

AIIMS B.Sc Nursing Chemistry

Sample Paper – 12

Duration: 36 Minutes

Maximum Marks: 30

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry section of the **AIIMS B.Sc Nursing (Hons)** entrance.
- Each correct answer carries **+1 mark**. **1/3 mark** is deducted per incorrect answer. Unattempted questions carry **no penalty**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11–12 (NCERT)** Chemistry.
- The actual exam is conducted in **Computer Based Test (CBT)** mode.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

Q1. The volume occupied by **0.25 mol** of an ideal gas at STP (molar volume = 22.4 L mol^{-1}) is:

- (A) 22.4 L
- (B) 11.2 L
- (C) 5.6 L
- (D) 2.24 L

Q2. The percentage by mass of oxygen in water, H_2O (molar mass = 18 g mol^{-1}), is approximately:

- (A) 88.9%
- (B) 11.1%
- (C) 50.0%



(D) 16.0%

Q3. The electronic configuration of a chlorine atom ($Z = 17$) in its ground state is:

(A) $1s^2 2s^2 2p^6 3s^2$

(B) $1s^2 2s^2 2p^6 3s^2 3p^3$

(C) $1s^2 2s^2 2p^6 3s^1 3p^6$

(D) $1s^2 2s^2 2p^6 3s^2 3p^5$

Q4. The boundary-surface diagram shown below, with two lobes along an axis separated by a node, represents which type of atomic orbital?



(A) s orbital

(B) p orbital

(C) d orbital

(D) f orbital

Q5. Which of the following elements has the **highest** first ionisation energy?

(A) Na

(B) Ne

(C) Li

(D) K

Q6. Which of the following compounds contains an **ionic** bond?

(A) HCl

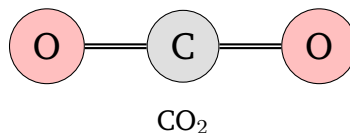
(B) CH_4

(C) Cl_2



(D) NaCl

Q7. The molecule represented by the linear arrangement below (central carbon double-bonded to two oxygen atoms) has bond angle:



(A) 180°

(B) 120°

(C) 109.5°

(D) 90°

Q8. The abnormally high boiling point of water compared with H₂S is mainly due to:

(A) ionic bonding

(B) metallic bonding

(C) hydrogen bonding

(D) covalent network bonding

Q9. A gas occupies **300 mL** at **300 K**. At constant pressure, its volume at **400 K** (Charles' law) becomes:

(A) 225 mL

(B) 400 mL

(C) 300 mL

(D) 350 mL

Q10. A reaction that releases heat to the surroundings is called:

(A) endothermic

(B) isothermal



- (C) exothermic
- (D) adiabatic

Q11. For the reaction $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$, the correct equilibrium constant expression K_c is:

- (A) $\frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2}$
- (B) $\frac{[\text{SO}_3]}{[\text{SO}_2][\text{O}_2]}$
- (C) $\frac{[\text{SO}_3]^2[\text{O}_2]}{[\text{SO}_2]^2}$
- (D) $\frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$

Q12. An aqueous solution of sodium chloride (NaCl), the salt of a strong acid and a strong base, is:

- (A) neutral (pH \approx 7)
- (B) strongly acidic
- (C) strongly basic
- (D) amphoteric

Q13. In the reaction $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$, the species that acts as the **oxidising agent** is:

- (A) Zn
- (B) Cu^{2+}
- (C) SO_4^{2-}
- (D) ZnSO_4

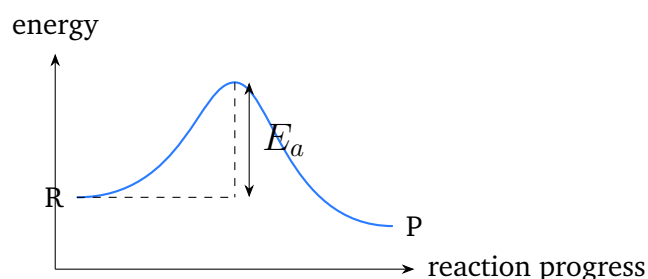
Q14. During the electrolysis of molten NaCl, the product formed at the **cathode** is:

- (A) Cl_2 gas



- (B) O₂ gas
- (C) H₂ gas
- (D) Na metal

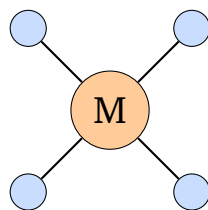
Q15. In the reaction-energy profile shown below, the quantity marked E_a represents:



- (A) the activation energy of the forward reaction
 - (B) the enthalpy of the products
 - (C) the enthalpy change of the reaction
 - (D) the kinetic energy of reactants
- Q16.** The noble gases (group 18) are chemically inert mainly because they have:
- (A) incomplete outer shells
 - (B) one valence electron
 - (C) a completely filled outermost shell (octet/duplet)
 - (D) high reactivity with water
- Q17.** Aqueous solutions of many transition-metal ions are coloured. This colour is mainly due to:
- (A) *s-s* electron transitions
 - (B) *d-d* electron transitions
 - (C) nuclear transitions
 - (D) complete absence of unpaired electrons

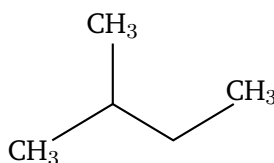


Q18. The complex shown below, with four ligands at the corners of a square around the central metal, has the geometry:



4 ligands (square)

- (A) octahedral
(B) linear
(C) square planar
(D) trigonal pyramidal
- Q19.** Among the group-14 elements, the property of forming long chains of self-linked atoms (catenation) is shown maximally by:
- (A) carbon
(B) silicon
(C) tin
(D) lead
- Q20.** The IUPAC name of the compound whose skeletal structure is shown below is:



- (A) n-butane
(B) n-pentane
(C) 2-methylpropane
(D) 2-methylbutane



Q21. The general molecular formula of an alkyne is:

- (A) C_nH_{2n+2}
- (B) C_nH_{2n-2}
- (C) C_nH_{2n}
- (D) C_nH_n

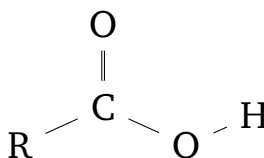
Q22. According to Huckel's rule, an aromatic ring must contain a number of delocalised π electrons equal to:

- (A) $4n$
- (B) $2n$
- (C) $4n + 2$
- (D) $n + 1$

Q23. Which of the following carbocations is the **most** stable?

- (A) tertiary (3°) carbocation
- (B) secondary (2°) carbocation
- (C) primary (1°) carbocation
- (D) methyl carbocation

Q24. The functional group shown below ($-COOH$) characterises which class of organic compounds?



- (A) alcohols
- (B) carboxylic acids
- (C) aldehydes
- (D) ethers



- Q25.** The oxidation of a **primary alcohol** ($R-CH_2OH$) first gives:
- (A) a ketone
 - (B) a carboxylic acid only
 - (C) an ester
 - (D) an aldehyde
- Q26.** In the SN_2 substitution of a haloalkane, the rate depends on the concentration of:
- (A) both the haloalkane and the nucleophile
 - (B) the haloalkane only
 - (C) the nucleophile only
 - (D) neither reactant
- Q27.** Among the following, which is the **strongest base** in the gas phase / aqueous medium (a typical aliphatic amine)?
- (A) aniline ($C_6H_5NH_2$)
 - (B) ammonia (NH_3)
 - (C) ethylamine ($C_2H_5NH_2$)
 - (D) acetamide (CH_3CONH_2)
- Q28.** The building blocks (monomers) of proteins are:
- (A) glucose units
 - (B) amino acids
 - (C) fatty acids
 - (D) nucleotides
- Q29.** Which of the following is an example of a **condensation** polymer?
- (A) polythene
 - (B) polystyrene



- (C) PVC
- (D) nylon-6,6

Q30. Substances such as BHT and BHA are added to food mainly to act as:

- (A) antioxidants (to prevent rancidity)
- (B) artificial sweeteners
- (C) antibiotics
- (D) food colours



Detailed Solutions

Q1.

Solution

Concept — Molar Volume at STP: One mole of any ideal gas occupies 22.4 L at STP, so volume = moles \times 22.4 L.

Step 1 — Substitute:

$$V = 0.25 \times 22.4 \text{ L}$$

Step 2 — Compute:

$$V = 5.6 \text{ L}$$

Why other options are wrong:

- 22.4 L is for 1 mol, 11.2 L for 0.5 mol, and 2.24 L for 0.1 mol.

Final Answer: $V = 5.6 \text{ L} \Rightarrow$ C

Answer: (C) [Go Back to Q1](#)

Q2.

Solution

Concept — Percentage Composition: % of an element = $\frac{\text{mass of element in 1 mol}}{\text{molar mass}} \times 100$.

Step 1 — Mass of oxygen in H₂O: One O atom = 16 g out of 18 g total.

Step 2 — Compute:

$$\% \text{ O} = \frac{16}{18} \times 100 = 88.9\%$$

Why other options are wrong:

- 11.1% is the percentage of hydrogen; 50% and 16% ignore the molar-mass ratio.

Final Answer: $\% \text{ O} \approx 88.9\% \Rightarrow$ A

Answer: (A) [Go Back to Q2](#)



Q3.

Solution

Concept — Electronic Configuration: Fill orbitals in order of increasing energy (Aufbau) up to Z electrons.

Explanation: Chlorine has 17 electrons: $1s^2 2s^2 2p^6 3s^2 3p^5$ ($2+2+6+2+5 = 17$).

Why other options are wrong:

- The other configurations either total fewer than 17 electrons or violate the filling order.

Final Answer: Cl is $1s^2 2s^2 2p^6 3s^2 3p^5 \Rightarrow$

[Go Back to Q3](#)

Q4.

Solution

Concept — Orbital Shapes: An s orbital is spherical; a p orbital is dumb-bell shaped with two lobes and a nodal plane through the nucleus.

Explanation: The figure shows two lobes lying along one axis separated by a node at the nucleus, which is the characteristic shape of a p orbital.

Why other options are wrong:

- An s orbital is a single sphere; d and f orbitals have four or more lobes / more complex shapes.

Final Answer: The dumb-bell shape is a p orbital \Rightarrow

[Go Back to Q4](#)

Q5.

Solution

Concept — Ionisation Energy Trend: Ionisation energy increases across a period and decreases down a group; noble gases have the highest values.

Explanation: Ne is a noble gas with a stable, fully filled shell, so removing an electron needs the most energy among the listed atoms.

Why other options are wrong:



- Na, Li and K are alkali metals that lose their single valence electron easily (low ionisation energy).

Final Answer: Ne has the highest ionisation energy \Rightarrow

Answer: (B) [Go Back to Q5](#)

Q6.

Solution

Concept — Bond Types: An ionic bond forms by transfer of electrons between a metal and a non-metal; a covalent bond shares electrons between non-metals.

Explanation: NaCl forms by transfer of an electron from Na to Cl, giving Na^+ and Cl^- held by an ionic bond.

Why other options are wrong:

- HCl and CH_4 are covalent; Cl_2 is a non-polar covalent molecule.

Final Answer: NaCl is ionic \Rightarrow

Answer: (D) [Go Back to Q6](#)

Q7.

Solution

Concept — VSEPR (Linear Molecule): A central atom with two bonding regions and no lone pairs is linear, with a bond angle of 180° .

Explanation: In CO_2 the carbon forms two double bonds and has no lone pairs, so $\text{O}=\text{C}=\text{O}$ is linear with a bond angle of 180° .

Why other options are wrong:

- 120° is trigonal planar, 109.5° is tetrahedral, and 90° is for octahedral positions.

Final Answer: The CO_2 bond angle is $180^\circ \Rightarrow$

Answer: (A) [Go Back to Q7](#)



Q8.

Solution

Concept — Hydrogen Bonding: When H is bonded to a highly electronegative atom (F, O, N), strong intermolecular hydrogen bonds form, raising the boiling point.

Explanation: Water molecules form extensive **hydrogen bonds** (O–H···O), so water boils much higher than H₂S, where S is less electronegative and forms no hydrogen bonds.

Why other options are wrong:

- Water is molecular, not ionic, metallic, or a covalent network solid.

Final Answer: Hydrogen bonding raises water's boiling point ⇒

Answer: (C) [Go Back to Q8](#)

Q9.

Solution

Concept — Charles' Law: At constant pressure, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (T in kelvin).

Step 1 — Substitute:

$$\frac{300}{300} = \frac{V_2}{400}$$

Step 2 — Solve:

$$V_2 = 300 \times \frac{400}{300} = 400 \text{ mL}$$

Why other options are wrong:

- Volume must increase with temperature, so 225, 300 and 350 mL are too small.

Final Answer: $V_2 = 400 \text{ mL}$ ⇒

Answer: (B) [Go Back to Q9](#)



Q10.

Solution

Concept — Exothermic vs Endothermic: An exothermic reaction releases heat ($\Delta H < 0$); an endothermic one absorbs heat ($\Delta H > 0$).

Explanation: A reaction that gives out heat to the surroundings is **exothermic**.

Why other options are wrong:

- Endothermic absorbs heat; isothermal means constant temperature; adiabatic means no heat exchange.

Final Answer: Releasing heat means exothermic \Rightarrow C

Answer: (C) [Go Back to Q10](#)

Q11.

Solution

Concept — Equilibrium Constant: For $aA + bB \rightleftharpoons cC$, $K_c = \frac{[C]^c}{[A]^a[B]^b}$ (products over reactants, raised to their coefficients).

Explanation: For $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$,

$$K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$$

Why other options are wrong:

- The other forms invert the ratio or use wrong exponents.

Final Answer: $K_c = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]} \Rightarrow$ D

Answer: (D) [Go Back to Q11](#)



Q12.

Solution

Concept — Salt Hydrolysis: A salt of a strong acid and a strong base does not hydrolyse, so its solution is neutral.

Explanation: NaCl comes from HCl (strong acid) and NaOH (strong base); neither ion hydrolyses, so the solution is **neutral**, $\text{pH} \approx 7$.

Why other options are wrong:

- It is neither acidic nor basic; NaCl is not amphoteric.

Final Answer: NaCl solution is neutral \Rightarrow

[Go Back to Q12](#)

Q13.

Solution

Concept — Oxidising Agent: The oxidising agent is the species that gets reduced (gains electrons).

Explanation: Cu^{2+} is reduced to Cu (gains 2 electrons), so Cu^{2+} is the oxidising agent. Zn is oxidised, so Zn is the reducing agent.

Why other options are wrong:

- Zn is the reducing agent; SO_4^{2-} is a spectator ion; ZnSO_4 is a product.

Final Answer: Cu^{2+} is the oxidising agent \Rightarrow

[Go Back to Q13](#)

Q14.

Solution

Concept — Electrolysis: At the cathode reduction occurs (cations gain electrons); at the anode oxidation occurs.

Explanation: In molten NaCl, Na^+ ions migrate to the cathode and are reduced: $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$. So **sodium metal** forms at the cathode (Cl_2 forms at the anode).

Why other options are wrong:

- Cl_2 is the anode product; no O_2 or H_2 forms from dry molten NaCl.



Final Answer: Na metal forms at the cathode \Rightarrow

Answer: (D) [Go Back to Q14](#)

Q15.

Solution

Concept — Activation Energy: E_a is the minimum extra energy (above the reactants' energy) needed to reach the transition state at the top of the energy barrier.

Explanation: In the profile, the gap from the reactant level (R) up to the peak is the **activation energy of the forward reaction**.

Why other options are wrong:

- The product enthalpy and the overall ΔH are measured from the baseline levels, not from R to the peak; kinetic energy of reactants is unrelated.

Final Answer: E_a is the forward activation energy \Rightarrow

Answer: (A) [Go Back to Q15](#)

Q16.

Solution

Concept — Noble Gas Stability: A completely filled outermost shell gives a stable electronic arrangement with little tendency to react.

Explanation: Noble gases have a **completely filled outermost shell** (octet, or duplet for He), so they are chemically inert.

Why other options are wrong:

- Their shells are complete, not incomplete; they have eight (not one) valence electrons and do not react readily with water.

Final Answer: Inert due to a filled outer shell \Rightarrow

Answer: (C) [Go Back to Q16](#)



Q17.

Solution

Concept — Colour of Transition-Metal Ions: Partly filled d orbitals allow electrons to jump between split d levels, absorbing visible light.

Explanation: The colour arises from $d-d$ **electron transitions**: an electron absorbs a particular wavelength and the complementary colour is seen.

Why other options are wrong:

- $s-s$ and nuclear transitions do not give visible colour; ions with no unpaired d electrons are usually colourless.

Final Answer: Colour comes from $d-d$ transitions \Rightarrow **B**

Answer: (B) [Go Back to Q17](#)

Q18.

Solution

Concept — Coordination Geometry: Four ligands placed at the corners of a square in one plane around the metal give a square-planar geometry (coordination number 4).

Explanation: The figure shows four ligands at the corners of a square, so the geometry is **square planar** (e.g. $[\text{Ni}(\text{CN})_4]^{2-}$).

Why other options are wrong:

- Octahedral needs six ligands; linear needs two; trigonal pyramidal is not a coordination-number-4 plane.

Final Answer: The geometry is square planar \Rightarrow **C**

Answer: (C) [Go Back to Q18](#)



Q19.

Solution

Concept — Catenation: The ability to form chains by self-linking decreases down group 14 as the element–element bond gets weaker.

Explanation: Carbon forms the strongest C–C bonds and shows catenation to the greatest extent (the basis of organic chemistry).

Why other options are wrong:

- Silicon catenates much less; tin and lead show very little catenation.

Final Answer: Carbon shows maximum catenation \Rightarrow

[Go Back to Q19](#)

Q20.

Solution

Concept — IUPAC Naming: Find the longest carbon chain, then name branches as substituents.

Explanation: The structure is a four-carbon main chain (butane) with a methyl branch on carbon 2: $\text{CH}_3\text{--CH}(\text{CH}_3)\text{--CH}_2\text{--CH}_3$. That is **2-methylbutane**.

Why other options are wrong:

- n-Butane and n-pentane are straight chains; 2-methylpropane has only a three-carbon main chain.

Final Answer: The compound is 2-methylbutane \Rightarrow

[Go Back to Q20](#)

Q21.

Solution

Concept — General Formulae: Alkanes are $\text{C}_n\text{H}_{2n+2}$, alkenes C_nH_{2n} , and alkynes $\text{C}_n\text{H}_{2n-2}$ (one triple bond reduces H by 4 relative to an alkane).

Explanation: An alkyne has the general formula $\text{C}_n\text{H}_{2n-2}$ (e.g. ethyne C_2H_2).

Why other options are wrong:

- $\text{C}_n\text{H}_{2n+2}$ is an alkane, C_nH_{2n} is an alkene; C_nH_n is not a standard formula.



Final Answer: Alkyne is $C_nH_{2n-2} \Rightarrow$

Answer: (B) [Go Back to Q21](#)

Q22.

Solution

Concept — Huckel's Rule: A planar, cyclic, fully conjugated ring is aromatic if it has $4n + 2$ delocalised π electrons ($n = 0, 1, 2, \dots$).

Explanation: Benzene has 6 π electrons = $4(1) + 2$, satisfying the $4n + 2$ rule.

Why other options are wrong:

- $4n$ electrons indicate anti-aromaticity; $2n$ and $n + 1$ are not Huckel's rule.

Final Answer: Aromatic rings have $4n + 2 \pi$ electrons \Rightarrow

Answer: (C) [Go Back to Q22](#)

Q23.

Solution

Concept — Carbocation Stability: Stability increases with the number of electron-donating alkyl groups (which spread the positive charge): $3^\circ > 2^\circ > 1^\circ >$ methyl.

Explanation: A tertiary (3°) carbocation has three alkyl groups donating electron density, so it is the most stable.

Why other options are wrong:

- Secondary, primary and methyl cations have fewer stabilising alkyl groups.

Final Answer: The 3° carbocation is most stable \Rightarrow

Answer: (A) [Go Back to Q23](#)



Q24.

Solution

Concept — Carboxyl Group: The $-\text{COOH}$ group (a carbonyl $\text{C}=\text{O}$ attached to a hydroxyl $-\text{OH}$ on the same carbon) defines carboxylic acids.

Explanation: The figure shows $\text{R}-\text{COOH}$, which is the **carboxylic acid** functional group (e.g. acetic acid).

Why other options are wrong:

- Alcohols have only $-\text{OH}$; aldehydes have $-\text{CHO}$; ethers have $\text{C}-\text{O}-\text{C}$.

Final Answer: $-\text{COOH}$ characterises carboxylic acids \Rightarrow **B**

Answer: (B) [Go Back to Q24](#)

Q25.

Solution

Concept — Oxidation of Alcohols: Primary alcohols are oxidised first to aldehydes, and on further oxidation to carboxylic acids; secondary alcohols give ketones.

Explanation: $\text{R}-\text{CH}_2\text{OH}$ is first oxidised to $\text{R}-\text{CHO}$, an **aldehyde** (and only on stronger/continued oxidation does it become the acid).

Why other options are wrong:

- Ketones come from secondary alcohols; “acid only” skips the first aldehyde step; an ester needs an acid + alcohol.

Final Answer: Primary alcohol first gives an aldehyde \Rightarrow **D**

Answer: (D) [Go Back to Q25](#)

Q26.

Solution

Concept — $\text{S}_{\text{N}}2$ Mechanism: $\text{S}_{\text{N}}2$ is a one-step bimolecular reaction; the rate-determining step involves both the substrate and the nucleophile, so rate $= k[\text{R}-\text{X}][\text{Nu}^-]$.

Explanation: The rate of an $\text{S}_{\text{N}}2$ reaction depends on **both the haloalkane and the nucleophile** (second-order overall).

Why other options are wrong:



- Dependence on the substrate only is the SN1 case; “nucleophile only” or “neither” is incorrect for SN2.

Final Answer: SN2 rate depends on both reactants \Rightarrow

Answer: (A) [Go Back to Q26](#)

Q27.

Solution

Concept — Basicity of Amines: Aliphatic amines are stronger bases than ammonia because the alkyl group donates electron density to nitrogen; aniline is weaker because the lone pair is delocalised into the ring.

Explanation: Ethylamine (an aliphatic amine) is the strongest base here, more basic than ammonia, while aniline and acetamide are much weaker.

Why other options are wrong:

- Aniline’s lone pair is delocalised; acetamide’s lone pair is pulled by the C=O; ammonia lacks the +I alkyl group.

Final Answer: Ethylamine is the strongest base \Rightarrow

Answer: (C) [Go Back to Q27](#)

Q28.

Solution

Concept — Proteins: Proteins are natural polymers (polypeptides) made by linking amino acids through peptide bonds.

Explanation: The monomer units of proteins are **amino acids**.

Why other options are wrong:

- Glucose units build polysaccharides; fatty acids build fats; nucleotides build nucleic acids.

Final Answer: Proteins are made of amino acids \Rightarrow

Answer: (B) [Go Back to Q28](#)



Q29.

Solution

Concept — Condensation vs Addition Polymers: Condensation polymers form by joining monomers with elimination of a small molecule (like water); addition polymers form by simple addition across double bonds.

Explanation: Nylon-6,6 forms from a diamine and a dicarboxylic acid with loss of water, so it is a condensation polymer.

Why other options are wrong:

- Polythene, polystyrene and PVC are addition polymers of alkene monomers.

Final Answer: Nylon-6,6 is a condensation polymer \Rightarrow

[Go Back to Q29](#)

Q30.

Solution

Concept — Food Chemistry: Antioxidants prevent the oxidation (rancidity) of fats and oils in food.

Explanation: BHT (butylated hydroxytoluene) and BHA (butylated hydroxyanisole) are added as **antioxidants** to stop fats from turning rancid.

Why other options are wrong:

- They are not sweeteners, antibiotics, or colouring agents.

Final Answer: BHT and BHA are antioxidants \Rightarrow

[Go Back to Q30](#)



Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	A	3	D	4	B	5	B
6	D	7	A	8	C	9	B	10	C
11	D	12	A	13	B	14	D	15	A
16	C	17	B	18	C	19	A	20	D
21	B	22	C	23	A	24	B	25	D
26	A	27	C	28	B	29	D	30	A

