TALLENTEX Chemistry

Sample Paper – 9

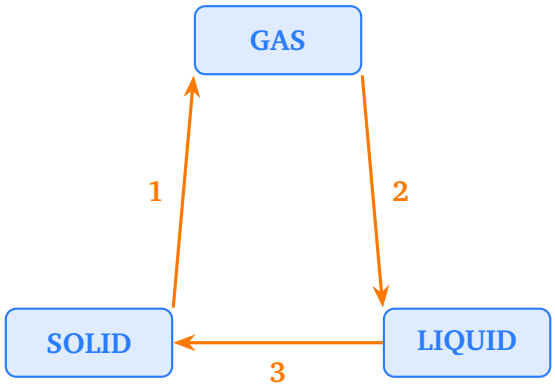
Duration: 23 Minutes **Maximum Marks: 60**

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. The diagram below shows the six changes of state between solid, liquid, and gas. The arrows are numbered 1, 2, and 3. Which row in the table below **correctly identifies** all three labelled transitions?



(A) Arrow 1 = Evaporation; Arrow 2 = Deposition; Arrow 3 = Melting

(B) Arrow 1 = Sublimation; Arrow 2 = Condensation; Arrow 3 = Freezing

(C) Arrow 1 = Melting; Arrow 2 = Condensation; Arrow 3 = Evaporation

(D) Arrow 1 = Sublimation; Arrow 2 = Evaporation; Arrow 3 = Condensation

Q2. Solids have a **definite shape and volume** because:

(A) The intermolecular forces of attraction are very strong and particles can only vibrate about their fixed positions

(B) Solids have very low density compared to liquids and gases

(C) The particles in a solid move freely throughout the container

(D) Solids always have high melting points above 500°C

Q3. A student wants to separate cream from milk. The **most appropriate** separation technique for this purpose is:

(A) Magnetic separation

(B) Sublimation

(C) Centrifugation

(D) Paper chromatography

Q4. Which of the following statements **correctly distinguishes** a compound from a mixture?

(A) A compound can be separated by physical methods; a mixture cannot

(B) A mixture has a fixed melting point; a compound does not

(C) Both compounds and mixtures have variable composition

(D) A compound has fixed composition and properties different from its constituents; a mixture retains the properties of its components

Q5. Which of the following molecules is **triatomic** (consisting of exactly three atoms per molecule)?

(A) Ozone (O_3)

(B) Nitrogen (N_2)

(C) Phosphorus (P_4)

(D) Sulphur (S_8)

Q6. Dalton's atomic theory stated that atoms are **indivisible** and **indestructible**. Which of the following phenomena **contradicts** this postulate?

(A) Law of Conservation of Mass

(B) Nuclear fission of uranium-235

(C) Formation of water from hydrogen and oxygen

(D) Gay-Lussac's Law of Gaseous Volumes

Q7. How many moles of oxygen atoms are present in 3.01×10^{23} atoms of oxygen? (Take Avogadro's number $N_A = 6.02 \times 10^{23}$)

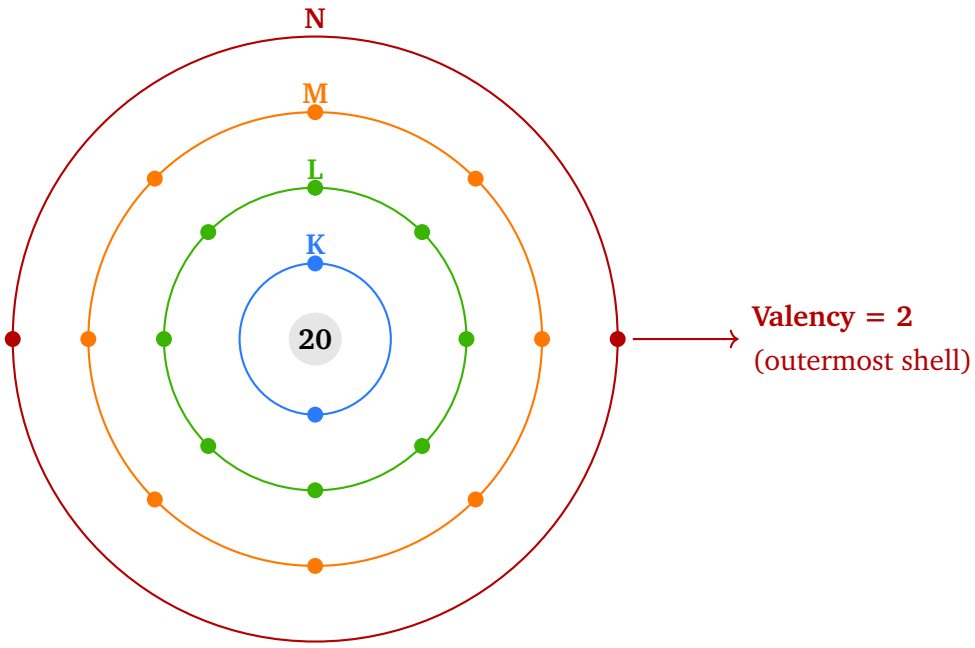
(A) 2 mol

(B) 1 mol

(C) 0.5 mol

(D) 0.25 mol

Q8. The electron shell diagram of calcium (Ca, $Z = 20$) is shown below. What is the **correct electronic configuration** of calcium, and what is its **valency**?



(A) Configuration: 2, 8, 10; Valency = 10

(B) Configuration: 2, 8, 8; Valency = 8

(C) Configuration: 2, 10, 8; Valency = 2

(D) Configuration: 2, 8, 8, 2; Valency = 2

Q9. An element has the electronic configuration $2, 8, 8, 1$. This element is:

(A) Potassium (K)

(B) Sodium (Na)

(C) Calcium (Ca)

(D) Copper (Cu)

Q10. According to Bohr's model of the atom, when an electron jumps from a **higher energy level** to a **lower energy level**, the atom:

(A) Absorbs energy in the form of heat

(B) Emits energy in the form of light (a photon)

(C) Gains a proton from the nucleus

(D) Loses a neutron from the nucleus

Q11. A student adds pieces of iron (Fe), silver (Ag), and zinc (Zn) separately to copper sulphate solution ($CuSO_4$). Based on the **reactivity series**, which metals will **displace copper** from the solution?

(A) Only silver (Ag)

(B) Only iron (Fe)

(C) Iron (Fe) and zinc (Zn) both

(D) Silver (Ag) and zinc (Zn) both

Q12. Aluminium oxide (Al_2O_3) is described as **amphoteric**. This means:

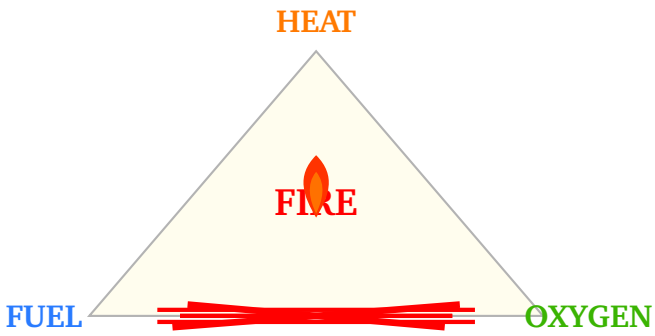
(A) It reacts with both water and carbon dioxide

(B) It dissolves only in strong bases, not in acids

(C) It neither reacts with acids nor with bases

(D) It reacts with both dilute acids (giving a salt and water) and with strong bases like NaOH (giving sodium aluminate)

Q13. The diagram below shows the **fire triangle**. A fire requires all three sides to be present simultaneously. Which of the following actions will **most effectively extinguish** a burning fire by removing one side of the triangle?



(A) Spraying water on the burning material (removes heat) or covering with CO_2 (cuts off oxygen supply)

(B) Adding more fuel to make the fire burn faster and exhaust itself

(C) Increasing the temperature of the surroundings

(D) Moving the fire to an area with more oxygen supply

Q14. When copper sulphate ($CuSO_4$) solution is electrolysed using **copper electrodes**, what is observed at the cathode and anode?

(A) Copper dissolves at the cathode; copper is deposited at the anode

(B) Copper is deposited at the cathode; the copper anode dissolves (loses mass)

(C) Oxygen gas is released at the cathode; hydrogen gas at the anode

(D) Both electrodes remain unchanged in mass

Q15. Destructive distillation of coal yields three important products. Which option **correctly matches** each product with its primary use?

(A) Coke — making dyes; Coal tar — smelting iron; Coal gas — making plastics

(B) Coke — domestic fuel only; Coal tar — making petrol; Coal gas — making fertilisers

(C) Coke — smelting iron in blast furnaces; Coal tar — making dyes, drugs, and explosives; Coal gas — used as fuel in industries

(D) Coke — making glass; Coal tar — used as lubricant in engines; Coal gas — used in refrigerators

Detailed Solutions

1.

Solution

Concept — Changes of State: Matter can undergo six interconversions between solid, liquid, and gas. Direct solid-to-gas conversion is sublimation; gas-to-liquid is condensation; and liquid-to-solid is freezing. Each transition has a specific name depending on the direction of the change.

Step 1 — Identify Arrow 1 (Solid → Gas): Arrow 1 goes directly from SOLID to GAS, bypassing the liquid state. This direct conversion is called **sublimation** (e.g., camphor, dry ice).

Step 2 — Identify Arrow 2 (Gas → Liquid) and Arrow 3 (Liquid → Solid): Arrow 2 goes from GAS to LIQUID — this is **condensation** (gas loses heat and becomes liquid). Arrow 3 goes from LIQUID to SOLID — this is **freezing** (liquid loses heat and solidifies).

Why other options are wrong:

- (A): Evaporation is liquid → gas, not solid → gas; deposition is gas → solid, not gas → liquid.
- (B): Correct — Sublimation, Condensation, Freezing.
- (C): Melting is solid → liquid; Arrow 1 skips the liquid state entirely.
- (D): Arrow 2 is condensation (gas → liquid), not evaporation; Arrow 3 is freezing, not condensation.

Answer: (B) Go Back to Q 1

2.

Solution

Concept — Intermolecular Forces in Solids: The defining property of solids is their definite shape and volume, which arises from very strong intermolecular forces of attraction. These forces hold particles so tightly that they can only vibrate in place and cannot move from their fixed positions.

Step 1 — Analyse the cause of rigidity: In solids, intermolecular distances are very small and attractive forces are very large. Particles are locked in a regular arrangement and only oscillate about fixed positions. This gives solids their rigidity and fixed volume.

Step 2 — Rule out incorrect reasoning: Density, freedom of movement, and melting point are consequences or unrelated properties — they are not the fundamental cause of definite shape and volume.

Why other options are wrong:

- (A): Correct — strong intermolecular forces restrict particles to fixed positions.
- (B): Solids generally have higher density than liquids/gases, not lower.
- (C): Free movement of particles describes gases, not solids.
- (D): Many solids (e.g., ice, wax) have melting points well below 500°C.

Answer: (A) Go Back to Q 2

3.

Solution

Concept — Centrifugation: Centrifugation uses centrifugal force to separate components of different densities in a mixture. It is particularly effective for separating colloidal or suspended particles that cannot be filtered easily, such as cream from milk.

Step 1 — Why centrifugation works for cream: Milk is a colloidal emulsion. When spun rapidly in a centrifuge, the denser component (skim milk) moves outward while the less dense cream collects near the centre. This is the principle used in dairies.

Step 2 — Eliminate other techniques: Magnetic separation requires magnetic components; sublimation requires a volatile solid; paper chromatography separates dissolved pigments or dyes — none of these apply to separating cream from milk.

Why other options are wrong:

- (A): Magnetic separation applies only when one component is magnetic; cream is not.
- (B): Sublimation separates a solid that directly vaporises; cream cannot sublime.
- (C): Correct — centrifugation separates cream from milk by density difference.
- (D): Paper chromatography separates dissolved coloured substances, not fat

globules.

Answer: (C) Go Back to Q 3

4.

Solution

Concept — Compounds vs Mixtures: A compound is a pure substance formed by the chemical combination of two or more elements in a fixed ratio. A mixture is formed by physically combining substances, and its components retain their individual properties.

Step 1 — Key distinction: A compound has a fixed composition (law of definite proportions) and its properties differ from its constituent elements (e.g., water is liquid, but hydrogen and oxygen are gases). A mixture has variable composition and its components retain their individual properties.

Step 2 — Verify option D: Option D correctly states: compound has fixed composition with emergent properties; mixture retains the properties of its components. This is the standard NCERT distinction.

Why other options are wrong:

- (A): Reversed — compounds are separated by chemical methods; many mixtures can be separated physically.
- (B): Compounds have fixed melting points; mixtures generally do not.
- (C): Compounds have fixed composition; only mixtures have variable composition.
- (D): Correct — fixed composition and altered properties for compounds; retained properties for mixtures.

Answer: (D) Go Back to Q 4

5.

Solution

Concept — Atomicity of Molecules: Atomicity is the number of atoms present in one molecule of an element or compound. Triatomic means exactly 3 atoms per molecule.

Step 1 — Count atoms in each option:

- O_3 (Ozone): 3 atoms — **triatomic**
- N_2 (Nitrogen): 2 atoms — diatomic
- P_4 (Phosphorus): 4 atoms — tetra-atomic
- S_8 (Sulphur): 8 atoms — poly-atomic

Step 2 — Identify the triatomic molecule: Only ozone (O_3) has exactly 3 atoms per molecule. Carbon dioxide (CO_2) and water (H_2O) are other common triatomic molecules.

Why other options are wrong:

- (A): Correct — O_3 has atomicity 3.
- (B): N_2 is diatomic (2 atoms).
- (C): P_4 is tetra-atomic (4 atoms).
- (D): S_8 is poly-atomic (8 atoms).

Answer: (A) Go Back to Q 5

6.

Solution

Concept — Dalton's Atomic Theory and its Limitations: Dalton proposed that atoms are the smallest indivisible particles of matter and cannot be created, destroyed, or subdivided. Later discoveries showed that atoms do have internal structure and can indeed be split.

Step 1 — Identify the postulate being tested: The postulate is: atoms are **indivisible** and **indestructible**. Any phenomenon that splits an atom directly contradicts this.

Step 2 — Evaluate nuclear fission: Nuclear fission of uranium-235 splits the nucleus of the uranium atom into smaller nuclei (e.g., barium and krypton) with the release of enormous energy. This directly proves atoms are **divisible**, contradicting Dalton's postulate.

Why other options are wrong:

- (A): Law of Conservation of Mass actually *supports* Dalton's theory.
- (B): Correct — nuclear fission splits the atom, contradicting indivisibility.
- (C): Chemical combination of H and O into water is consistent with Dalton's

theory.

- (D): Gay-Lussac's law supports atomic-molecular theory and does not split atoms.

Answer: (B) Go Back to Q 6

7.

Solution

Concept — Mole Concept: One mole of any substance contains 6.02×10^{23} particles (Avogadro's number, N_A). The number of moles is calculated as:

$$\text{Number of moles} = \frac{\text{Number of atoms}}{N_A}$$

Step 1 — Apply the formula:

$$\text{moles} = \frac{3.01 \times 10^{23}}{6.02 \times 10^{23}} = \frac{3.01}{6.02} = 0.5 \text{ mol}$$

Step 2 — Verify the calculation: 3.01×10^{23} is exactly half of 6.02×10^{23}, so the answer is **0.5 mol**.

Why other options are wrong:

- (A): 2 mol would require $2 \times 6.02 \times 10^{23} = 12.04 \times 10^{23}$ atoms.
- (B): 1 mol would require 6.02×10^{23} atoms (twice the given value).
- (C): Correct — $3.01 \times 10^{23} \div 6.02 \times 10^{23} = 0.5$ mol.
- (D): 0.25 mol would require $0.25 \times 6.02 \times 10^{23} = 1.505 \times 10^{23}$ atoms.

Answer: (C) Go Back to Q 7

8.

Solution

Concept — Electronic Configuration and Valency: Electrons are filled into shells K, L, M, N in order, with maximum capacities 2, 8, 18, 32 respectively. For elements up to $Z = 20$, the M shell is filled to only 8 before the N shell begins. Valency is determined by the number of electrons in the outermost shell.

Step 1 — Fill electrons for Ca ($Z = 20$):

- K shell: 2 electrons (full)
- L shell: 8 electrons (full)
- M shell: 8 electrons (capped at 8 for $Z \leq 20$)
- N shell: $20 - 2 - 8 - 8 = 2$ electrons

Configuration: **2, 8, 8, 2**

Step 2 — Determine valency: The outermost (N) shell has 2 electrons. Calcium can lose these 2 electrons to achieve a stable noble gas configuration. Therefore, valency of Ca = **2**.

Why other options are wrong:

- (A): 2, 8, 10 is incorrect; the M shell does not hold 10 electrons for $Z \leq 20$.
- (B): 2, 8, 8 accounts for only 18 electrons; Ca has 20.
- (C): 2, 10, 8 is an invalid filling order; electrons fill shells sequentially.
- (D): Correct — 2, 8, 8, 2 with valency 2.

Answer: (D) Go Back to Q 8

9.

Solution

Concept — Identifying Elements from Electronic Configuration: The total number of electrons equals the atomic number. Adding the electrons in each shell gives Z, which identifies the element on the periodic table.

Step 1 — Find atomic number from configuration 2, 8, 8, 1:

$$Z = 2 + 8 + 8 + 1 = 19$$

Element with atomic number 19 is **Potassium (K)**.

Step 2 — Confirm valency: The outermost shell has 1 electron, so potassium has valency 1 and is highly reactive, belonging to Group 1 of the periodic table.

Why other options are wrong:

- (A): Correct — $Z = 19$ is potassium (K).
- (B): Sodium (Na) has $Z = 11$ with configuration 2, 8, 1.

- (C): Calcium (Ca) has $Z = 20$ with configuration 2, 8, 8, 2.
- (D): Copper (Cu) has $Z = 29$ with a special configuration 2, 8, 18, 1.

Answer: (A) Go Back to Q 9

10.

Solution

Concept — Bohr's Model and Energy Emission: In Bohr's model, electrons occupy discrete energy levels (orbits). When an electron transitions from a higher energy level to a lower one, it releases the difference in energy as a photon of light. The reverse (lower to higher) requires energy absorption.

Step 1 — Direction of transition: Higher level $\rightarrow$ lower level means the electron is losing energy. This energy is released as electromagnetic radiation (a photon of light), not absorbed.

Step 2 — Eliminate incorrect options: Protons and neutrons are nuclear particles and are unaffected by electron transitions. Heat absorption describes the reverse process (excitation, lower to higher).

Why other options are wrong:

- (A): Energy absorption occurs when electrons move from lower to higher levels (excitation), not from higher to lower.
- (B): Correct — the atom emits a photon of light when the electron drops to a lower energy level.
- (C): Protons cannot be gained from the nucleus by electron transitions.
- (D): Neutrons are unaffected by electronic transitions.

Answer: (B) Go Back to Q 10

11.

Solution

Concept — Reactivity Series and Displacement Reactions: A more reactive metal can displace a less reactive metal from its salt solution. The reactivity order for the metals in question is: Zn $>$ Fe $>$ Cu $>$ Ag. Therefore, any metal above copper in the series will displace it.

Step 1 — Compare reactivities:

- Zinc (Zn): more reactive than Cu → displaces Cu from $CuSO_4$
- Iron (Fe): more reactive than Cu → displaces Cu from $CuSO_4$
- Silver (Ag): less reactive than Cu → **cannot** displace Cu

Step 2 — Write the displacement reactions:

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu \downarrow$$

$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu \downarrow$$

Why other options are wrong:

- (A): Silver is less reactive than copper and cannot displace it.
- (B): Iron displaces copper, but so does zinc — this option is incomplete.
- (C): Correct — both Fe and Zn are above Cu in the reactivity series.
- (D): Silver cannot displace copper; only Zn and Fe can.

Answer: (C) Go Back to Q 11

12.

Solution

Concept — Amphoteric Oxides: An amphoteric oxide is one that can react with both acids and bases to form salt and water. Aluminium oxide (Al_2O_3) is the classic example of an amphoteric oxide studied at this level.

Step 1 — Reaction with an acid:

$$Al_2O_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2O$$

(reacts with dilute sulphuric acid to give aluminium sulphate and water)

Step 2 — Reaction with a base:

$$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$$

(reacts with NaOH to give sodium aluminate and water)

Why other options are wrong:

- (A): Reaction with water and CO_2 does not define amphoteric behaviour.
- (B): Al_2O_3 dissolves in both acids and strong bases — not only bases.
- (C): Amphoteric means it reacts with both; it is not unreactive toward acids or bases.
- (D): Correct — reacts with dilute acids and strong bases, forming salt and water in each case.

Answer: (D) Go Back to Q 12

13.

Solution

Concept — The Fire Triangle: Combustion requires three components: fuel, heat (ignition temperature), and oxygen. Removing any one of these three sides of the fire triangle extinguishes the fire. This is the basis of all firefighting methods.

Step 1 — Analyse option A: *Spraying water* absorbs heat and lowers the temperature below the ignition point, removing the **heat** side of the triangle. *Covering with* CO_2 (from a fire extinguisher) forms a blanket that cuts off the **oxygen** supply. Both actions directly remove one side of the fire triangle.

Step 2 — Eliminate other options: Adding more fuel (option B) intensifies the fire. Increasing temperature (option C) sustains combustion. Providing more oxygen (option D) feeds the fire. None of these remove a side of the triangle.

Why other options are wrong:

- (A): Correct — water removes heat; CO_2 removes oxygen.
- (B): Adding fuel sustains or intensifies combustion.
- (C): Increasing surrounding temperature keeps the material above its ignition point.
- (D): More oxygen supply accelerates burning rather than extinguishing it.

Answer: (A) Go Back to Q 13

14.

Solution

Concept — Electrolysis with Active Electrodes: When copper sulphate solution is electrolysed using copper electrodes, the copper anode dissolves (oxidation: Cu $\rightarrow$ Cu^{2+} + $2e^{-}$) and copper ions from the solution are deposited at the copper cathode (reduction: Cu^{2+} + $2e^{-}$ $\rightarrow$ Cu). The concentration of $CuSO_4$ remains unchanged. This is the principle behind electroplating and copper refining.

Step 1 — At the cathode (reduction):

$$Cu^{2+}(aq) + 2e^{-} \rightarrow Cu(s) \quad \text{(copper deposited)}$$

Step 2 — At the anode (oxidation):

$$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^{-} \quad \text{(anode dissolves, loses mass)}$$

Why other options are wrong:

- (A): Reversed — copper deposits at the cathode and dissolves from the anode, not the other way around.
- (B): Correct — copper deposited at cathode; copper anode dissolves.
- (C): Hydrogen and oxygen gases are released when inert electrodes (platinum) are used with dilute sulphuric acid, not with copper electrodes in $CuSO_4$.
- (D): The anode loses mass (dissolves) while the cathode gains mass (deposition); they do not remain unchanged.

Answer: (B) Go Back to Q 14

15.

Solution

Concept — Destructive Distillation of Coal: When coal is heated strongly in the absence of air (destructive distillation), it yields three major products: coke, coal tar, and coal gas. Each has important industrial applications.

Step 1 — Products and their uses:

- **Coke**: Almost pure carbon; used as a reducing agent in blast furnaces to smelt iron ore (Fe_2O_3) into iron.

- **Coal tar**: A black, thick liquid; distilled further to obtain naphthalene, benzene, and other compounds used to make dyes, drugs, explosives, and synthetic fibres.
- **Coal gas**: A mixture of hydrogen, methane, and carbon monoxide; used as industrial fuel (historically for street lighting).

Step 2 — Verify option C: Option C correctly matches all three products with their primary uses as per NCERT Class 8.

Why other options are wrong:

- (A): Coke is not used for making dyes; coal tar is used for dyes.
- (B): Coal tar is not used for making petrol; petrol comes from petroleum refining.
- (C): Correct — coke for iron smelting; coal tar for dyes/drugs/explosives; coal gas as fuel.
- (D): Coke does not make glass; coal tar is not a lubricant; coal gas is not used in refrigerators.

Answer: (C) Go Back to Q 15

Answer Key

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