TALLENTEX Chemistry

Sample Paper – 1

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. Rohan hangs a wet towel in a room with no wind. After some time, the towel becomes dry and the surrounding air near the towel feels cooler. Which of the following **best** explains why the air near the towel feels cooler?

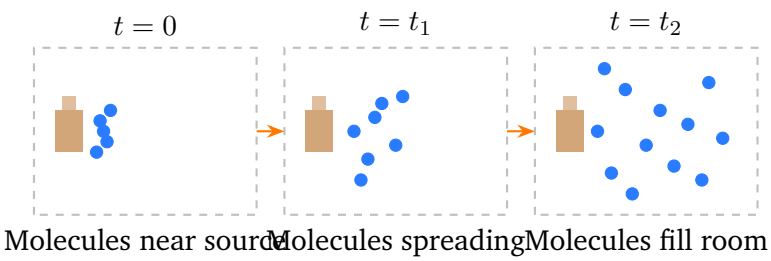
(A) Water molecules at the surface gain energy from the surroundings during evaporation, thereby lowering the temperature of the surroundings.

(B) The wet towel absorbs heat from the air by conduction and stores it inside the water.

(C) Water molecules at the surface lose energy to the surroundings, raising the surrounding temperature.

(D) The rate of evaporation is higher indoors, so the towel cools only due to convection currents.

Q2. A bottle of perfume is opened at one corner of a room. Within a few minutes, the fragrance is detected at the opposite corner even without any fan or wind. The TikZ diagram below represents the spread of perfume molecules at three instants. Which statement **correctly** explains this observation?



(A) Perfume molecules are heavier than air and settle at the bottom of the room, so they spread by gravity.

(B) Perfume molecules move randomly in all directions due to their kinetic energy and intermix with air molecules; this process is called diffusion.

(C) Air molecules push the perfume molecules towards the opposite corner by applying force.

(D) The fragrance spreads only because the room temperature rises, which breaks the perfume into smaller parts.

Q3. Priya prepares four mixtures in the laboratory: (I) salt dissolved in water, (II) chalk powder stirred in water, (III) milk in water, (IV) oil shaken in water. She filters each mixture through a filter paper. Which mixture passes completely through the filter paper **and** also appears transparent?

(A) Milk in water, because milk particles are very small.

(B) Chalk powder in water, because chalk dissolves completely.

(C) Salt dissolved in water, because it forms a true solution with particles smaller than 1 nm.

(D) Oil shaken in water, because oil particles disperse uniformly and pass through filter paper.

Q4. A student has four mixtures: (P) sand and water, (Q) common salt and water, (R) sugar and water, (S) a mixture of chalk powder and water. Which mixture is **best** separated by simple filtration to recover the insoluble solid?

(A) Common salt and water, because salt forms crystals easily.

(B) Sugar and water, because sugar does not dissolve completely in cold water.

(C) Common salt and water, because salt is less dense than water and floats.

(D) Chalk powder and water, because chalk is insoluble in water and is retained by filter paper.

Q5. The atomic mass unit (amu) is defined as a standard for measuring atomic masses. Which of the following **correctly** defines 1 atomic mass unit (1 amu)?

(A) $\frac{1}{16}$ of the mass of one atom of oxygen-16.

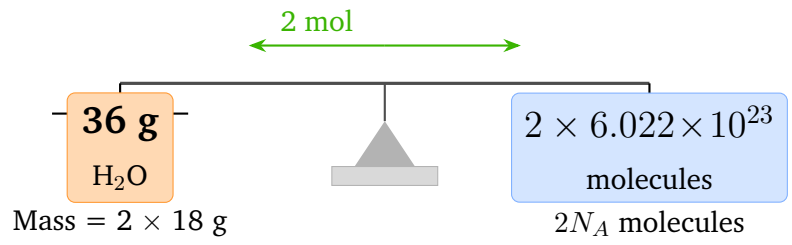
(B) $\frac{1}{12}$ of the mass of one atom of carbon-12.

(C) $\frac{1}{14}$ of the mass of one atom of nitrogen-14.

(D) The mass of one proton in a hydrogen atom.

Q6. Avogadro's number is 6.022×10^{23}. The molar mass of water (H_2O) is 18 g mol^{-1}. How many **molecules** are present in 36 g of water?

The diagram below illustrates the mole concept.



(A) 6.022×10^{23} molecules

(B) 3.011×10^{23} molecules

(C) 1.2044×10^{24} molecules

(D) 1.8066×10^{24} molecules

Q7. Using the criss-cross method, the molecular formula of the compound formed between aluminium (valency = 3) and oxygen (valency = 2) is determined. Which of the following is the **correct** molecular formula?

(A) AlO

(B) Al_2O_3 would be wrong; the correct formula is AlO_3

(C) Al_3O_2

(D) Al_2O_3

Q8. Niels Bohr proposed a model of the atom in 1913. Which of the following statements is a **correct postulate** of Bohr's atomic model?

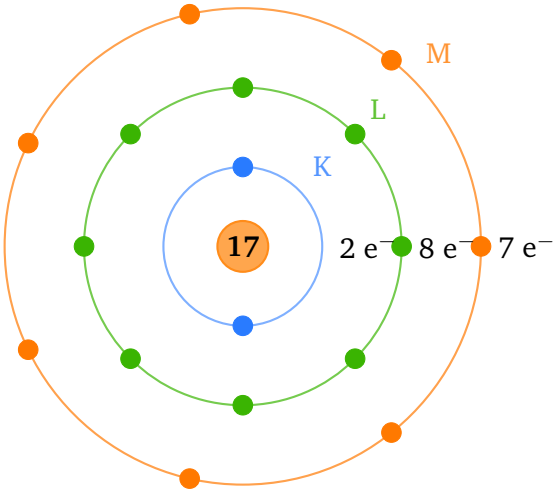
(A) Electrons revolve around the nucleus in fixed circular orbits called stationary states, and do **not** radiate energy while doing so.

(B) Electrons can occupy any arbitrary orbit between two shells, and continuously radiate energy.

(C) The nucleus of an atom is negatively charged and electrons are distributed throughout the atom.

(D) Electrons lose energy continuously as they orbit the nucleus, causing them to spiral inward.

Q9. An element X has an atomic number of 17. The TikZ diagram below shows its electron shell arrangement. What is the **correct** electronic configuration of element X?



(A) 2, 8, 6, 1

(B) 2, 8, 7

(C) 2, 7, 8

(D) 2, 6, 9

Q10. Two atoms of the same element have atomic number 8, but one has a mass number of 16 and the other has a mass number of 18. These two atoms are called:

(A) Isobars, because they have the same atomic number.

(B) Allotropes, because they are different forms of the same element.

(C) Isotopes, because they have the same atomic number but different mass numbers.

(D) Isomers, because they have identical electron configurations.

Q11. Copper wires are used to carry electric current in households because copper can be drawn into long, thin wires. Which physical property of metals allows them to be **drawn into wires**?

(A) Malleability — the ability to be beaten into thin sheets.

(B) Conductivity — the ability to allow heat to flow through.

(C) Sonority — the ability to produce a ringing sound when struck.

(D) Ductility — the ability to be drawn into thin wires.

Q12. Magnesium ribbon burns in oxygen with a dazzling white flame. The product formed when magnesium reacts with oxygen is:

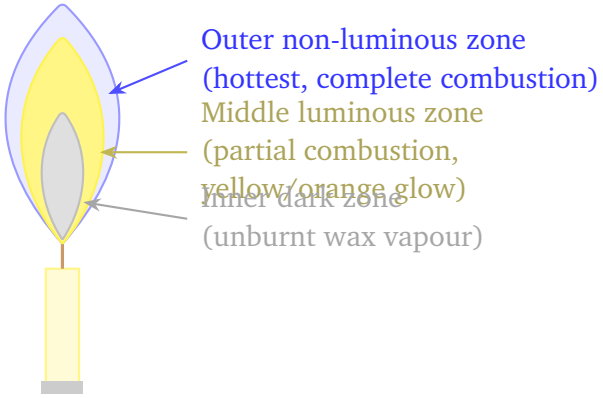
(A) Magnesium oxide (MgO), formed by the reaction: $2Mg + O_2 \rightarrow 2MgO$

(B) Magnesium dioxide (MgO_2), formed by the reaction: $Mg + O_2 \rightarrow MgO_2$

(C) Magnesium peroxide (Mg_2O_3), formed by a direct combination reaction.

(D) No product is formed; magnesium only melts without reacting with oxygen.

Q13. A student observes a burning candle carefully. The figure below shows a candle flame with three distinct zones. Which of the following correctly identifies the **middle luminous zone** of the candle flame?



(A) The innermost zone, which contains unburnt wax vapour and is the coldest part of the flame.

(B) The middle zone, where partial combustion occurs, producing a bright yellow-orange glow due to incandescent carbon particles.

(C) The outermost zone, which is colourless and the hottest part of the flame.

(D) The wick itself, which acts as the primary source of heat in the flame.

Q14. An iron spoon is to be electroplated with copper. The spoon is connected to the negative terminal of a battery (cathode) and a pure copper rod

is connected to the positive terminal (anode), both immersed in copper sulphate solution. What is **deposited at the cathode** during the process?

(A) Sulphate ions from the copper sulphate solution.

(B) Iron from the spoon, which dissolves and moves toward the anode.

(C) Copper, as copper ions (Cu^{2+}) from the solution gain electrons at the cathode and are deposited as metallic copper.

(D) Copper sulphate crystals, which form when the solution is electrolysed.

Q15. Nylon is a widely used synthetic fibre. A student lists the following properties of nylon: (P) very strong and can bear heavy loads, (Q) elastic and returns to original shape, (R) lustrous and has a silky appearance, (S) absorbs moisture very well and keeps the body dry. Which property in the list does **NOT** correctly belong to nylon?

(A) (P) — Nylon is not strong enough to bear loads.

(B) (Q) — Nylon does not have elasticity.

(C) (R) — Nylon is not lustrous; it appears dull.

(D) (S) — Nylon does **not** absorb moisture well; it is hydrophobic and moisture absorption is poor.

Detailed Solutions

Q1.

Solution

Concept: Evaporation is a surface phenomenon that requires energy (latent heat). The energy is absorbed from the surroundings, causing cooling.

Step 1 — Identify what happens at the towel surface: Water molecules at the surface of the wet towel that have higher kinetic energy escape into the air as vapour (evaporate). They take this energy from the surrounding air and the towel surface.

Step 2 — Effect on surroundings: Because energy is taken *from* the surroundings, the average kinetic energy (and hence temperature) of the surrounding air *decreases*. This is why the air near the towel feels cooler — a phenomenon also responsible for sweating cooling the human body.

Why other options are wrong:

- (B) Water does not absorb heat by conduction to store it; the cooling is due to energy taken during phase change.
- (C) Water molecules *gain* (not lose) energy from surroundings — the surroundings lose energy, lowering temperature.
- (D) Convection currents are not the cause; the cooling occurs even without air movement.

Answer: (A) Go Back to Q 1

Q2.

Solution

Concept: Diffusion is the process by which particles of one substance spread into the space occupied by another substance due to their random kinetic motion. Gases diffuse fastest because their particles have maximum kinetic energy and intermolecular spaces.

Step 1: Perfume molecules in air are in the gaseous state. They possess kinetic energy and move randomly in all directions.

Step 2: As shown in the diagram (panel progression from $t = 0$ to t_2), perfume molecules start near the source and gradually spread throughout the room by intermixing with air molecules — this is diffusion. No external force, gravity, or temperature change is required.

Why other options are wrong:

- (A) Perfume molecules are not necessarily heavier than air; even if they were, diffusion opposes settling by gravity.
- (C) Air molecules do not push perfume molecules; intermixing is due to individual random motion.
- (D) Temperature rise is not necessary for diffusion at room temperature; the process occurs spontaneously.

Answer: (B) **Go Back to Q 2**

Q3.

Solution

Concept: A *true solution* is a homogeneous mixture in which solute particles are smaller than 1 nm. These particles pass through both filter paper and semipermeable membranes, and the solution appears transparent/clear.

Step 1 — Classify each mixture:

- Salt in water: True solution — particles < 1 nm, transparent, passes filter paper. ✓
- Chalk in water: Suspension — particles > 1000 nm, retained by filter paper. ×
- Milk in water: Colloid (emulsion) — particles 1–1000 nm, appears white/opaque. ×
- Oil in water: Emulsion (colloid) — appears milky, does not pass filter paper cleanly. ×

Step 2: Only the salt solution (true solution) passes through filter paper completely **and** appears transparent.

Why other options are wrong: Options (A), (B), and (D) describe colloids or suspensions which are either opaque or retained by filter paper.

Answer: (C) **Go Back to Q 3**

Q4.

Solution

Concept: Filtration separates an *insoluble solid* from a liquid. The solid is retained on the filter paper (residue), while the liquid passes through (filtrate).

Step 1 — Identify solubility:

- Sand in water: Sand is insoluble. Filtration works but the question asks which *best* demonstrates recovering an insoluble solid in a typical school scenario.
- Salt and sugar in water: Both are soluble — they pass through filter paper and cannot be recovered by filtration.
- Chalk in water: Chalk ($CaCO_3$) is *insoluble* in water and is readily retained by filter paper.

Step 2: Among the given choices, option (D) — chalk powder and water — is the **best** answer because chalk is completely insoluble and forms a suspension that is cleanly separated by filtration. Options (A) and (B) involve soluble substances; option (C) gives an incorrect reason (salt does not float).

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept: The atomic mass unit is defined relative to the carbon-12 isotope, which was adopted internationally in 1961 as the standard for atomic masses.

Step 1 — Recall the definition:

$$1 \text{ amu} = \frac{1}{12} \times \text{mass of one atom of } {}^{12}\text{C}$$

Step 2 — Verify: One atom of C-12 has a mass of 1.9926×10^{-26} kg, so 1 amu $= \dfrac{1.9926 \times 10^{-26}}{12} \approx 1.66 \times 10^{-27}$ kg. This is consistent with textbook values.

Why other options are wrong:

- (A) Oxygen-16 was historically used, but the current standard is C-12, not $\frac{1}{16}$ of O-16.
- (C) Nitrogen-14 is not used as the standard.
- (D) The mass of a proton (1.67×10^{-27} kg) is approximately 1 amu but is not the formal definition.

Answer: (B) Go Back to Q 5

Q6.

Solution

Concept: The mole is the SI unit of amount of substance. 1 mole of any substance contains $N_A = 6.022 \times 10^{23}$ entities (molecules, atoms, ions, etc.). The molar mass of H_2O = 18 g mol^{-1}.

Step 1 — Find number of moles:

$$n = \frac{\text{given mass}}{\text{molar mass}} = \frac{36 \text{ g}}{18 \text{ g mol}^{-1}} = 2 \text{ mol}$$

Step 2 — Find number of molecules:

$$N = n \times N_A = 2 \times 6.022 \times 10^{23} = 1.2044 \times 10^{24} \text{ molecules}$$

As shown in the balance diagram, 36 g of water (2 moles) corresponds to $2N_A$ molecules on the right side of the scale.

Why other options are wrong:

- (A) 6.022×10^{23} corresponds to only 1 mole (18 g) of water.
- (B) 3.011×10^{23} would be $\frac{1}{2}$ mole, i.e., 9 g of water.
- (D) 1.8066×10^{24} would require 3 moles (54 g) of water.

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept: The criss-cross method uses the valencies of combining elements to determine the subscripts in the molecular formula. The valency of one element becomes the subscript of the other.

Step 1 — Apply criss-cross:

$$Al^{3+} \quad O^{2-} \xrightarrow{\text{criss-cross}} Al_2O_3$$

The valency of Al (3) becomes the subscript of O, and the valency of O (2) becomes the subscript of Al. Since 2 and 3 have no common factor to simplify, the formula remains Al_2O_3.

Step 2 — Verify charge balance:

$$2 \times (+3) + 3 \times (-2) = +6 - 6 = 0 \quad \checkmark$$

Why other options are wrong:

- (A) AlO would require equal valencies (both 1), which is incorrect here.
- (B) AlO_3 is incorrect; this would imply Al has valency 6 or O has valency 1.
- (C) Al_3O_2 reverses the subscripts incorrectly; this gives a charge imbalance: $3(+3) + 2(-2) = +5 \neq 0$.

Answer: (D) Go Back to Q 7

Q8.

Solution

Concept: Bohr's atomic model (1913) introduced quantised orbits for electrons to overcome the problem of the classically predicted collapse of atoms due to continuous energy radiation.

Key Postulates of Bohr's Model:

- Electrons revolve in fixed circular orbits (stationary states) around the nucleus.
- While in a stationary state, an electron does *not* radiate energy.
- Each orbit has a fixed energy; electrons emit or absorb energy only when they jump between orbits.

Step 1: Option (A) correctly states that electrons revolve in fixed orbits and do not radiate energy — this is the defining postulate of Bohr's model that distinguished it from classical physics.

Why other options are wrong:

- (B) Electrons cannot occupy arbitrary orbits between shells — orbits are quantised.
- (C) This describes Thomson's plum-pudding model, not Bohr's.
- (D) Continuous energy loss and inward spiraling is the classical (non-Bohr) prediction that Bohr's model was designed to refute.

Answer: (A) Go Back to Q 8

Q9.

Solution

Concept: The electronic configuration of an element is determined by filling electrons into shells (K, L, M, ...) using the rule that each shell can hold a maximum of $2n^2$ electrons (K=2, L=8, M=18, but typically filled to 8 before opening the next).

Step 1 — Fill the shells for Z = 17:

- K shell (1st orbit): maximum 2 electrons $\rightarrow$ **2**
- L shell (2nd orbit): maximum 8 electrons $\rightarrow$ **8**
- M shell (3rd orbit): remaining $17 - 2 - 8 = 7$ electrons $\rightarrow$ **7**

Step 2: Electronic configuration of element X (Chlorine, Cl) = **2, 8, 7**, as shown in the shell diagram with 2 electrons on the innermost ring, 8 on the second, and 7 on the third.

Why other options are wrong:

- (A) 2, 8, 6, 1 adds up to 17 but has 4 shells, which is not correct for Z=17 (Cl only has 3 shells).
- (C) 2, 7, 8 — the M shell cannot hold 8 if the L shell is not filled first; order is reversed.
- (D) 2, 6, 9 — L shell can hold maximum 8; 9 in M shell is incorrect for Z=17.

Answer: (B) **Go Back to Q 9**

Q10.

Solution

Concept: Atoms of the same element always have the same atomic number (number of protons). However, they may differ in the number of neutrons, giving different mass numbers. Such atoms are called *isotopes*.

Step 1 — Identify the relationship:

- Both atoms have atomic number = 8 $\Rightarrow$ same element (Oxygen).
- Mass numbers differ: 16 vs 18 $\Rightarrow$ different number of neutrons (8 vs 10).

Step 2: By definition, atoms with the *same atomic number but different mass numbers* are **isotopes**. Examples: ^{16}O and ^{18}O are both oxygen isotopes.

Why other options are wrong:

- (A) Isobars have the *same mass number* but *different* atomic numbers — the opposite of this case.
- (B) Allotropes are different physical forms of the same element (e.g., diamond and graphite for carbon), not different atoms.
- (D) Isomers refer to compounds with the same molecular formula but different structural arrangements; not applicable to atoms.

Answer: (C) Go Back to Q 10

Q11.

Solution

Concept: Metals have several characteristic physical properties. Two important ones are:

- **Malleability**: ability to be beaten into thin sheets (e.g., gold foil, aluminium sheets).
- **Ductility**: ability to be drawn into thin wires (e.g., copper and aluminium wires).

Step 1: The question asks about the property that allows metals to be *drawn into wires*. This is **ductility**, not malleability.

Step 2: Copper is highly ductile, which is why it is used for electrical wiring.

Why other options are wrong:

- (A) Malleability describes being beaten into sheets, not drawn into wires.
- (B) Conductivity relates to heat/electricity transfer, not the physical shaping of metals.
- (C) Sonority is the ability to produce a ringing sound, unrelated to wire-drawing.

Answer: (D) Go Back to Q 11

Q12.

Solution

Concept: When metals burn in oxygen, they form metal oxides. This is a combination (synthesis) reaction. Magnesium is an active metal that burns with a characteristic bright white flame.

Step 1 — Write the unbalanced equation:

$$Mg + O_2 \rightarrow MgO$$

Step 2 — Balance the equation:

$$2Mg + O_2 \rightarrow 2MgO$$

Left side: 2 Mg, 2 O. Right side: 2 Mg, 2 O. ✓

The product is **magnesium oxide (MgO)**, a white powder.

Why other options are wrong:

- (B) MgO_2 (magnesium peroxide) is not the product of direct combustion in oxygen under normal conditions.
- (C) Mg_2O_3 does not exist; magnesium has a fixed valency of 2, forming MgO only.
- (D) Magnesium definitely reacts with oxygen; the reaction is vigorous and produces a dazzling white light.

Answer: (A) Go Back to Q 12

Q13.

Solution

Concept: A candle flame has three distinct zones, each with different temperatures and combustion completeness:

(a) **Innermost dark zone**: Unburnt wax vapour rises from the wick. Coldest zone. No combustion.

(b) **Middle luminous zone**: Partial combustion of carbon-containing compounds. Glowing carbon particles (soot) produce the characteristic yellow-orange glow. Moderately hot.

(c) **Outer non-luminous zone**: Complete combustion. Produces CO_2 and H_2O. Hottest zone. Appears almost colourless or faint blue.

Step 1: The question asks specifically about the **middle luminous zone**. As shown in the candle flame diagram, this is the bright yellow/orange region around the dark inner zone.

Step 2: The glow is due to tiny incandescent carbon particles that are partially combusted in this zone. A goldsmith uses the outermost zone (hottest) for heating gold.

Why other options are wrong:

- (A) Describes the *innermost* dark zone (unburnt wax vapour, coldest) — not the middle zone.
- (C) Describes the *outermost* non-luminous zone (hottest, complete combustion) — not the middle zone.
- (D) The wick itself is not a zone of the flame; it is the fuel delivery structure.

Answer: (B) **Go Back to Q 13**

Q14.

Solution

Concept: In electroplating, the object to be plated is the **cathode** (negative electrode) and the plating metal is the **anode** (positive electrode). The electrolyte contains ions of the plating metal.

Step 1 — Understand the electrode reactions:

- At the **anode** (copper rod): Copper dissolves — $\text{Cu} \rightarrow \text{Cu}^{2+} + 2e^-$
- At the **cathode** (iron spoon): Copper ions are deposited — $\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$

Step 2: Copper ions (Cu^{2+}) from the copper sulphate solution migrate to the cathode (iron spoon), gain 2 electrons each, and are deposited as a thin layer of metallic **copper** on the spoon.

Why other options are wrong:

- (A) Sulphate ions (SO_4^{2-}) are negatively charged and move toward the anode, not the cathode.
- (B) Iron does not dissolve from the cathode; the cathode receives material (copper) rather than losing it.
- (D) Copper sulphate crystals are not deposited; the process deposits elemental copper metal.

Answer: (C) Go Back to Q 14

Q15.

Solution

Concept: Nylon is a synthetic polyamide fibre manufactured from coal, water, and air. It has several useful properties but also some limitations compared to natural fibres.

Properties of Nylon:

- **Strong**: Nylon is one of the strongest synthetic fibres; used in parachutes, ropes, and toothbrush bristles. ✓
- **Elastic**: Nylon returns to its original shape after stretching. ✓
- **Lustrous**: It has a silky, shiny appearance, often used as a silk substitute. ✓
- **Moisture absorption**: Nylon does *not* absorb moisture well. It is **hydrophobic** (water-repellent), which is why it feels uncomfortable in summer or humid conditions. This property does **NOT** belong to nylon. ×

Step 1: Property (S) — "absorbs moisture very well" — is **incorrect** for nylon. Natural fibres like cotton absorb moisture readily; nylon does not.

Why other options are wrong:

- (A) Nylon IS strong — used in climbing ropes and gear.
- (B) Nylon IS elastic — returns to shape after extension.
- (C) Nylon IS lustrous — it mimics silk's appearance.

Answer: (D) Go Back to Q 15

Answer Key

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