TALLENTEX Chemistry

Sample Paper – 8

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.

Questions

Q1. Which of the following is considered the **fifth state of matter**, formed when certain gases are cooled to temperatures very close to absolute zero (≈ 0 K)?

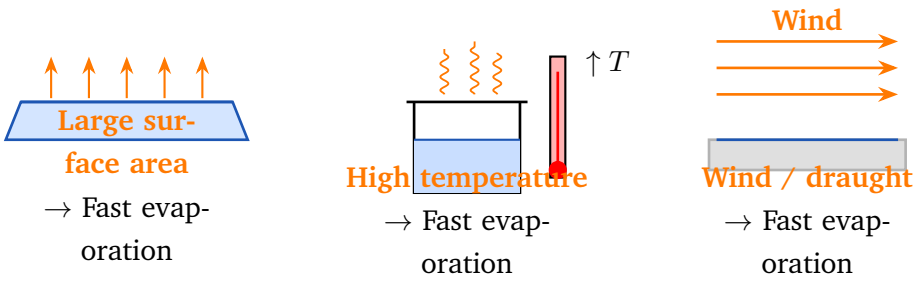
(A) Plasma

(B) Liquid crystal

(C) Bose-Einstein condensate

(D) Fermionic condensate

Q2. Study the diagram below showing three situations. Which option correctly lists **all three factors** shown that *increase* the rate of evaporation?



(A) Surface area, temperature, wind speed

(B) Temperature, humidity, wind speed

(C) Surface area, pressure, temperature

(D) Wind speed, nature of liquid, pressure

Q3. Which of the following statements is **correct** about a **suspension**?

(A) Particles in a suspension are smaller than 1 nm and cannot be seen even with a microscope.

(B) Particles in a suspension are large enough to settle on standing and make the mixture opaque.

(C) A suspension is a homogeneous mixture and does not scatter light.

(D) Particles of a suspension pass through filter paper without being retained.

Q4. A student has an impure sample of potassium nitrate (KNO_3) containing some common salt (NaCl). The **best method** to obtain pure KNO_3 from this mixture is:

(A) Simple distillation

(B) Chromatography

(C) Sublimation

(D) Crystallization

Q5. Avogadro's hypothesis states that equal volumes of all gases, at the **same temperature and pressure**, contain:

(A) Equal number of molecules

(B) Equal number of atoms

(C) Equal masses

(D) Equal number of moles of electrons

Q6. The **actual mass** of one atom of carbon-12 (C-12) is approximately:

(A) 12 g

(B) 1.99×10^{-23} kg

(C) 1.99×10^{-23} g

(D) 6.02×10^{23} g

Q7. When one formula unit of sodium sulphate (Na_2SO_4) dissociates completely in water, the ions produced are:

(A) 1 Na^+ and 1 SO_4^{2-}

(B) 1 Na^+ and 2 SO_4^{2-}

(C) 2 Na^+ and 2 SO_4^{2-}

(D) 2 Na^+ and 1 SO_4^{2-}

Q8. Henry Moseley's work established that the **fundamental property** that uniquely identifies a chemical element is its:

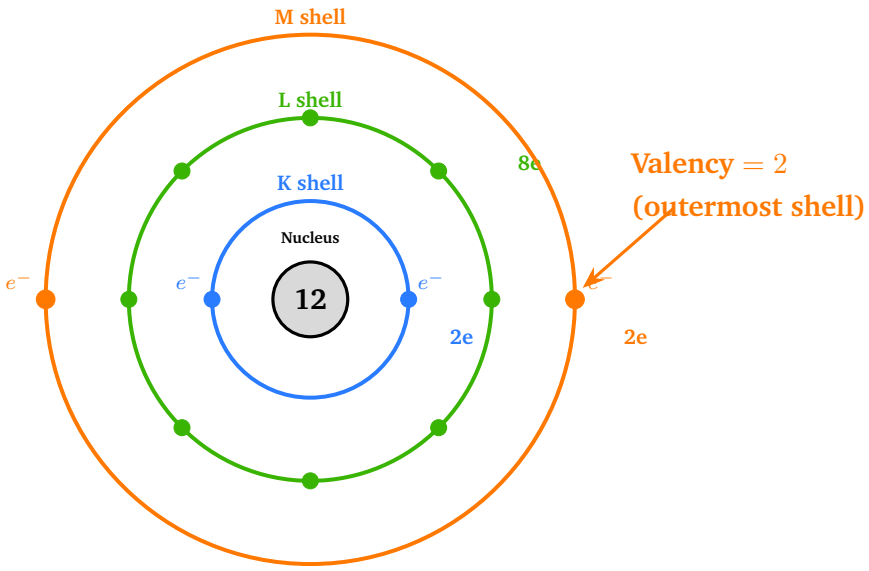
(A) Atomic mass

(B) Atomic number (number of protons in the nucleus)

(C) Number of neutrons

(D) Mass number

Q9. The electron shell diagram of magnesium (Mg, $Z = 12$) is shown below. What is the **valency** of magnesium, and how is it determined from the diagram?



(A) Valency $= 8$; determined by electrons in the L shell

(B) Valency $= 10$; sum of electrons in K and L shells

(C) Valency $= 2$; determined by electrons in the outermost (M) shell

(D) Valency $= 12$; equal to atomic number

Q10. Which of the following correctly pairs a **radioactive isotope** with its **medical application**?

(A) Iodine-131 (I-131) — treatment of thyroid disorders; Cobalt-60 (Co-60) — cancer radiotherapy

(B) Carbon-14 (C-14) — treatment of bone cancer; Uranium-235 (U-235) — kidney disorders

(C) Iodine-131 (I-131) — treatment of cancer; Carbon-14 (C-14) — thyroid disorders

(D) Cobalt-60 (Co-60) — detection of leaks in pipelines; Iodine-131 (I-131) — food preservation

Q11. When iron (Fe) reacts with **dilute sulphuric acid** (H_2SO_4), the products formed are:

(A) Iron(III) sulphate and water

(B) Iron(III) oxide and hydrogen gas

(C) Iron(II) oxide and sulphur dioxide

(D) Iron(II) sulphate ($FeSO_4$) and hydrogen gas (H_2)

Q12. Sulphur dioxide (SO_2) released during the burning of fossil fuels dissolves in rain water to form:

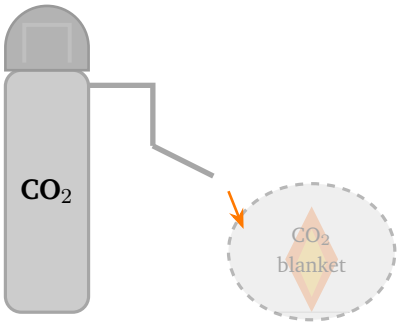
(A) Sulphuric acid (H_2SO_4), contributing to global warming

(B) Sulphurous acid (H_2SO_3), contributing to acid rain

(C) Hydrogen sulphide (H_2S), contributing to smog

(D) Sulphur trioxide (SO_3), which is harmless

Q13. The diagram below shows a CO_2 fire extinguisher being used on a fire. Why is **carbon dioxide** effective as a fire extinguisher?



CO_2 blanket removes O_2

(cuts off oxygen supply to the fire)

(A) It is heavier than air and cuts off the supply of oxygen to the fire

(B) It reacts with fuel to form a non-combustible compound

(C) It absorbs heat and cools the fuel below ignition temperature

(D) It releases water vapour that douses the flames

Q14. Electroplating is widely used in everyday life. Which of the following is a **correct** example of its practical application?

(A) Coating iron pipes with cement to prevent rusting

(B) Mixing copper powder into plastic to make it conduct electricity

(C) Plating jewellery with gold and coating food cans with tin to prevent corrosion

(D) Painting bridges with lead-based paint to protect them from weathering

Q15. Which **synthetic fibre** closely resembles natural wool in appearance and feel, and is commonly used to make sweaters, blankets, and shawls?

(A) Nylon

(B) Acrylic

(C) Polyester

(D) Rayon

Detailed Solutions

Q1.

Solution

Concept: Matter exists in five states: solid, liquid, gas, plasma, and Bose-Einstein condensate (BEC). The first three are familiar. Plasma is the fourth state found in stars and lightning. BEC is the fifth state, predicted by Satyendra Nath Bose and Albert Einstein, formed at temperatures extremely close to absolute zero (0 K or $-273.15\,^{\circ}\text{C}$).

Step 1 — Formation of BEC: When certain gases (e.g., rubidium atoms) are cooled to near 0 K, atoms lose almost all kinetic energy and "condense" into the lowest quantum state, behaving as a single quantum entity. This forms the Bose-Einstein condensate.

Step 2 — Identifying the answer: The question asks for the fifth state of matter formed near absolute zero. This is the Bose-Einstein condensate (option C).

Why other options are wrong:

- (A): Plasma is the *fourth* state of matter, formed at extremely *high* temperatures (not near 0 K).
- (B): Liquid crystal is an intermediate state between liquid and solid; it is not classified as a distinct fifth state of matter.
- (D): Fermionic condensate is a related but distinct quantum state (formed from fermions, not bosons) and is not the standard "fifth state" referred to in NCERT context.

Answer: (C) Go Back to Q 1

Q2.

Solution

Concept: Evaporation is a surface phenomenon. According to NCERT Class 9, the factors that *increase* the rate of evaporation are: (i) increase in surface area, (ii) increase in temperature, (iii) increase in wind speed (draught), and (iv) decrease in humidity.

Step 1 — Analysing the diagram: The three panels show (i) a wide shallow dish with a large surface area, (ii) a beaker being heated (high temperature), and (iii) wind arrows blowing over a liquid surface.

Step 2 — Matching to options: All three factors shown — surface area, temper-

ature, and wind speed — increase evaporation rate. This matches option (A).

Why other options are wrong:

- (A): Correct — surface area, temperature, and wind speed are all shown and all increase evaporation.
- (B): Humidity is not shown in the diagram; moreover, *higher* humidity *decreases* evaporation, not increases it.
- (C): Pressure is not depicted; higher atmospheric pressure *decreases* evaporation.
- (D): Nature of liquid and pressure are not shown; they are additional factors but not the ones illustrated.

Answer: (A) Go Back to Q 2

Q3.

Solution

Concept: A suspension is a heterogeneous mixture in which solute particles are larger than 1000 nm (1 μm). Key properties: particles settle on standing, the mixture is opaque, particles are retained on filter paper, and they scatter a beam of light (Tyndall effect strongly visible).

Step 1 — Key properties of a suspension:

- Particle size: > 1000 nm (visible to naked eye or under microscope)
- Stability: *unstable* — particles settle on standing
- Appearance: *opaque*
- Filtration: particles are *retained* by filter paper

Step 2 — Evaluating option (B): "Particles in a suspension are large enough to settle on standing and make the mixture opaque." This is precisely correct for a suspension.

Why other options are wrong:

- (A): Particles smaller than 1 nm describe a *true solution* (solute particles), not a suspension.
- (C): Suspensions are *heterogeneous*, not homogeneous; they do scatter light (Tyndall effect).

- (D): Particles of a suspension are *retained* by filter paper, not passed through.

Answer: (B) Go Back to Q 3

Q4.

Solution

Concept: Crystallization is the process of purifying a substance that has different solubilities at different temperatures. KNO_3 is highly soluble in hot water and sparingly soluble in cold water, whereas NaCl has nearly the same solubility at all temperatures. This difference makes crystallization the ideal method.

Step 1 — Procedure of crystallization for KNO_3:

(a) Dissolve the impure KNO_3 in minimum hot water.

(b) Filter to remove insoluble impurities.

(c) Allow the hot saturated solution to cool slowly.

(d) KNO_3 crystallizes out because its solubility drops sharply with temperature; NaCl remains in solution.

(e) Filter and dry the pure KNO_3 crystals.

Step 2 — Why crystallization is the best method: The large difference in temperature-dependent solubility between KNO_3 and NaCl makes crystallization (option D) ideal.

Why other options are wrong:

- (A): Simple distillation separates liquids or removes a solvent; it cannot separate two solid solutes.
- (B): Chromatography separates mixtures of dyes or pigments, not salts with large solubility differences.
- (C): Sublimation works only for solids that directly convert to gas (e.g., ammonium chloride, camphor); KNO_3 does not sublime.

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept: Avogadro's hypothesis (1811): "Equal volumes of all gases, at the same temperature and pressure, contain equal numbers of *molecules*." This is a foundational law in chemistry that helped reconcile Dalton's atomic theory with Gay-Lussac's law of combining volumes.

Step 1 — Statement of Avogadro's hypothesis: The hypothesis specifically refers to equal numbers of *molecules*, not atoms, masses, or moles of electrons.

Step 2 — Application: For example, 1 L of H_2 and 1 L of O_2 at the same T and P contain the same number of molecules. This is option (A).

Why other options are wrong:

- (A): Correct — equal number of *molecules*.
- (B): Equal number of *atoms* would be incorrect because different molecules have different numbers of atoms (e.g., O_2 has 2 atoms per molecule, O_3 has 3).
- (C): Equal masses would be incorrect; masses depend on the molar mass of the gas.
- (D): Equal moles of electrons has no relevance to Avogadro's hypothesis.

Answer: (A) Go Back to Q 5

Q6.

Solution

Concept: The atomic mass unit (u or amu) is defined as $\frac{1}{12}$ the mass of one carbon-12 atom. The actual mass of one C-12 atom is obtained by dividing the molar mass (12 g/mol) by Avogadro's number ($N_A = 6.022 \times 10^{23}$ mol^{-1}).

Step 1 — Calculation:

$$\text{Mass of one C-12 atom} = \frac{12\ \text{g/mol}}{6.022 \times 10^{23}\ \text{mol}^{-1}} = 1.993 \times 10^{-23}\ \text{g} \approx 1.99 \times 10^{-23}\ \text{g}$$

Step 2 — Identifying option (C): 1.99×10^{-23} g is the correct actual mass of one C-12 atom.

Why other options are wrong:

- (A): 12 g is the *molar mass* of carbon (mass of one *mole* of C-12 atoms), not one atom.

- (B): 1.99×10^{-23} kg is incorrect in units; 1.99×10^{-23} g $= 1.99 \times 10^{-26}$ kg.
- (D): 6.02×10^{23} g is Avogadro's number itself (dimensionally incorrect for a mass).

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept: Sodium sulphate (Na_2SO_4) is an ionic compound. Its formula indicates two sodium ions (Na^+) and one sulphate ion (SO_4^{2-}) per formula unit. Charge balance: $2(+1) + 1(-2) = 0$. When dissolved in water, it dissociates completely:

$$Na_2SO_4 \xrightarrow{H_2O} 2\,Na^+ + SO_4^{2-}$$

Step 1 — Counting ions: From the formula Na_2SO_4: subscript 2 before Na means 2 Na^+ ions; subscript 4 is part of the polyatomic sulphate ion, not a separate counter. One formula unit gives 2 Na^+ and 1 SO_4^{2-}.

Step 2 — Charge verification: $2 \times (+1) + 1 \times (-2) = 0$. Electrically neutral. Correct.

Why other options are wrong:

- (A): 1 Na^+ and 1 SO_4^{2-} gives net charge $= -1 \neq 0$. Incorrect.
- (B): 1 Na^+ and 2 SO_4^{2-} gives net charge $= -3 \neq 0$. Incorrect.
- (C): 2 Na^+ and 2 SO_4^{2-} gives net charge $= -2 \neq 0$. Incorrect.
- (D): 2 Na^+ and 1 SO_4^{2-} gives net charge $= 0$. Correct.

Answer: (D) Go Back to Q 7

Q8.

Solution

Concept: Henry Moseley (1913) studied X-ray spectra of elements and discovered that the frequency of characteristic X-rays is related to the atomic number (Z), i.e., the number of protons in the nucleus. He concluded that atomic number, not atomic mass, is the fundamental property that defines an element.

Step 1 — Moseley's finding: Elements arranged by increasing atomic number (not atomic mass) gave a consistent, gap-free periodic table. Isotopes (same Z,

different mass) are the same element, confirming Z is the defining property.

Step 2 — Significance: Before Moseley, elements were arranged by atomic mass (Mendeleev). Moseley's work corrected anomalies (e.g., Ar and K) and predicted missing elements.

Why other options are wrong:

- (A): Atomic mass was Mendeleev's basis; Moseley showed it is *not* the fundamental identity property.
- (B): Correct — atomic number (number of protons) uniquely identifies an element.
- (C): Number of neutrons varies within isotopes of the same element (same Z, different N).
- (D): Mass number $= Z + N$ can differ between isotopes; it is not the unique identifier.

Answer: (B) Go Back to Q 8

Q9.

Solution

Concept: Valency is determined by the number of electrons in the outermost (valence) shell. For elements with 1–4 valence electrons, valency equals the number of valence electrons. For elements with 5–8 valence electrons, valency $= 8-$ (valence electrons). Mg has $Z = 12$.

Step 1 — Electronic configuration of Mg:

$$\text{Mg } (Z = 12): \quad K = 2, \quad L = 8, \quad M = 2$$

The electron distribution follows the $2n^2$ rule: K can hold max 2, L max 8. So 12 electrons fill as 2, 8, 2.

Step 2 — Determining valency: The outermost shell (M shell) has **2 electrons**. Since $2 \leq 4$, valency $= 2$. Mg loses 2 electrons to form Mg^{2+}, achieving the stable configuration of Ne (2,8).

Why other options are wrong:

- (A): Valency $= 8$ (L shell electrons) is wrong; valency is from the *outermost* shell, not an inner shell.
- (B): Sum of K and L electrons $= 10$ has no chemical meaning for valency.

- (C): Correct — valency $= 2$, from the 2 electrons in the outermost M shell.
- (D): Valency $= 12$ (atomic number) is meaningless; valency is not the atomic number.

Answer: (C) Go Back to Q 9

Q10.

Solution

Concept: Radioactive isotopes (radioisotopes) have important medical uses. NCERT Class 9 specifically mentions: Iodine-131 for diagnosing and treating thyroid disorders (iodine is preferentially absorbed by the thyroid gland), and Cobalt-60 for cancer radiotherapy (gamma rays destroy cancer cells).

Step 1 — Iodine-131 (I-131): The thyroid gland absorbs iodine to produce hormones. Radioactive I-131 is given to patients; it accumulates in the thyroid, and its radiation can detect tumours or destroy overactive thyroid tissue.

Step 2 — Cobalt-60 (Co-60): Emits high-energy gamma rays used in radiation therapy (radiotherapy) to destroy cancer cells. This is the "cobalt bomb" treatment for cancer.

Why other options are wrong:

- (A): Correct — I-131 for thyroid, Co-60 for cancer radiotherapy.
- (B): C-14 is used in carbon dating (archaeology), not bone cancer treatment; U-235 is a nuclear fuel, not a medical isotope.
- (C): I-131 targets the thyroid, not general cancers; C-14 is not used for thyroid treatment.
- (D): Co-60 can detect pipeline leaks, but its primary *medical* use is radiotherapy; I-131 is not used for food preservation.

Answer: (A) Go Back to Q 10

Q11.

Solution

Concept: Metals above hydrogen in the reactivity series react with dilute acids to displace hydrogen gas and form a salt. Iron (Fe) reacts with dilute sulphuric acid to form iron(II) sulphate ($FeSO_4$) and hydrogen gas (H_2), because Fe is less reactive than Mg/Al but more reactive than Cu; it forms the $+2$ (ferrous) state

with dilute acids.

Step 1 — Balanced equation:

$$Fe + H_2SO_4(dil.) \longrightarrow FeSO_4 + H_2 \uparrow$$

Step 2 — Iron forms Fe^{2+} (not Fe^{3+}) with dilute acid: With dilute H_2SO_4, Fe is oxidized to Fe(II) (ferrous sulphate, light green solution). Fe(III) (ferric) is formed under oxidizing conditions, not with dilute acid alone.

Why other options are wrong:

- (A): Iron(III) sulphate requires oxidizing conditions (concentrated acid or oxidizing agent); with *dilute* H_2SO_4, Fe(II) is formed. Water is not a product.
- (B): Iron(III) oxide is a solid formed by rusting (reaction with O_2 and water), not by reaction with dilute acid.
- (C): Iron(II) oxide and sulphur dioxide — SO_2 is not produced in this reaction; sulphate ion remains intact.
- (D): Correct — $FeSO_4$ (iron(II) sulphate) and H_2 gas.

Answer: (D) Go Back to Q 11

Q12.

Solution

Concept: Sulphur dioxide (SO_2) is a non-metallic oxide. Non-metallic oxides are acidic in nature. When SO_2 dissolves in water, it forms sulphurous acid (H_2SO_3), which is a weak acid. This contributes to acid rain, damaging buildings, statues, soil, and aquatic life.

Step 1 — Reaction of SO_2 with water:

$$SO_2 + H_2O \longrightarrow H_2SO_3 \quad \text{(sulphurous acid)}$$

Step 2 — Role in acid rain: SO_2 and NO_x from burning fossil fuels dissolve in atmospheric water to form acid rain (H_2SO_3 and dilute HNO_3/HNO_2), with pH below 5.6.

Why other options are wrong:

- (A): Sulphuric acid (H_2SO_4) is formed from SO_3 (sulphur trioxide), not directly from SO_2. Also, H_2SO_4 contributes to acid rain, not primarily global warming.

- (B): Correct — H_2SO_3 (sulphurous acid) and it contributes to acid rain.
- (C): Hydrogen sulphide (H_2S) has a foul smell; it is not produced by SO_2 dissolving in water; it is produced by the reaction of sulphide salts with acids.
- (D): SO_3 is the acidic anhydride of H_2SO_4; it is *not* harmless and is not produced by SO_2 dissolving in water.

Answer: (B) Go Back to Q 12

Q13.

Solution

Concept: For combustion to occur, three things are needed: fuel, heat, and oxygen (fire triangle). A fire can be extinguished by removing any one of these. CO_2 extinguishers work primarily by *smothering* the fire: CO_2 is denser than air, forms a blanket over the burning material, and cuts off the oxygen supply.

Step 1 — Properties of CO_2 relevant to fire fighting:

- CO_2 does not support combustion (it is already fully oxidized).
- CO_2 is about 1.5 times denser than air; it sinks and displaces oxygen around the fire.
- It does not react with most substances, making it safe for electrical fires and paper/wood fires.

Step 2 — Mechanism: The CO_2 cloud (as shown in the diagram) covers the flame, cutting off the oxygen supply. Without O_2, the combustion reaction stops.

Why other options are wrong:

- (A): Correct — CO_2 is heavier than air and cuts off oxygen supply.
- (B): CO_2 does not react chemically with the fuel in the fire-extinguishing process.
- (C): CO_2 extinguishers have some cooling effect but this is secondary; water extinguishers primarily cool the fuel. The main mechanism for CO_2 is oxygen exclusion.
- (D): CO_2 extinguishers release CO_2 gas, not water vapour.

Answer: (A) Go Back to Q 13

Q14.

Solution

Concept: Electroplating is the process of depositing a thin layer of one metal over another using electricity. Common applications include: (i) gold/silver plating of jewellery to make it attractive and durable; (ii) tin coating of food cans (tin cans) to prevent iron from reacting with food (corrosion protection); (iii) chromium plating of car parts; (iv) zinc plating (galvanising) of iron to prevent rusting.

Step 1 — Jewellery electroplating: Cheap metals are coated with gold or silver to give them the appearance and corrosion resistance of precious metals at lower cost. This is a direct application of electroplating.

Step 2 — Tin-coated food cans: Iron cans are electroplated with tin because tin is non-toxic, does not react with food, and prevents the iron from rusting. This is a standard NCERT Class 8 example.

Why other options are wrong:

- (A): Coating iron pipes with cement is a physical/mechanical protection method, not electroplating.
- (B): Mixing copper powder into plastic to improve conductivity is a physical blending process, not electroplating.
- (C): Correct — gold plating of jewellery and tin plating of food cans are both electroplating applications.
- (D): Painting bridges with lead-based paint is a chemical surface coating, not electroplating.

Answer: (C) Go Back to Q 14

Q15.

Solution

Concept: Acrylic is a synthetic fibre made from a polymer called polyacrylonitrile (PAN). It closely resembles natural wool in warmth, softness, and appearance. It is cheaper than wool, lighter, and resistant to moth attack. It is widely used in making sweaters, blankets, shawls, and carpets. NCERT Class 8 explicitly states that acrylic is used as a substitute for wool.

Step 1 — Properties of acrylic:

- Resembles wool in appearance and warmth
- Softer and lighter than natural wool

- Cheaper; does not shrink; moth-resistant
- Used to make: sweaters, blankets, shawls, carpets, imitation fur

Step 2 — Distinguishing acrylic from other synthetic fibres:

- Nylon: very strong, used in ropes, parachutes, toothbrush bristles, stockings
- Polyester: used in clothing (Terylene/Dacron), bottles, films; less wool-like
- Rayon: made from cellulose (semi-synthetic); resembles silk, not wool

Why other options are wrong:

- (A): Nylon resembles silk in smoothness; it is used in ropes, stockings, and parachutes — not as a wool substitute.
- (B): Correct — acrylic resembles wool and is used in sweaters and blankets.
- (C): Polyester is used in fabrics and bottles; it does not have the wool-like texture of acrylic.
- (D): Rayon (artificial silk) is made from plant cellulose and resembles silk, not wool.

Answer: (B) Go Back to Q 15

Answer Key

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