. These particles, later called **electrons**, travel from the negative electrode (cathode) to the positive electrode (anode) and beyond to a fluorescent screen.

Step 1 — The experiment: When a high voltage was applied across a sealed glass tube containing gas at very low pressure, glowing rays emerged from the cathode and travelled toward the anode.

Step 2 — Key findings:

- The rays travelled in straight lines.

- They were deflected toward a positive plate — confirming they carry negative charge.
- The charge-to-mass ratio was the same regardless of the cathode material, proving electrons are a fundamental constituent of all atoms.

Why other options are wrong:

- (A): **Correct.** Cathode rays are negatively charged electrons travelling from cathode to anode.
- (B): Positively charged particles (protons/canal rays) travel in the opposite direction (anode to cathode), not cathode rays.
- (C): Cathode rays are not electromagnetic radiation; they are deflected by electric and magnetic fields, unlike light.
- (D): The experiment actually proved that atoms do have internal structure (they contain electrons), contradicting the indivisible atom idea.

Answer: (A) Go Back to Q 8

Q9.

Solution

Concept: Electrons are arranged in shells (energy levels) around the nucleus. The maximum number of electrons in a shell is given by $2n^2$, where n is the shell number. For Argon ($Z = 18$), we fill the shells sequentially.

Step 1 — Fill the shells:

- Shell K ($n = 1$): maximum $2(1)^2 = 2$ electrons. Fill with **2**.
- Shell L ($n = 2$): maximum $2(2)^2 = 8$ electrons. Fill with **8**.
- Shell M ($n = 3$): remaining $18 - 2 - 8 = \mathbf{8}$ electrons.

Step 2 — Electronic configuration of Ar: $2, 8, 8$. Argon has atomic number 18 and is a noble gas (Group 18).

Why other options are wrong:

- (A): Chlorine (Z = 17) has configuration 2, 8, 7 — one less electron than argon.
- (B): **Correct.** Argon (Z = 18) has electronic configuration 2, 8, 8.

- (C): Calcium (Z = 20) has configuration 2, 8, 8, 2 — two additional electrons in a fourth shell.
- (D): Sulphur (Z = 16) has configuration 2, 8, 6 — two fewer electrons than argon in the M shell.

Answer: (B) Go Back to Q 9

Q10.

Solution

Concept: Mass number (A) is always a whole number equal to the total count of protons and neutrons in the nucleus. **Atomic mass** (relative atomic mass) is the weighted average mass of all naturally occurring isotopes of an element, expressed in atomic mass units (u), and is often a decimal.

Step 1 — Mass number: $A = Z + N$, where Z = proton number and N = neutron number. It is always a positive integer.

Step 2 — Atomic mass: The atomic mass takes into account the abundance of each isotope. For chlorine, for example, it is approximately 35.5 u because it is a mix of ^{35}Cl and ^{37}Cl.

Why other options are wrong:

- (A): This is reversed — atomic mass is the weighted average and can be a decimal; mass number is the whole number.
- (B): They are not identical; atomic mass is often a non-integer due to isotopic averaging.
- (C): Mass number counts both protons and neutrons, not just protons.
- (D): **Correct.** Mass number = protons + neutrons; atomic mass = average mass relative to $\frac{1}{12}$ of carbon-12.

Answer: (D) Go Back to Q 10

Q11.

Solution

Concept: Metals have several characteristic physical properties. **Sonority** is the property of metals to produce a ringing or bell-like sound when struck with a hard object.

Step 1 — Identify the property: The school bell produces a loud, ringing sound when struck. This occurs because the metal vibrates and the sound energy travels as waves for a long time — this is sonority.

Step 2 — Distinguish from other properties:

- **Ductility** = can be drawn into thin wires (e.g., copper wire)
- **Malleability** = can be beaten into thin sheets (e.g., gold foil)
- **Conductivity** = ability to conduct heat and electricity

Why other options are wrong:

- (A): **Correct.** Sonority is the ringing-sound property of metals.
- (B): Ductility relates to drawing metals into wires, not sound production.
- (C): Malleability relates to beating metals into sheets, not sound.
- (D): Conductivity relates to heat/electricity flow, not sound production.

Answer: (A) Go Back to Q 11

Q12.

Solution

Concept: In general, non-metals are poor conductors of electricity. However, **graphite** (an allotrope of carbon) is an important exception — it conducts electricity due to the presence of delocalised electrons in its layered structure.

Step 1 — Why graphite conducts: In graphite, each carbon atom forms three covalent bonds with neighbours, leaving one electron per atom free to move. These delocalised electrons allow graphite to conduct electricity, similar to metals.

Step 2 — Applications: Graphite is used as electrodes in electrolysis and in dry cell batteries precisely because it is a conducting non-metal.

Why other options are wrong:

- (A): Sulphur is a non-metal and does not conduct electricity.
- (B): Phosphorus is a non-metal and does not conduct electricity.
- (C): **Correct.** Graphite is the non-metal exception that conducts electricity.
- (D): Iodine is a non-metal and does not conduct electricity (though it does sublime).

Answer: (C) Go Back to Q 12

Q13.

Solution

Concept: Calorific value is the amount of heat energy produced by the complete combustion of 1 kg of a fuel. A higher calorific value means a fuel produces more energy per kilogram.

Step 1 — Compare the values given:

- Wood: $\approx 17{,}000$ kJ/kg
- Coal: $\approx 25{,}000$ kJ/kg
- LPG: $\approx 55{,}000$ kJ/kg
- Hydrogen: $\approx 1{,}50{,}000$ kJ/kg

Step 2 — Identify the highest: Hydrogen has the highest calorific value among fuels — approximately 1,50,000 kJ/kg, making it the most energy-dense fuel by mass.

Why other options are wrong:

- (A): Wood has the lowest calorific value of the given options.
- (B): Coal has a higher value than wood but is much lower than LPG and hydrogen.
- (C): LPG has a high calorific value ($\approx 55{,}000$ kJ/kg) but lower than hydrogen.
- (D): **Correct.** Hydrogen has the highest calorific value ($\approx 1{,}50{,}000$ kJ/kg).

Answer: (D) Go Back to Q 13

Q14.

Solution

Concept: Liquids that allow electricity to pass through them are called **conductors of electricity** (electrolytes). Salt water (NaCl solution) is a good conductor because NaCl dissociates into Na^+ and Cl^- ions. Sugar water does not dissociate into ions and is a **non-conductor** (non-electrolyte).

Step 1 — Salt solution: NaCl in water: $NaCl \rightarrow Na^+ + Cl^-$. Free ions carry

charge, completing the circuit. The bulb **glows**.

Step 2 — Sugar solution: $C_{12}H_{22}O_{11}$ dissolves in water but does not ionise. No free ions are present. The circuit is not completed. The bulb **does not glow**.

Why other options are wrong:

- (A): This reverses the result — sugar solution would not light the bulb.
- (B): **Correct.** Salt solution conducts (bulb glows); sugar solution does not (bulb stays off).
- (C): The bulb cannot glow equally for both because sugar solution is a non-electrolyte.
- (D): Salt solution definitely conducts electricity, so the bulb would glow.

Answer: (B) Go Back to Q 14

Q15.

Solution

Concept: CNG (Compressed Natural Gas) is mainly methane (CH_4). **LPG** (Liquefied Petroleum Gas) is mainly propane (C_3H_8) and butane (C_4H_{10}). CNG is considered a cleaner fuel because methane has a higher hydrogen-to-carbon ratio, producing more water and less carbon dioxide per unit of energy.

Step 1 — Compare compositions:

- CNG: primarily methane (CH_4) — 1 carbon, 4 hydrogens
- LPG: propane (C_3H_8) and butane (C_4H_{10}) — more carbons per molecule

Step 2 — Compare densities:

- Methane (CNG) is **lighter than air** — disperses upward quickly if it leaks, reducing fire risk.
- LPG is **heavier than air** — accumulates near the floor, which is a fire and explosion hazard.

Why other options are wrong:

- (A): **Correct.** CNG (methane) is cleaner than LPG and lighter than air.
- (B): LPG is not cleaner than CNG; it produces more carbon emissions per unit energy.

- (C): CNG is lighter than air (not heavier), making it safer in terms of dispersal upon leakage.
- (D): CNG and LPG have different chemical compositions and different calorific values.

Answer: (A) Go Back to Q 15

Answer Key

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