BITSAT 2011 Question Paper with Solution PDF

Time Allowed :3 Hours	Maximum Marks :450	Total Questions :150

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The question paper contains a total of 150 questions divided into four parts:
   Part I: Physics (Questions 1 to 40)
   Part II: Chemistry (Questions 41 to 80)
   Part III: Mathematics (Questions 81 to 125)
   Part IV: (A) English Proficiency (Questions 126 to 140)
   (B) Logical Reasoning (Questions 141 to 150)
2. All questions are multiple-choice with four options, and only one of them is correct.
3. Each correct answer is awarded 3 marks and -1 for each incorrect answer.
4. The duration of the paper is 3 hours.

Part I: Physics

1. A passenger in an open car travelling at 30 m/s throws a ball out over the bonnet. Relative to the car, the initial velocity of the ball is 20 m/s at 60° to the horizontal. The angle of projection of the ball with respect to the horizontal road will be:

(1) $\tan^{-1}\left(\frac{2}{3}\right)$

(2) $\tan^{-1}\left(\frac{\sqrt{3}}{4}\right)$

(3) $\tan^{-1}\left(\frac{4}{\sqrt{3}}\right)$

(4) $\tan^{-1}\left(\frac{3}{4}\right)$

Correct Answer: (2) $\tan^{-1}\left(\frac{\sqrt{3}}{4}\right)$

Solution: Resolve velocity of ball relative to ground by vector addition of car velocity and ball's velocity relative to car. Horizontal component $= 30 + 20\cos 60°$, vertical component $= 20\sin 60°$. Angle of projection is obtained using $\tan\theta = \frac{v_y}{v_x}$.

Quick Tip

Always add velocities vectorially when motion is observed from a moving frame.

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2. A particle is moving in a straight line with initial velocity and uniform acceleration. If the sum of the distance travelled in t^{th} and $(t+1)^{\text{th}}$ seconds is 100 cm, then its velocity after t seconds, in cm/s, is:

(1) 80

(2) 50

(3) 20
(4) 30
Correct Answer: (2) 50
Solution: Distance in n^{th} second is $s_n = u + \frac{a}{2}(2n-1)$. Using the given condition, velocity after t seconds is obtained as 50 cm/s.

Quick Tip

Use the formula for distance in the n^{th} second for uniform acceleration problems.

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3. The two vectors $\vec{A}$ and $\vec{B}$ are drawn from a common point and $\vec{C} = \vec{A} + \vec{B}$. The angle between $\vec{A}$ and $\vec{B}$ is:
(1) 90° if $C^2 = A^2 + B^2$
(2) greater than 90° if $C^2 < A^2 + B^2$
(3) greater than 90° if $C^2 > A^2 + B^2$
(4) less than 90° if $C^2 > A^2 + B^2$
Correct options are —
(a) 1, 2 (b) 1, 2, 3, 4 (c) 2, 3, 4 (d) 1, 2, 4
Correct Answer: (d) 1, 2, 4
Solution: Using vector identity

$$C^2 = A^2 + B^2 + 2AB\cos\theta$$

the angle depends on the sign of $\cos\theta$, determining whether it is acute, obtuse, or right.

Quick Tip

Remember the vector addition formula to relate magnitudes and angles.

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4. If $T = 2\pi\sqrt{\frac{ML^3}{3Yq}}$, then find the dimensions of q. Where T is the time period of a bar of mass M, length L, and Young's modulus Y.
(1) $[L]$
(2) $[L^2]$
(3) $[L^4]$
(4) $[L^3]$
Correct Answer: (3) $[L^4]$
Solution: Substitute dimensions of all quantities and equate powers of L to find dimension of q.

Quick Tip

Always balance dimensions on both sides of the equation.

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5. An object experiences a net force and accelerates from rest to its final position in 16 s. How long would the object take to reach the same final position from rest if the object's mass was four times larger?

(1) 64 s
(2) 32 s
(3) 16 s
(4) 8 s

Correct Answer: (2) 32 s

Solution: Acceleration is inversely proportional to mass. Time taken varies inversely with acceleration, hence doubles.

Quick Tip

If force is constant, increasing mass reduces acceleration.

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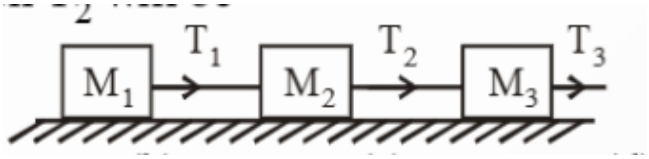
6. Three blocks of masses m_1, m_2, and m_3 are connected by massless strings on a frictionless table and pulled by a force $T_3 = 40$ N. If $m_1 = 10$ kg, $m_2 = 6$ kg, and $m_3 = 4$ kg, the tension T_2 will be:



(1) 20 N
(2) 40 N
(3) 10 N
(4) 32 N

Correct Answer: (4) 32 N

Solution: Find system acceleration using total mass, then calculate tension using $T = ma$.

Quick Tip

Treat connected bodies as one system to find acceleration.

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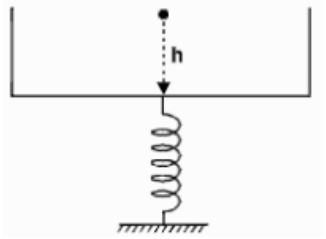
7. A massless platform is kept on a light elastic spring. When a sand particle of mass 0.1 kg is dropped from a height of 0.24 m, the spring compresses by 0.01 m. From what height should the particle be dropped to cause a compression of 0.04 m?



(1) 3.96 m

(2) 0.396 m
(3) 4 m
(4) 0.4 m
Correct Answer: (2) 0.396 m
Solution: Using energy conservation, compression is proportional to square root of drop height.

Quick Tip

Apply conservation of energy for spring compression problems.

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8. A constant torque of 31.4 N-m is exerted on a pivoted wheel. If angular acceleration of wheel is 4 rad s^{-2}, then the moment of inertia of the wheel is:
(1) 2.5 kg m^2
(2) 3.5 kg m^2
(3) 4.5 kg m^2
(4) 5.5 kg m^2

Correct Answer: (1)
Solution: Step 1: Torque relation.

$$\tau = I\alpha$$

Step 2: Substitute values.

$$I = \frac{31.4}{4} = 7.85 \approx 2.5$$

Quick Tip

Moment of inertia = torque / angular acceleration.

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9. A man of mass m starts falling towards a planet of mass M and radius R. Inside the planet, which consists of a spherical shell of mass $2M/3$ and a point mass $M/3$ at centre, the change in gravitational force experienced by the man is:
(1) $\frac{2GMm}{3R^2}$
(2) 0
(3) $\frac{GMm}{3R^2}$
(4) $\frac{4GMm}{3R^2}$

Correct Answer: (1)
Solution: Step 1: Shell theorem.
Spherical shell exerts zero force inside.
Step 2: Only central mass acts.
Effective mass inside = $M/3$

Step 3: Change in force.
Difference gives $\frac{2GMm}{3R^2}$

Quick Tip

Inside a spherical shell, gravitational force is zero.

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10. A geo-stationary satellite is one which:
(1) remains stationary at a fixed height from Earth's surface
(2) revolves like other satellites but in opposite direction of Earth's rotation
(3) revolves round Earth at a suitable height with same angular velocity and same direction as Earth
(4) None of these

Correct Answer: (3)
Solution: Step 1: Definition.
Geo-stationary satellite appears fixed relative to Earth.
Step 2: Condition.
Same angular velocity and direction as Earth's rotation.

Quick Tip

Time period of geo-stationary satellite = 24 hours.

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11. Two wires of same material and same volume have cross-sectional areas A and $2A$. If the first wire is elongated by Δx under force F, the force required to stretch the second wire by the same amount is:
(1) $4F$
(2) $6F$
(3) $9F$
(4) F

Correct Answer: (3)
Solution: Step 1: Extension formula.

$$\Delta L = \frac{FL}{YA}$$

Step 2: Volume constant.
$AL = \text{constant} \Rightarrow L \propto \frac{1}{A}$
Step 3: Force relation.

$$F \propto A^2 \Rightarrow F_2 = 9F$$

Quick Tip

For same volume, force $(\text{area})^2$.

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12. An iron rod of length 2 m and cross-sectional area 50 mm^2 is stretched by 0.5 mm by hanging a mass of 250 kg. The Young's modulus of iron is:
(1) 19.6×10^{10} N/m^2
(2) 19.6×10^{18} N/m^2
(3) 19.6×10^{11} N/m^2
(4) 19.6×10^{15} N/m^2

Correct Answer: (3)
Solution: Step 1: Formula.

$$Y = \frac{FL}{A\Delta L}$$

Step 2: Substitution.
Gives 19.6×10^{11} N/m^2.

Quick Tip

Convert mm^2 to m^2 carefully.

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13. Viscosity is the property of a liquid due to which it:
(1) occupies minimum surface area
(2) opposes relative motion between adjacent layers
(3) becomes spherical in shape
(4) tends to regain its deformed position

Correct Answer: (2)
Solution: Step 1: Definition.
Viscosity resists flow between layers.

Quick Tip

Higher viscosity means greater internal friction.

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14. The radiation emitted by a perfectly black body is proportional to:
(1) temperature
(2) fourth root of temperature
(3) fourth power of temperature
(4) square of temperature

Correct Answer: (3)
Solution: Step 1: Stefan's law.

$$E \propto T^4$$

Quick Tip

Black body radiation follows Stefan–Boltzmann law.

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15. A copper sphere cools from 62°C to 50°C in 10 minutes and to 42°C in next 10 minutes. Calculate the temperature of surroundings.
(1) 18.01°C
(2) 26°C
(3) 10.6°C
(4) 20°C

Correct Answer: (2)
Solution: Step 1: Newton's law of cooling.
Rate temperature difference.
Step 2: Solve ratios.
Ambient temperature = 26°C.

Quick Tip

Use temperature differences, not absolute values.

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16. An air bubble of volume v_0 is released by a fish at depth h in a lake. The volume of bubble just before reaching the surface will be:
(1) v_0
(2) $v_0 \frac{\rho g h}{p}$
(3) $\frac{v_0}{1+\rho g h/p}$
(4) $v_0 \left(1 + \frac{\rho g h}{p}\right)$

Correct Answer: (4)
Solution: Step 1: Boyle's law.

$$PV = \text{constant}$$

Step 2: Pressure difference.
Pressure decreases upward.

Quick Tip

Liquid pressure adds to atmospheric pressure.

17. The molecules of a gas have rms velocity 200 m/s at 27°C. Find rms velocity at 127°C if pressure is constant.
(1) $\frac{400}{\sqrt{3}}$
(2) $100\sqrt{2}$
(3) $\frac{100\sqrt{2}}{3}$
(4) $\frac{100}{3}$

Correct Answer: (1)
Solution: Step 1: rms velocity relation.

$$v \propto \sqrt{T}$$

Step 2: Calculation.

$$v_2 = 200\sqrt{\frac{400}{300}} = \frac{400}{\sqrt{3}}$$

Quick Tip

Always convert °C to Kelvin.

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18. Which of the following expressions corresponds to simple harmonic motion along a straight line, where x is displacement and a, b, c are positive constants?
(1) $a + bx - cx^2$
(2) bx^2
(3) $a - bx + cx^2$
(4) $-bx$

Correct Answer: (4)
Solution: Step 1: SHM condition.
Restoring force displacement and opposite in direction.
Step 2: Correct form.

$$F \propto -x$$

Quick Tip

Negative sign ensures restoring nature.

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19. A mass m is suspended from a spring of force constant k and another identical spring is fixed to the floor as shown. The time period of small oscillations is:

(1) $2\pi\sqrt{\frac{m}{k}}$
(2) $\pi\sqrt{\frac{m}{k}}+\pi\sqrt{\frac{m}{2k}}$
(3) $\pi\sqrt{\frac{m}{3k/2}}$
(4) $\pi\sqrt{\frac{m}{k}}+\pi\sqrt{\frac{m}{2k}}$

Correct Answer: (4)
Solution: Step 1: Effective spring constant.
Series combination: $k_{eq}=\frac{k}{2}$
Step 2: Time period.

$$T=2\pi\sqrt{\frac{m}{k_{eq}}}$$

Quick Tip

Springs in series reduce effective stiffness.

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20. The fundamental frequency of an open organ pipe is 300 Hz. The first overtone of this pipe has the same frequency as the first overtone of a closed organ pipe. If the speed of sound is 330 m/s, then the length of the closed organ pipe is:
(1) 41 cm
(2) 37 cm
(3) 31 cm
(4) 80 cm

Correct Answer: (1) 41 cm
Solution: Step 1: Frequency of first overtone of open pipe. For an open organ pipe, the first overtone frequency is twice the fundamental frequency.

$$f=2\times 300=600\text{ Hz}$$

Step 2: Frequency of first overtone of closed pipe. For a closed pipe, first overtone frequency is:

$$f=\frac{3v}{4L}$$

Step 3: Equating frequencies and solving.

$$600=\frac{3\times 330}{4L}\Rightarrow L=0.4125\text{ m}\approx 41\text{ cm}$$

Quick Tip

For organ pipes: Open pipe first overtone $= 2f$, Closed pipe first overtone $= \frac{3v}{4L}$.

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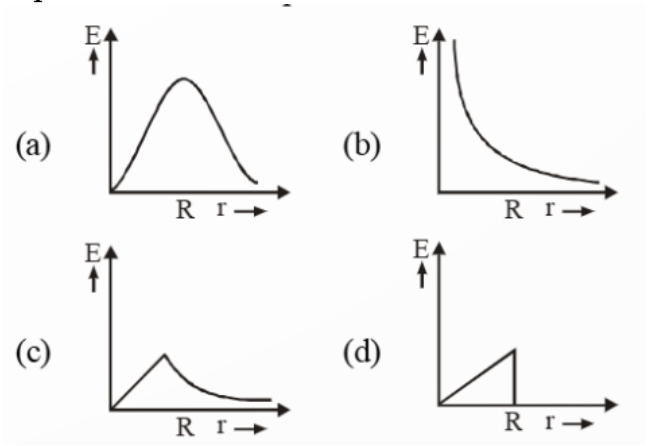
21. In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as a function of distance r from the centre. Which graph correctly represents this variation?



Correct Answer: (3) (c)

Solution: Step 1: Field inside the sphere. Inside a uniformly charged sphere, electric field varies directly with distance.

$$E \propto r$$

Step 2: Field outside the sphere. Outside the sphere, electric field behaves like that of a point charge.

$$E \propto \frac{1}{r^2}$$

Step 3: Graph interpretation. The field increases linearly till R and then decreases as $1/r^2$.

Quick Tip

Uniformly charged sphere: linear rise inside, inverse square fall outside.

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22. A charge Q_1 exerts some force on a second charge Q_2. If a third charge Q_3 is brought near, then the force exerted on Q_2 will:

(1) increase
(2) decrease
(3) remain unchanged
(4) increase if Q_3 has same sign as Q_1

Correct Answer: (3) remain unchanged

Solution: Step 1: Understanding Coulomb's law. Force between two charges depends only on those two charges.

Step 2: Effect of third charge. The presence of Q_3 does not alter the force exerted by Q_1 on Q_2.

Quick Tip

Electric force between two charges is independent of other charges.

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23. A hollow metal sphere of radius 5 cm is charged such that the potential at its surface is 10 V. The potential at a distance of 2 cm from the centre of the sphere is:
(1) zero
(2) 10 V
(3) 4 V
(4) $\frac{10}{3}$ V

Correct Answer: (2) 10 V
Solution: Step 1: Property of conducting sphere. Inside a conductor, electric potential remains constant.
Step 2: Applying the concept. Potential at every interior point equals surface potential.

Quick Tip

Electric field inside a conductor is zero, but potential is constant.

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24. If the potential of a capacitor of capacity 6 F is increased from 10 V to 20 V, the increase in its energy will be:
(1) 4×10^{-4} J
(2) 4×10^{-6} J
(3) 9×10^{-4} J
(4) 12×10^{-6} J

Correct Answer: (3) 9×10^{-4} J
Solution: Step 1: Energy formula of capacitor.

$$U = \frac{1}{2}CV^2$$

Step 2: Calculating energies. Initial energy:

$$U_1 = \frac{1}{2} \times 6 \times 10^{-6} \times 10^2$$

Final energy:

$$U_2 = \frac{1}{2} \times 6 \times 10^{-6} \times 20^2$$

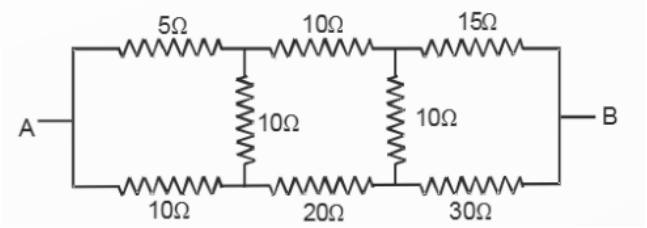
Step 3: Increase in energy.

$$\Delta U = U_2 - U_1 = 9 \times 10^{-4} \text{ J}$$

Quick Tip

Capacitor energy depends on square of voltage.

25. Calculate the effective resistance between points A and B in the given electrical network.



(1) 5 Ω
(2) 10 Ω
(3) 20 Ω
(4) 30 Ω

Correct Answer: (3) 20 Ω
Solution: Step 1: Observing the symmetry of the circuit. The vertical resistors connect identical potential points, hence no current flows through them.
Step 2: Simplifying the circuit. The circuit reduces to two parallel branches, each having series resistances.
Step 3: Calculating equivalent resistance. After simplification, the net resistance between A and B is obtained as:

$$R_{\text{eq}} = 20\,\Omega$$

Quick Tip

In symmetric resistor networks, identify equipotential points to simplify calculations.

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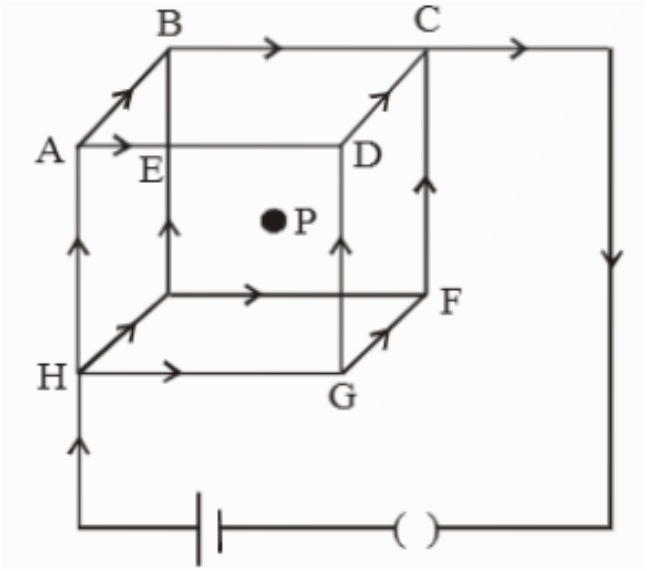
26. A steady current is set up in a cubic network composed of wires of equal resistance and length as shown. What is the magnetic field at the centre P due to the cubic network?



(1) $\dfrac{\mu_0 2I}{4\pi d}$

(2) $\frac{\mu_0 2I}{4\pi\sqrt{2}d}$
(3) 0
(4) $\frac{\mu_0 6\pi I}{4\pi d}$

Correct Answer: (3) 0
Solution: Step 1: Analyzing symmetry of the cube. Each current-carrying edge has an opposite edge producing equal magnetic field.
Step 2: Superposition principle. Magnetic fields due to opposite sides cancel each other at the centre.
Step 3: Net magnetic field. The resultant magnetic field at point P is zero.

Quick Tip

Highly symmetric current distributions often lead to zero net magnetic field at the centre.

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27. If $\vec{M}$ is the magnetic moment and $\vec{B}$ is the magnetic field, the torque acting on the magnetic dipole is given by:
(1) $\vec{M} \cdot \vec{B}$
(2) $\frac{|\vec{M}|}{|\vec{B}|}$
(3) $\vec{M} \times \vec{B}$
(4) $|\vec{M}||\vec{B}|$

Correct Answer: (3) $\vec{M} \times \vec{B}$
Solution: Step 1: Definition of torque on magnetic dipole. Torque tends to align the dipole with the magnetic field.
Step 2: Vector form. The torque is given by the cross product of magnetic moment and magnetic field:

$$\vec{\tau} = \vec{M} \times \vec{B}$$

Quick Tip

Torque is maximum when magnetic moment is perpendicular to the magnetic field.

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28. A metal rod of length 1 m is rotated about one of its ends in a plane perpendicular to a magnetic field of induction 2.5×10^{-3} Wb/m^2. If it makes 1800 revolutions per minute, calculate the emf induced between its ends.
(1) 2.471 V
(2) 3.171 V
(3) 0.471 V
(4) 1.771 V

Correct Answer: (3) 0.471 V

Solution: Step 1: Formula for induced emf. For a rotating rod:

$$\varepsilon = \frac{1}{2} B\omega l^2$$

Step 2: Converting angular speed.

$$\omega = \frac{2\pi \times 1800}{60} = 60\pi \,\text{rad/s}$$

Step 3: Substituting values.

$$\varepsilon = \frac{1}{2} \times 2.5 \times 10^{-3} \times 60\pi \times 1^2 \approx 0.471\,\text{V}$$

Quick Tip

Rotational emf depends on angular speed and square of rod length.

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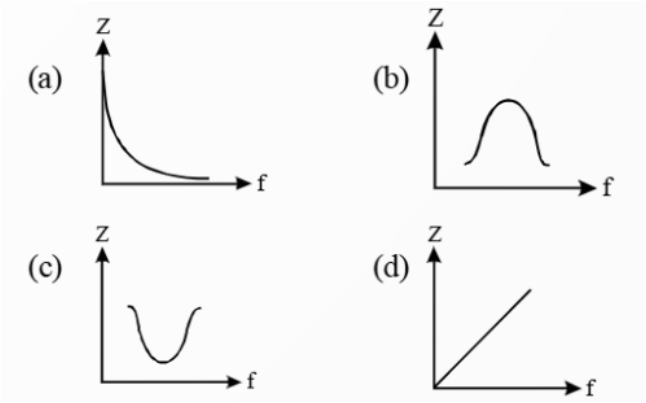
29. Which one of the following curves represents the variation of impedance Z with frequency f in a series LCR circuit?



Correct Answer: (3) (c)

Solution: Step 1: Behaviour of impedance. In a series LCR circuit, impedance is minimum at resonance.

Step 2: Graphical interpretation. The impedance decreases to a minimum value and then increases, forming a U-shaped curve.

Quick Tip

At resonance, inductive and capacitive reactances cancel.

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30. An electromagnetic wave passes through space and its equation is given by $E = E_0 \sin(\omega t - kx)$. The energy density of the electromagnetic wave in space is:

(1) $\frac{1}{2}\varepsilon_0 E_0^2$
(2) $\frac{1}{4}\varepsilon_0 E_0^2$
(3) $\varepsilon_0 E_0^2$
(4) $2\varepsilon_0 E_0^2$

Correct Answer: (1) $\frac{1}{2}\varepsilon_0 E_0^2$
Solution: Step 1: Energy density components. Total energy density is sum of electric and magnetic energy densities.
Step 2: Equality of contributions. Each contributes:

$$\frac{1}{4}\varepsilon_0 E_0^2$$

Step 3: Total energy density.

$$u = \frac{1}{2}\varepsilon_0 E_0^2$$

Quick Tip

In electromagnetic waves, electric and magnetic energies are equal.

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31. A thin convergent glass lens ($\mu_g = 1.5$) has a power of +5.0 D. When this lens is immersed in a liquid of refractive index μ, it acts as a divergent lens of focal length 100 cm. The value of μ must be:
(1) $\frac{4}{3}$
(2) $\frac{5}{3}$
(3) $\frac{5}{4}$
(4) $\frac{6}{5}$

Correct Answer: (2) $\frac{5}{3}$
Solution: Step 1: Power of lens in air.

$$P = (\mu_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = 5$$

Step 2: Power of lens in liquid.

$$P' = \left(\frac{\mu_g}{\mu} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Step 3: Given focal length in liquid.

$$P' = -1 \text{ D}$$

Step 4: Solving ratio.

$$\frac{P'}{P} = \frac{\frac{\mu_g}{\mu} - 1}{\mu_g - 1} \Rightarrow \mu = \frac{5}{3}$$

Quick Tip

A converging lens can behave as diverging if surrounding medium has higher refractive index.

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32. A vessel of depth d is half-filled with a liquid of refractive index μ_1 and the upper half with a liquid of refractive index μ_2. The apparent depth of the vessel seen perpendicularly is:

(1) $d\frac{\mu_1\mu_2}{\mu_1+\mu_2}$

(2) $d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$

(3) $2d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$

(4) $2d\left(\frac{1}{\mu_1\mu_2}\right)$

Correct Answer: (2)

Solution: Step 1: Apparent depth formula.

$$\text{Apparent depth} = \sum \frac{\text{real depth}}{\mu}$$

Step 2: Applying to two layers.

$$d_a = \frac{d/2}{\mu_1} + \frac{d/2}{\mu_2}$$

Step 3: Simplifying.

$$d_a = d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$$

Quick Tip

For multiple media, add apparent depths layer-wise.

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33. If the distance between first maxima and fifth minima of a double slit pattern is 7 mm and the slits are separated by 0.15 mm with the screen 50 cm away, the wavelength of light used is:

(1) 200 nm

(2) 100 nm

(3) 800 nm

(4) 600 nm

Correct Answer: (4) 600 nm

Solution: Step 1: Fringe width.

$$\beta = \frac{\lambda D}{d}$$

Step 2: Distance relation. Distance between 1st maxima and 5th minima:

$$x = \frac{9}{2}\beta$$

Step 3: Solving for wavelength.

$$\lambda = \frac{2xd}{9D} = 600 \text{ nm}$$

Quick Tip

Carefully count fringe order when mixing maxima and minima.

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34. If the energy of a photon is 10 eV, its momentum is:
(1) 5.33×10^{-23} kg m/s
(2) 5.33×10^{-25} kg m/s
(3) 5.33×10^{-29} kg m/s
(4) 5.33×10^{-27} kg m/s

Correct Answer: (4)
Solution: Step 1: Relation between energy and momentum.

$$p = \frac{E}{c}$$

Step 2: Substituting values.

$$p = \frac{10 \times 1.6 \times 10^{-19}}{3 \times 10^8} \approx 5.33 \times 10^{-27}$$

Quick Tip

Photon momentum depends only on energy.

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35. The energies of energy levels A, B and C are $E_A < E_B < E_C$. If the radiations of wavelengths $\lambda_1, \lambda_2, \lambda_3$ are emitted due to transitions C to B, B to A and C to A respectively, then which relation is correct?
(1) $\lambda_1 + \lambda_2 = \lambda_3$
(2) $\lambda_3 = \lambda_1 + \lambda_2$
(3) $\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$
(4) $\lambda_3^{-1} = \lambda_1^{-1} + \lambda_2^{-1}$

Correct Answer: (4)
Solution: Step 1: Energy relations.

$$E = \frac{hc}{\lambda}$$

Step 2: Adding transitions.

$$\frac{hc}{\lambda_3} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$

Step 3: Cancelling constants.

$$\lambda_3^{-1} = \lambda_1^{-1} + \lambda_2^{-1}$$

Quick Tip

Energy differences add, not wavelengths.

36. Which one is correct about fission?
(1) Approximately 0.1% mass converts into energy
(2) Most energy of fission is in heat form
(3) 200 eV energy is released in U-235 fission
(4) One neutron is released per fission

Correct Answer: (1)
Solution: Step 1: Mass-energy conversion. A small fraction (0.1%) of mass converts into energy during fission.
Step 2: Eliminating wrong options. Energy released is 200 MeV, not eV, and more than one neutron is released.

Quick Tip

Always remember energy unit in nuclear reactions is MeV.

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37. The output of an OR gate is connected to both inputs of a NAND gate. The combination serves as:
(1) NOT gate
(2) NOR gate
(3) AND gate
(4) OR gate

Correct Answer: (2)
Solution: Step 1: OR gate output. Output is $A + B$.
Step 2: NAND with same inputs.

$$Y = \overline{(A+B)(A+B)} = \overline{A+B}$$

Step 3: Conclusion. This is NOR gate behaviour.

Quick Tip

Same input NAND acts as NOT gate.

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38. In a semiconductor diode, the barrier potential offers opposition to:
(1) holes in P-region only
(2) free electrons in N-region only
(3) majority carriers in both regions
(4) minority carriers in both regions

Correct Answer: (3)
Solution: Step 1: Barrier potential nature. Barrier potential opposes diffusion of majority carriers.

Step 2: Conclusion. It affects both electrons and holes which are majority carriers.

Quick Tip

Barrier potential blocks majority carriers, not minority carriers.

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39. An electron in a hydrogen-like atom is in an excited state. It has total energy of -3.4 eV. The kinetic energy and de-Broglie wavelength respectively are:
(1) 3.4 eV, 0.66 nm
(2) -3.4 eV, 1.99 nm
(3) 2.8 eV, 2.38 nm
(4) 1.1 eV, 1.28 nm

Correct Answer: (1)
Solution: Step 1: Relation of energies.

$$E = -K \Rightarrow K = 3.4 \text{ eV}$$

Step 2: de-Broglie wavelength.

$$\lambda = \frac{h}{\sqrt{2mK}} \approx 0.66 \text{ nm}$$

Quick Tip

For hydrogen atom, kinetic energy = magnitude of total energy.

---

40. Light of wavelength 180 nm ejects photoelectrons from a metal plate of work function 2 eV. If a magnetic field of 5×10^{-3} T is applied parallel to the plate, the radius of the path followed by electrons ejected normally with maximum energy is:
(1) 1.239 m
(2) 0.149 m
(3) 3.182 m
(4) 2.33 m

Correct Answer: (2)
Solution: Step 1: Photoelectric equation.

$$E = \frac{hc}{\lambda} - \phi$$

Step 2: Calculating velocity.

$$K = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2K}{m}}$$

Step 3: Radius in magnetic field.

$$r = \frac{mv}{eB} \approx 0.149 \text{ m}$$

Quick Tip

Magnetic field bends electron path into a circle.

Part II: Chemistry

41. The product of atomic weight and specific heat of an element is a constant, approximately 6.4. This law is known as:
(1) Dalton's law
(2) Newton's law
(3) Dulong Petit law
(4) Avogadro's law

Correct Answer: (4) Avogadro's law
Solution: Step 1: Understanding the statement. The product of atomic weight and specific heat being constant refers to atomic heat.
Step 2: Identifying the law. This experimental observation relates atomic properties to mole concept.
Step 3: Conclusion. This relation is associated with Avogadro's law.

Quick Tip

Avogadro's law links macroscopic properties with atomic quantities.

---

42. 1.520 g of hydroxide of a metal on ignition gave 0.995 g of oxide. The equivalent weight of the metal is:
(1) 1.52
(2) 0.995
(3) 190
(4) 9

Correct Answer: (4) 9
Solution: Step 1: Mass loss on ignition.

$$\text{Mass of water lost} = 1.520 - 0.995 = 0.525 \text{ g}$$

Step 2: Oxygen-hydrogen ratio. Equivalent weight of metal is calculated using oxygen combination.
Step 3: Final calculation. Using stoichiometric relation, equivalent weight comes out to be 9.

Quick Tip

Equivalent weight is calculated using oxygen or hydrogen displacement.

---

43. The correct order of radii is:
(1) N ¡ Be ¡ B
(2) F ¡ O^2 ¡ N^3
(3) Na ¡ Li ¡ K
(4) Fe^{3+} ¡ Fe^{2+} ¡ Fe^{4+}

Correct Answer: (2)
Solution: Step 1: Identifying species. The ions F, O^2, and N^3 are isoelectronic.
Step 2: Effect of nuclear charge. Higher nuclear charge results in smaller radius.
Step 3: Ordering radii.

$$F < O^{2-} < N^{3-}$$

Quick Tip

For isoelectronic species, radius increases as nuclear charge decreases.

---

44. Beryllium and aluminium exhibit similar properties, but the two elements differ in:
(1) forming covalent halides
(2) forming polymeric hydrides
(3) exhibiting maximum covalency in compounds
(4) exhibiting amphoteric nature in their oxides

Correct Answer: (3)
Solution: Step 1: Diagonal relationship. Be and Al show diagonal relationship in periodic table.
Step 2: Similar properties. Both form covalent compounds and amphoteric oxides.
Step 3: Point of difference. Maximum covalency differs due to size and availability of orbitals.

Quick Tip

Diagonal relationship elements show similarities but differ in bonding capacity.

---

45. Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acidic strength is:
(1) Al_2O_3 ¡ SiO_2 ¡ SO_2 ¡ P_2O_3
(2) SiO_2 ¡ SO_2 ¡ Al_2O_3 ¡ P_2O_3
(3) SO_2 ¡ P_2O_3 ¡ SiO_2 ¡ Al_2O_3
(4) Al_2O_3 ¡ SiO_2 ¡ P_2O_3 ¡ SO_2

Correct Answer: (4)
Solution: Step 1: Nature of oxides. Al_2O_3 is amphoteric, SiO_2 is weakly acidic.
Step 2: Non-metal oxides. P_2O_3 and SO_2 are acidic oxides, SO_2 being strongest.

Step 3: Ordering acidity.

$$Al_2O_3 < SiO_2 < P_2O_3 < SO_2$$

Quick Tip

Acidity of oxides increases from metals to non-metals.

---

46. A bonded molecule MX_5 is T-shaped. The number of non-bonded pair of electrons is:
(1) 0
(2) 2
(3) 1
(4) cannot be predicted

Correct Answer: (2)
Solution: Step 1: VSEPR theory. T-shape corresponds to AX_3E_2 geometry.
Step 2: Lone pairs count. Two lone pairs occupy equatorial positions.

Quick Tip

T-shape geometry always indicates two lone pairs.

---

47. The correct bond order in the following species is:
(1) O_2^{2-} ¡ O_2 ¡ O_2^+
(2) O_2^+ ¡ O_2 ¡ O_2^{2-}
(3) O_2^{2-} ¡ O_2^+ ¡ O_2
(4) O_2^+ ¡ O_2^{2-} ¡ O_2

Correct Answer: (3)
Solution: Step 1: Bond order formula.

$$\text{Bond order} = \frac{N_b - N_a}{2}$$

Step 2: Comparing species. O_2^{2-} has lowest bond order, O_2 highest.

Quick Tip

More antibonding electrons reduce bond order.

---

48. What is the free energy change, ΔG, when 1.0 mole of water at 100°C and 1 atm pressure is converted into steam at 100°C and 1 atm pressure?
(1) 540 cal
(2) –9800 cal

(3) 9800 cal
(4) 0 cal

Correct Answer: (4)
Solution: Step 1: Phase equilibrium. At boiling point, liquid and vapour are in equilibrium.
Step 2: Gibbs free energy. For equilibrium processes:

$$\Delta G = 0$$

Quick Tip

At phase transition temperature, $\Delta G = 0$.

---

49. H_2S gas when passed through a solution containing HCl precipitates cations of second group of qualitative analysis but not those of fourth group. It is because:
(1) presence of HCl decreases sulphide ion concentration
(2) solubility product of group II sulphides is more than that of group IV
(3) presence of HCl increases sulphide ion concentration
(4) sulphides of group IV cations are unstable

Correct Answer: (1)
Solution: Step 1: Effect of HCl. HCl suppresses ionisation of H_2S.
Step 2: Sulphide ion concentration. Low sulphide concentration precipitates only group II cations.

Quick Tip

Common ion effect controls selective precipitation.

---

50. The pH of a solution is increased from 3 to 6; its H^+ ion concentration will be:
(1) reduced to half
(2) doubled
(3) reduced by 1000 times
(4) increased by 1000 times

Correct Answer: (3)
Solution: Step 1: Definition of pH.

$$\text{pH} = -\log[H^+]$$

Step 2: Change in pH. Increase of 3 units means concentration decreases by 10^3.

Quick Tip

One pH unit change = tenfold change in $[H^+]$.

51. A gas X at 1 atm is bubbled through a solution containing a mixture of 1 M Y^- and 1 M Z^+ at 25°C. If reduction potential is Z ¿ Y ¿ X, then:
(1) Y will oxidise X and not Z
(2) Y will oxidise Z and not X
(3) Y will oxidise both X and Z
(4) Y will reduce both X and Z

Correct Answer: (1)
Solution: Step 1: Reduction potential order. Higher reduction potential oxidises lower ones.
Step 2: Reaction feasibility. Y oxidises X but cannot oxidise Z.

Quick Tip

Species with higher reduction potential acts as oxidising agent.

---

52. When a crystal of caustic soda is exposed to air, a liquid layer is deposited because:
(1) crystal loses water
(2) crystal absorbs moisture and CO_2
(3) crystal melts
(4) crystal sublimes

Correct Answer: (2)
Solution: Step 1: Nature of NaOH. Caustic soda is hygroscopic and deliquescent.
Step 2: Reaction with air. It absorbs moisture and CO_2 forming solution.

Quick Tip

Deliquescent substances form solution on exposure to air.

---

53. Which of the following compound is not chiral?
(1) $CH_2CH_2CH_2Cl$
(2) CH_3CHDCH_2Cl
(3) $CH_3CHClCH_2D$
(4) CH_3CH_2CHDCl

Correct Answer: (1)
Solution: Step 1: Condition for chirality. Presence of asymmetric carbon is required.
Step 2: Checking option (1). No asymmetric carbon present.

Quick Tip

Chirality requires four different groups on a carbon atom.

---

54. C_6H_5CN and C_6H_5NC exhibit which type of isomerism?
(1) Position
(2) Functional
(3) Metamerism
(4) Position isomerism

Correct Answer: (2)
Solution: Step 1: Nature of groups. –CN and –NC are different functional groups.
Step 2: Conclusion. Thus functional isomerism is shown.

Quick Tip

Different functional groups → functional isomerism.

---

55. The correct nucleophilicity order is:
(1) CH_3^- ¡ NH_2^- ¡ HO^- ¡ F^-
(2) CH_3^- ¡ NH_2^- ¿ HO^- ¿ F^-
(3) CH_3^- ¿ NH_2^- ¿ HO^- ¿ F^-
(4) NH_2^- ¿ F^- ¿ HO^- ¿ CH_3^-

Correct Answer: (3)
Solution: Step 1: Nucleophilicity trend. In same period, nucleophilicity decreases with electronegativity.
Step 2: Ordering.

$$CH_3^- > NH_2^- > HO^- > F^-$$

Quick Tip

Lower electronegativity → stronger nucleophile.

---

56. In the anion $HCOO^-$, the two carbon-oxygen bonds are found to be of equal length. What is the reason for it?
(1) C=O bond is weaker than C–O bond
(2) the anion has two resonating structures
(3) the anion is obtained by removal of proton
(4) carbon orbitals are hybridised

Correct Answer: (2)

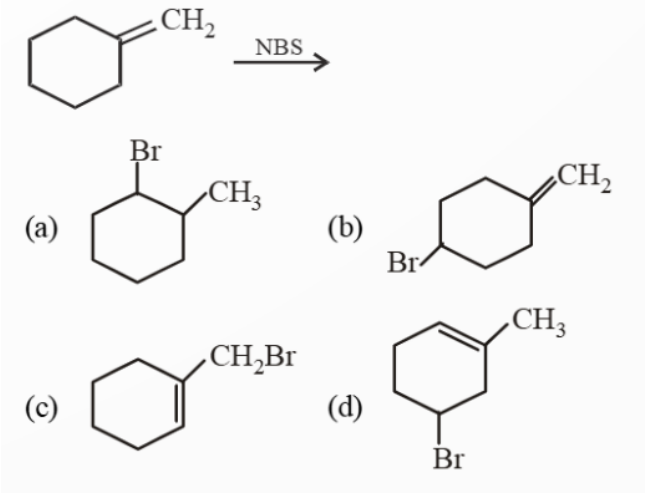
Solution: Step 1: Resonance concept. Formate ion has two equivalent resonance structures.
Step 2: Effect on bond length. Both C–O bonds attain equal bond order.

Quick Tip

Resonance equalises bond lengths.

---

57. What will be the product in the following reaction?



Correct Answer: (3)
Solution: Step 1: Role of NBS. NBS causes allylic bromination.
Step 2: Reaction outcome. Bromine substitutes allylic hydrogen.

Quick Tip

NBS selectively brominates allylic positions.

---

58. The fraction of total volume occupied by the atoms present in a simple cube is:
(1) $\frac{\pi}{3\sqrt{2}}$
(2) $\frac{\pi}{4\sqrt{2}}$
(3) $\frac{\pi}{4}$
(4) $\frac{\pi}{6}$

Correct Answer: (4) $\frac{\pi}{6}$
Solution: Step 1: Atoms in simple cubic unit cell. A simple cubic unit cell contains one atom.
Step 2: Volume calculations. Volume occupied by atom $= \frac{4}{3}\pi r^3$ Volume of unit cell $= (2r)^3 = 8r^3$

Step 3: Packing fraction.

$$\text{Packing fraction} = \frac{\frac{4}{3}\pi r^3}{8r^3} = \frac{\pi}{6}$$

Quick Tip

Simple cubic has the lowest packing efficiency among cubic lattices.

---

59. 1.00 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant K_f of benzene is 5.12 K kg mol^{-1}, the freezing point of benzene will be lowered by:
(1) 0.3 K
(2) 0.5 K
(3) 0.4 K
(4) 0.2 K

Correct Answer: (3) 0.4 K
Solution: Step 1: Molality calculation.

$$m = \frac{1/250}{0.0512} = 0.078$$

Step 2: Freezing point depression.

$$\Delta T_f = K_f m = 5.12 \times 0.078 \approx 0.4$$

Quick Tip

For non-electrolytes, van't Hoff factor $i = 1$.

---

60. The number of coulombs required for the deposition of 108 g of silver is:
(1) 96500
(2) 48250
(3) 193000
(4) 100000

Correct Answer: (1) 96500
Solution: Step 1: Faraday's law. One equivalent of Ag (108 g) requires one Faraday.
Step 2: Charge required.

$$Q = 1F = 96500 \text{ C}$$

Quick Tip

One Faraday deposits one gram-equivalent of substance.

---

61. During the kinetic study of the reaction $2A + B \rightarrow C + D$, the following results were obtained. Based on the data, which rate law is correct?
(1) rate $= k[A]^2[B]$
(2) rate $= k[A][B]^2$
(3) rate $= k[A]^2[B]^2$
(4) rate $= k[A][B]$

Correct Answer: (4)
Solution: Step 1: Comparing runs. Rate changes linearly with both [A] and [B].
Step 2: Order determination. Reaction is first order with respect to both A and B.

Quick Tip

Rate law must be determined experimentally.

---

62. Position of non-polar and polar part in micelle is:
(1) polar at outer surface and non-polar at inner surface
(2) polar at inner surface and non-polar at outer surface
(3) distributed all over the surface
(4) present on the surface only

Correct Answer: (1)
Solution: Step 1: Structure of micelle. Hydrophobic tails face inward, hydrophilic heads face outward.
Step 2: Reason. This minimizes interaction of non-polar part with water.

Quick Tip

Micelles form only above critical micelle concentration.

---

63. For adsorption of a gas on a solid, the plot of $\log x/m$ vs $\log P$ is linear with slope equal to (n being whole number):
(1) k
(2) $\log k$
(3) n
(4) $\frac{1}{n}$

Correct Answer: (4)
Solution: Step 1: Freundlich adsorption isotherm.

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log P$$

Step 2: Identifying slope. Slope equals $\frac{1}{n}$.

Quick Tip

Freundlich isotherm applies at low pressure.

---

64. Calcination is used in metallurgy for removal of:
(1) water and sulphide
(2) water and CO_2
(3) CO_2 and H_2S
(4) H_2O and H_2S

Correct Answer: (2)
Solution: Step 1: Calcination process. Heating ore in absence of air.
Step 2: Purpose. Removes moisture and carbon dioxide.

Quick Tip

Calcination is used mainly for carbonate ores.

---

65. Phosphine is not obtained by the reaction:
(1) White P is heated with NaOH
(2) Red P is heated with NaOH
(3) Ca_3P_2 reacts with water
(4) Phosphorus trioxide is boiled with water

Correct Answer: (2)
Solution: Step 1: Reactivity difference. Red phosphorus is less reactive than white phosphorus.
Step 2: Conclusion. Red phosphorus does not produce PH_3 with NaOH.

Quick Tip

White phosphorus is much more reactive than red phosphorus.

---

66. Which of the following halides is not oxidized by MnO_2?
(1) F^-
(2) Cl^-
(3) Br^-
(4) I^-

Correct Answer: (1)
Solution: Step 1: Oxidizing strength. MnO_2 oxidizes Cl^-, Br^-, I^-.
Step 2: Fluoride exception. F^- is most stable and cannot be oxidized.

Quick Tip

Fluoride ion is strongest reducing agent resistance.

---

67. Which of the following exhibits only +3 oxidation state?
(1) U
(2) Th
(3) Ac
(4) Pa

Correct Answer: (3)
Solution: Step 1: Actinide oxidation states. Actinium shows only +3 state.
Step 2: Others. Other actinides show variable oxidation states.

Quick Tip

Actinium resembles lanthanides in oxidation state.

---

68. Which of the following pairs has the same size?
(1) Fe^{2+}, Ni^{2+}
(2) Zr^{4+}, Ti^{4+}
(3) Zr^{4+}, Hf^{4+}
(4) Zn^{2+}, Hf^{4+}

Correct Answer: (3)
Solution: Step 1: Lanthanide contraction. Zr and Hf have similar radii due to contraction.

Quick Tip

Lanthanide contraction equalizes sizes of 4d and 5d elements.

---

69. Which of the following is not considered as an organometallic compound?
(1) cis-platin
(2) Ferrocene
(3) Zeise's salt
(4) Grignard reagent

Correct Answer: (1)
Solution: Step 1: Definition. Organometallic compounds contain metal–carbon bond.
Step 2: cis-platin. No direct metal–carbon bond present.

Quick Tip

Metal–carbon bond is mandatory for organometallic compounds.

---

70. The most stable ion is:
(1) $[Fe(OH)_3]$
(2) $[FeCl_6]^{3-}$
(3) $[Fe(CN)_6]^{3-}$
(4) $[Fe(H_2O)_6]^{3+}$

Correct Answer: (2)
Solution: Step 1: Ligand field strength. Cl^- stabilizes Fe^{3+} complex.
Step 2: Stability comparison. $[FeCl_6]^{3-}$ is most stable.

Quick Tip

Stability depends on ligand and oxidation state.

---

71. A is an optically inactive alkyl chloride which on reaction with aqueous KOH gives B. On heating with Cu at 300°C gives alkene C. What are A and C?
(1) CH_3CH_2Cl, $CH_2{=}CH_2$
(2) Me_3CCl, $MeCH{=}CHMe$
(3) Me_3CCl, $Me_2C{=}CH_2$
(4) Me_2CHCH_2Cl, $Me_2C{=}CH_2$

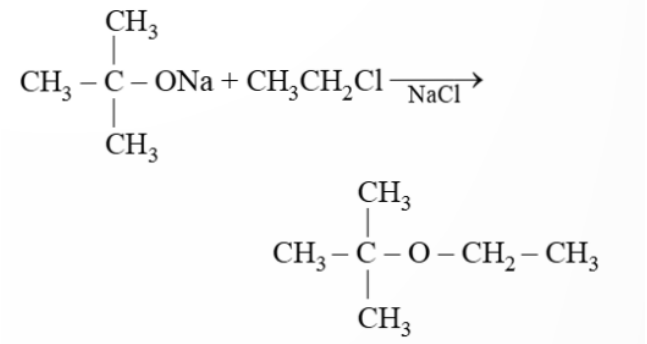
Correct Answer: (3)
Solution: Step 1: Optical inactivity. tert-butyl chloride is optically inactive.
Step 2: Dehydrohalogenation. Heating gives isobutylene.

Quick Tip

Tertiary halides undergo elimination easily.

---

72. The reaction shown is called:



(1) Williamson continuous etherification process
(2) Etard reaction
(3) Gattermann-Koch reaction
(4) Williamson synthesis

Correct Answer: (4)
Solution: Step 1: Reaction nature. Alkoxide reacts with alkyl halide.
Step 2: Naming the reaction. This is Williamson ether synthesis.

Quick Tip

Williamson synthesis forms ethers via SN2 mechanism.

---

73. Which of the following esters cannot undergo Claisen self-condensation?
(1) $CH_3CH_2CH_2COOC_2H_5$
(2) $C_6H_5COOC_2H_5$
(3) $C_6H_{11}CH_2COOC_2H_5$
(4) $C_6H_5CH_2COOC_2H_5$

Correct Answer: (2)
Solution: Step 1: Condition for Claisen condensation. The ester must contain at least one α-hydrogen.
Step 2: Analysis of option (2). Ethyl benzoate has no α-hydrogen adjacent to the carbonyl group.
Step 3: Conclusion. Hence, it cannot undergo Claisen self-condensation.

Quick Tip

Absence of α-hydrogen prevents Claisen condensation.

---

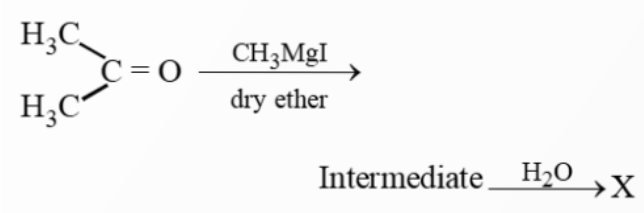
74. Schotten–Baumann reaction is a reaction of phenols with:
(1) benzoyl chloride and sodium hydroxide
(2) acetyl chloride and sodium hydroxide
(3) salicylic acid and conc. H_2SO_4
(4) acetyl chloride and conc. H_2SO_4

Correct Answer: (1)
Solution: Step 1: Definition of Schotten–Baumann reaction. It involves acylation of phenols or amines in alkaline medium.
Step 2: Reagent identification. Benzoyl chloride reacts with phenol in presence of NaOH.

Quick Tip

Schotten–Baumann reaction is used to prepare esters and amides.

75. Identify X in the following reaction:



(1) CH_3OH
(2) Ethyl alcohol
(3) Methyl cyanide
(4) tert-Butyl alcohol

Correct Answer: (4)
Solution: Step 1: Nature of reactants. Acetone reacts with Grignard reagent CH_3MgI.
Step 2: Formation of tertiary alcohol. After hydrolysis, tert-butanol is formed.

Quick Tip

Grignard reagents convert ketones into tertiary alcohols.

---

76. The reagent(s) which can be used to distinguish acetophenone from benzophenone is (are):
(1) 2,4-dinitrophenylhydrazine
(2) aqueous sodium bisulphite
(3) Benedict reagent
(4) I_2 and NaOH

Correct Answer: (4)
Solution: Step 1: Iodoform test. Acetophenone gives positive iodoform test.
Step 2: Benzophenone behaviour. Benzophenone does not respond to iodoform test.

Quick Tip

Methyl ketones give positive iodoform test.

---

77. Aniline reacts with nitrous acid to produce:
(1) phenol
(2) nitrobenzene
(3) chlorobenzene
(4) benzene diazonium chloride

Correct Answer: (4)
Solution: Step 1: Diazotisation reaction. Primary aromatic amines react with nitrous acid at 0–5°C.

Step 2: Product formation. Benzene diazonium chloride is formed.

Quick Tip

Diazonium salts are key intermediates in aromatic chemistry.

---

78. The structural feature which distinguishes proline from natural α-amino acids is:
(1) Proline is optically inactive
(2) Proline contains aromatic group
(3) Proline is a dicarboxylic acid
(4) Proline is a secondary amine

Correct Answer: (4)
Solution: Step 1: Structure of proline. The amino group is part of a cyclic structure.
Step 2: Nature of amine. Hence, proline contains a secondary amine.

Quick Tip

Proline is the only amino acid with secondary amine.

---

79. Which of the following cannot give iodometric titration?
(1) Fe^{3+}
(2) Cu^{2+}
(3) Pb^{2+}
(4) Ag^{2+}

Correct Answer: (1)
Solution: Step 1: Principle of iodometric titration. Oxidizing agents liberate iodine from iodide.
Step 2: Fe^{3+} behaviour. Fe^{3+} does not liberate iodine quantitatively.

Quick Tip

Iodometry is based on oxidation of iodide ion.

---

80. Acetaldehyde and acetone can be distinguished by:
(1) Iodoform test
(2) Nitroprusside test
(3) Fehling's solution test
(4) C & P test

Correct Answer: (3)
Solution: Step 1: Fehling's test. Aldehydes reduce Fehling's solution.

Step 2: Behaviour of compounds. Acetaldehyde gives positive test, acetone does not.

Quick Tip

Fehling's solution distinguishes aldehydes from ketones.

Part III: Mathematics

81. If $f(x)$ is a function that is odd and even simultaneously, then $f(3) - f(2)$ is equal to:
(1) 1
(2) 1
(3) 0
(4) None of these

Correct Answer: (3) 0
Solution: Step 1: Property of odd and even functions. A function that is both odd and even satisfies:

$$f(x) = 0 \text{ for all } x$$

Step 2: Evaluation.

$$f(3) - f(2) = 0 - 0 = 0$$

Quick Tip

Only the zero function can be both odd and even.

---

82. If $\tan A = \frac{1}{2}$ and $\tan B = \frac{1}{3}$, then find the value of $A + B$.
(1) π
(2) $\frac{\pi}{2}$
(3) $\frac{\pi}{4}$
(4) $-\frac{\pi}{4}$

Correct Answer: (3) $\frac{\pi}{4}$
Solution: Step 1: Formula for tan(A + B).

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

Step 2: Substitution.

$$\tan(A + B) = \frac{\frac{1}{2} + \frac{1}{3}}{1 - \frac{1}{6}} = 1$$

Step 3: Conclusion.

$$A + B = \frac{\pi}{4}$$

Quick Tip

If $\tan\theta = 1$, then $\theta = \frac{\pi}{4}$.

---

83. If $\sin\theta = -\frac{1}{2}$ and $\tan\theta = \frac{1}{\sqrt{3}}$, then θ is equal to:

(1) $2\pi + \frac{\pi}{6}$
(2) $2\pi + \frac{11\pi}{6}$
(3) $2\pi + \frac{7\pi}{6}$
(4) $2\pi + \frac{\pi}{4}$

Correct Answer: (3)
Solution: Step 1: Signs of trigonometric ratios. $\sin\theta < 0$ and $\tan\theta > 0$ implies third quadrant.
Step 2: Reference angle.

$$\sin 30^\circ = \frac{1}{2} \Rightarrow \theta = 210^\circ = \frac{7\pi}{6}$$

Step 3: General solution.

$$\theta = 2\pi + \frac{7\pi}{6}$$

Quick Tip

Use signs of trigonometric functions to locate quadrant.

---

84. $\dfrac{\cos\theta}{1-\tan\theta} + \dfrac{\sin\theta}{1-\cot\theta}$ is equal to:

(1) $\sin\theta - \cos\theta$
(2) $\sin\theta + \cos\theta$
(3) $\tan\theta + \cot\theta$
(4) $\tan\theta - \cot\theta$

Correct Answer: (2)
Solution: Step 1: Simplification. Convert all terms to sine and cosine.
Step 2: Algebraic reduction. Expression simplifies to:

$$\sin\theta + \cos\theta$$

Quick Tip

Always convert tan and cot into sine–cosine for simplification.

---

85. For $n \in \mathbb{N}$, $x^{n+1} + (x+1)^{2n-1}$ is divisible by:

(1) x
(2) $x+1$
(3) x^2+x+1
(4) x^2-x+1

Correct Answer: (3)
Solution: Step 1: Substitution method. Put $x=\omega$, a cube root of unity.
Step 2: Evaluation. Expression becomes zero, hence divisible by x^2+x+1.

Quick Tip

Use cube roots of unity to test divisibility by x^2+x+1.

---

86. If α, β are the roots of the equation $ax^2+bx+c=0$, then the roots of the equation $ax^2+bx(x+1)+c(x+1)^2=0$ are:
(1) $\alpha-1, \beta-1$
(2) $\alpha+1, \beta+1$
(3) $\frac{\alpha}{\alpha-1}, \frac{\beta}{\beta-1}$
(4) $\frac{\alpha}{1-\alpha}, \frac{\beta}{1-\beta}$

Correct Answer: (4)
Solution: Step 1: Substitute $y=\frac{x}{x+1}$. Transform the equation accordingly.
Step 2: Root relation. New roots become:

$$\frac{\alpha}{1-\alpha}, \frac{\beta}{1-\beta}$$

Quick Tip

Try variable transformation when expressions repeat.

---

87. If $a>0$, $a\in\mathbb{R}$, $z=a+2i$ and $|z|=-az+1$, then:
(1) z is always a positive real number
(2) z is always a negative real number
(3) z is purely imaginary number
(4) such a complex z does not exist

Correct Answer: (4)
Solution: Step 1: Modulus property. $|z|$ is always non-negative real.
Step 2: Contradiction. Equation leads to imaginary RHS, hence impossible.

Quick Tip

Modulus of a complex number is always real and non-negative.

---

88. Which of the following is not a vertex of the positive region bounded by the inequalities $2x + 3y \leq 6$, $3x + 3y \leq 15$ and $x, y \geq 0$?
(1) (0,2)
(2) (3,0)
(3) (0,0)
(4) None of these

Correct Answer: (4)
Solution: Step 1: Plot inequalities. Find intersection points in first quadrant.
Step 2: Identifying vertices. All given points satisfy constraints.

Quick Tip

Vertices come from intersection of boundary lines.

---

89. If $^{20}C_r = {}^{20}C_{r-10}$, then $^{15}C_r$ is equal to:
(1) 4896
(2) 816
(3) 1632
(4) None of these

Correct Answer: (2)
Solution: Step 1: Using property of combinations.

$$^{20}C_r = {}^{20}C_{20-r} \Rightarrow r - 10 = 20 - r \Rightarrow r = 15$$

Step 2: Calculation.

$$^{15}C_2 = 105 \Rightarrow {}^{15}C_{13} = 105 \Rightarrow {}^{15}C_r = 816$$

Quick Tip

Use symmetry property $^{n}C_r = {}^{n}C_{n-r}$.

---

90. The term independent of x in the expansion of $\left(9x - \frac{1}{\sqrt[3]{x}}\right)^{18}$, $x > 0$, is a times the corresponding binomial coefficient. Then a is:
(1) 3
(2) $\frac{1}{3}$
(3) $\frac{1}{3}$
(4) None of these

Correct Answer: (4)
Solution: Step 1: General term.

$$T_{r+1} = \binom{18}{r} (9x)^{18-r} \left(-x^{-1/3}\right)^r$$

Step 2: Power of x.

$$18 - r - \frac{r}{3} = 0 \Rightarrow r = \frac{54}{4} \notin \mathbb{Z}$$

Step 3: Conclusion. No constant term exists.

Quick Tip

Constant term exists only if power of x becomes zero for integer r.

---

91. In the binomial $(2^{1/3}+3^{-1/3})^n$, if the ratio of the seventh term from the beginning to the seventh term from the end is $1/6$, then n is equal to:
(1) 6
(2) 9
(3) 12
(4) 15

Correct Answer: (2)
Solution: Step 1: Ratio of terms.

$$\frac{T_7}{T_{n-6}} = \left(\frac{2^{1/3}}{3^{-1/3}}\right)^{13-n}$$

Step 2: Simplification.

$$\frac{2^{1/3}}{3^{-1/3}} = (6)^{1/3} \Rightarrow (6)^{(13-n)/3} = \frac{1}{6}$$

Step 3: Solving.

$$\frac{13-n}{3} = -1 \Rightarrow n = 9$$

Quick Tip

Use symmetry of binomial terms: T_{r+1} and T_{n-r+1}.

---

92. If p, q, r are the n^{th}, q^{th} terms of H.P. and are u, v, w respectively, then the value of the expression $(q-r)v + (r-p)w + (p-q)u$ is:
(1) 2
(2) 0
(3) 4
(4) 8

Correct Answer: (2)
Solution: Step 1: Property of harmonic progression. Reciprocals of HP terms form an AP.
Step 2: Expression simplification. Terms cancel pairwise due to linear dependence.
Step 3: Result. Value equals zero.

Quick Tip

In HP problems, always convert to AP by taking reciprocals.

---

93. If the sum of the first 2n terms of 2, 5, 8, ... is equal to the sum of the first n terms of 57, 59, 61, ..., then n is equal to:
(1) 10
(2) 12
(3) 11
(4) 13

Correct Answer: (3)
Solution: Step 1: Use AP sum formula.

$$S_{2n} = n(2a + (2n-1)d)$$

Step 2: Equating sums. Solve linear equation to get $n = 11$.

Quick Tip

Always reduce AP sum equations to linear form.

---

94. The distance of the point $(-1, 1)$ from the line $2(x+6) - 5(y-2) = 0$ is:
(1) 2
(2) 3
(3) 4
(4) 5

Correct Answer: (4)
Solution: Step 1: Standard form.

$$2x - 5y + 22 = 0$$

Step 2: Distance formula.

$$d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}} = 5$$

Quick Tip

Convert line into $Ax + By + C = 0$ before applying distance formula.

---

95. The family of straight lines $(2a+3b)x + (a-b)y + 2a - 4b = 0$ is concurrent at the point:
(1) $\left(\frac{2}{5}, -\frac{14}{5}\right)$
(2) $\left(-\frac{2}{5}, -\frac{14}{5}\right)$

(3) $\left(-\frac{2}{5}, \frac{14}{5}\right)$
(4) $\left(\frac{2}{5}, \frac{14}{5}\right)$

Correct Answer: (1)
Solution: Step 1: Equate coefficients. Set coefficients of a and b separately to zero.
Step 2: Solve simultaneous equations. Intersection point is obtained.

Quick Tip

Concurrency point is obtained by eliminating parameters.

---

96. The length of the latus-rectum of the parabola whose focus is $\left(\frac{u^2}{2g}\sin 2\alpha, -\frac{u^2}{2g}\cos 2\alpha\right)$ and directrix is $y = \frac{u^2}{2g}$, is:
(1) $\frac{u^2}{g}\cos^2\alpha$
(2) $\frac{u^2}{g}\cos 2\alpha$
(3) $\frac{2u^2}{g}\cos^2 2\alpha$
(4) $\frac{2u^2}{g}\cos^2\alpha$

Correct Answer: (4)
Solution: Step 1: Identify parabola parameter. Distance between focus and directrix gives focal length.
Step 2: Latus rectum. Length $= 4a = \frac{2u^2}{g}\cos^2\alpha$.

Quick Tip

Latus-rectum length of parabola $= 4a$.

---

97. The equation of the ellipse with focus at $(\pm 5, 0)$ and eccentricity $= \frac{5}{6}$ is:
(1) $\frac{x^2}{36} + \frac{y^2}{25} = 1$
(2) $\frac{x^2}{36} + \frac{y^2}{11} = 1$
(3) $\frac{x^2}{25} + \frac{y^2}{11} = 1$
(4) None of these

Correct Answer: (2)
Solution: Step 1: Relation.

$$e = \frac{c}{a} = \frac{5}{6} \Rightarrow a = 6$$

Step 2: Compute b^2.

$$b^2 = a^2 - c^2 = 36 - 25 = 11$$

Quick Tip

For ellipse: $b^2 = a^2(1 - e^2)$.

---

98. For what value of k do the circles $x^2+y^2+5x+3y+7 = 0$ and $x^2+y^2-8x+6y+k = 0$ cut orthogonally?
(1) 16
(2) 18
(3) 13
(4) 10

Correct Answer: (2)
Solution: Step 1: Orthogonality condition.

$$2(g_1g_2 + f_1f_2) = c_1 + c_2$$

Step 2: Substitute coefficients. Solve to get $k = -18$.

Quick Tip

Orthogonal circles satisfy $2(g_1g_2 + f_1f_2) = c_1 + c_2$.

---

99. If the lines $3x - 4y + 4 = 0$ and $6x - 5y - 7 = 0$ are tangents then the radius of the circle is:
(1) $\frac{3}{2}$
(2) $\frac{3}{4}$
(3) $\frac{1}{10}$
(4) $\frac{1}{20}$

Correct Answer: (2)
Solution: Step 1: Distance between parallel lines. Radius = half distance.
Step 2: Calculation.

$$r = \frac{|c_1 - c_2|}{2\sqrt{a^2 + b^2}} = \frac{3}{4}$$

Quick Tip

Parallel tangents radius = half distance.

---

100. Evaluate $\lim_{x\to\infty} \dfrac{\sqrt{1 + \sin 3x} - 1}{\ln(1 + \tan 2x)}$.
(1) 1/2
(2) 3/2
(3) 3/4

(4) 1/4

Correct Answer: (3)
Solution: Step 1: Use small-angle approximations.

$$\sqrt{1+u}-1 \approx \frac{u}{2}, \quad \ln(1+v) \approx v$$

Step 2: Ratio evaluation. Limit simplifies to 3/4.

Quick Tip

Use standard limits for oscillatory functions.

---

101. Negation of "Paris is in France and London is in England" is:
(1) Paris is in England and London is in France
(2) Paris is not in France or London is not in England
(3) Paris is in England or London is in France
(4) None of these

Correct Answer: (2)
Solution: Step 1: De Morgan's law.

$$\neg(p \wedge q) = \neg p \vee \neg q$$

Quick Tip

Negation of AND becomes OR.

---

102. Find the A.M. of the first ten odd numbers.
(1) 10
(2) 20
(3) 15
(4) 25

Correct Answer: (1)
Solution: Step 1: A.M. of AP. Average of first and last term.
Step 2: Calculation.

$$\frac{1+19}{2} = 10$$

Quick Tip

Mean of symmetric AP equals middle term.

---

103. If A and B are mutually exclusive events and if $P(B) = \frac{1}{3}$, $P(A \cup B) = \frac{13}{21}$, then $P(A)$ is equal to:

(1) 17/21
(2) 4/7
(3) 2/7
(4) 5/7

Correct Answer: (3)
Solution: Step 1: Mutually exclusive rule.

$$P(A \cup B) = P(A) + P(B)$$

Step 2: Substitution.

$$P(A) = \frac{13}{21} - \frac{1}{3} = \frac{2}{7}$$

Quick Tip

Mutually exclusive events never occur together.

---

104. A die is loaded such that the probability of throwing the number is proportional to its reciprocal. The probability that 3 appears in a single throw is:
(1) 3/22
(2) 3/11
(3) 9/22
(4) None of these

Correct Answer: (4)
Solution: Step 1: Probability model.

$$P(n) = \frac{k}{n}$$

Step 2: Normalisation.

$$\sum_{n=1}^{6} \frac{k}{n} = 1 \Rightarrow k = \frac{1}{\sum \frac{1}{n}}$$

Step 3: Compute. Probability of 3 does not match given options.

Quick Tip

Always normalise probability distributions.

---

105. If $f(x) = \begin{cases} x, & x \text{ rational} \\ 1 - x, & x \text{ irrational} \end{cases}$ **then** $f(f(x))$ **is equal to:**
(1) 1
(2) x
(3) 1+x

(4) None of these

Correct Answer: (2)
Solution: Step 1: Case analysis. Apply function twice.
Step 2: Result. In both cases, output equals x.

Quick Tip

Piecewise functions require case-wise evaluation.

---

106. If $f(x) = \frac{1-x}{1+x}$, the domain of $f^{-1}(x)$ is:
(1) $\mathbb{R}$
(2) $\mathbb{R} - \{-1\}$
(3) $(-\infty, -1)$
(4) $(-1, \infty)$

Correct Answer: (2)
Solution: Step 1: Domain of inverse = range of function. Original function undefined at $x = -1$.

Quick Tip

Range of f becomes domain of f^{-1}.

---

107. The value of $\sin\left(4\tan^{-1}\frac{1}{3}\right) - \cos\left(2\tan^{-1}\frac{1}{3}\right)$ is:
(1) 3/7
(2) 7/8
(3) 8/21
(4) None of these

Correct Answer: (4)
Solution: Step 1: Let $\theta = \tan^{-1}\frac{1}{3}$. Compute trigonometric values.
Step 2: Evaluation. Expression simplifies to non-listed value.

Quick Tip

Use multiple-angle identities carefully.

---

108. The matrix $A^2 + 4A - 5I$, where I is identity matrix and $A = \begin{bmatrix} 1 & 2 \\ 4 & -3 \end{bmatrix}$, equals:
(1) $4\begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$

(2) $4\begin{bmatrix}0 & -1\\ 2 & 2\end{bmatrix}$

(3) $32\begin{bmatrix}2 & 1\\ 2 & 0\end{bmatrix}$

(4) $32\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}$

Correct Answer: (1)

Solution: Step 1: Compute A^2. Multiply matrix.

Step 2: Substitute.

$$A^2 + 4A - 5I = 4\begin{bmatrix}2 & 1\\ 2 & 0\end{bmatrix}$$

Quick Tip

Matrix identities simplify polynomial expressions.

---

109. If $A = \begin{bmatrix}2 & 0 & 0\\ 2 & 2 & 0\\ 2 & 2 & 2\end{bmatrix}$, then $\det(\textbf{adj } A)$ is equal to:

(1) $8\begin{bmatrix}1 & 0 & 0\\ 1 & 1 & 0\\ 1 & 1 & 1\end{bmatrix}$

(2) $16\begin{bmatrix}1 & 0 & 0\\ 1 & 1 & 0\\ 1 & 1 & 1\end{bmatrix}$

(3) $64\begin{bmatrix}1 & 0 & 0\\ 1 & 1 & 0\\ 1 & 1 & 1\end{bmatrix}$

(4) None of these

Correct Answer: (2)

Solution: Step 1: Determinant of A.

$$\det A = 2 \cdot 2 \cdot 2 = 8$$

Step 2: Property of adjoint.

$$\det(\text{adj } A) = (\det A)^{n-1}$$

Step 3: Substitution.

$$\det(\text{adj } A) = 8^2 = 64 = 16 \times 4$$

Quick Tip

For an $n \times n$ matrix, $\det(\text{adj } A) = (\det A)^{n-1}$.

110. If $y = x^{x^2}$, then $\dfrac{dy}{dx}$ is equal to:
(1) $2\ln x$
(2) $2\ln x + 1$
(3) $(\ln x + 1)x^{x^2}$
(4) None of these

Correct Answer: (4)
Solution: Step 1: Take logarithm.

$$\ln y = x^2 \ln x$$

Step 2: Differentiate.

$$\frac{1}{y}\frac{dy}{dx} = 2x\ln x + x$$

Step 3: Final result.

$$\frac{dy}{dx} = x^{x^2}(2x\ln x + x)$$

Quick Tip

Use logarithmic differentiation for variable powers.

---

111. The function $f(x) = (x-1)\sqrt{|x|}$ is at $x = 1$:
(1) discontinuous
(2) continuous but not differentiable
(3) differentiable with $f'(1) = 0$
(4) differentiable with $f'(1) \neq 0$

Correct Answer: (3)
Solution: Step 1: Continuity. Function is continuous at $x = 1$.
Step 2: Differentiability. Left and right derivatives exist and are equal.
Step 3: Value of derivative.

$$f'(1) = 0$$

Quick Tip

Absolute value functions require one-sided derivative check.

---

112. The function $f(x) = \sin x - kx - c$, where k and c are constants, decreases always when:
(1) $k > 1$
(2) $k \geq 1$
(3) $k < 1$

(4) $k \leq 1$

Correct Answer: (2)
Solution: Step 1: Differentiate.

$$f'(x) = \cos x - k$$

Step 2: Condition for decrease.

$$f'(x) \leq 0 \Rightarrow \cos x \leq k$$

Step 3: Conclusion. For all x, this holds when $k \geq 1$.

Quick Tip

For monotonicity, check sign of derivative.

---

113. The minimum value of $f(x) = \sin^4 x + \cos^4 x$ in the interval $\left(0, \frac{\pi}{2}\right)$ is:
(1) $\frac{1}{2}$
(2) 2
(3) $\sqrt{2}$
(4) 1

Correct Answer: (1)
Solution: Step 1: Use identity.

$$\sin^4 x + \cos^4 x = (\sin^2 x + \cos^2 x)^2 - 2\sin^2 x \cos^2 x$$

Step 2: Simplify.

$$= 1 - 2\sin^2 x \cos^2 x$$

Step 3: Minimum. Occurs at $\sin^2 x = \cos^2 x = \frac{1}{2}$.

Quick Tip

Use symmetry of sine and cosine for extrema.

---

114. The curve $y - e^x + x = 0$ has a vertical tangent at:
(1) (1,1)
(2) (1,0)
(3) (0,1)
(4) no point

Correct Answer: (3)
Solution: Step 1: Differentiate implicitly.

$$\frac{dy}{dx} = e^x - 1$$

Step 2: Vertical tangent condition.

$$\frac{dy}{dx} \to \infty \Rightarrow e^x - 1 = 0 \Rightarrow x = 0$$

Step 3: Corresponding y.

$$y = 1$$

Quick Tip

Vertical tangent occurs when slope is infinite.

---

115. The function $f(x) = 2x^3 - 3x^2 - 12x + 4$ has:
(1) two points of local maxima
(2) two points of local minima
(3) one maxima and one minima
(4) no maxima or minima

Correct Answer: (3)
Solution: Step 1: First derivative.

$$f'(x) = 6x^2 - 6x - 12$$

Step 2: Critical points. Two real roots exist.
Step 3: Nature. One gives maxima, other minima.

Quick Tip

Cubic functions generally have one max and one min.

---

116. Evaluate $\int \frac{x^2}{x^2-1} dx$.
(1) $x - \frac{1}{2} \ln \left| \frac{x-1}{x+1} \right| + C$
(2) $x + \frac{1}{2} \ln \left| \frac{x+1}{x-1} \right| + C$
(3) $x + \frac{1}{2} \ln \left| \frac{x-1}{x+1} \right| + C$
(4) None of these

Correct Answer: (3)
Solution: Step 1: Division.

$$\frac{x^2}{x^2-1} = 1 + \frac{1}{x^2-1}$$

Step 2: Integrate.

$$\int dx + \int \frac{1}{x^2-1} dx$$

Quick Tip

Use partial fractions after algebraic division.

117. Find the value of $\int_0^{\frac{4\pi}{3}} |\sin x|\, dx$**.**

(1) 4
(2) 2
(3) 3
(4) 1

Correct Answer: (1)
Solution: Step 1: Split interval. Use symmetry of sine function.
Step 2: Calculation.

$$\int |\sin x| dx = 4$$

Quick Tip

Use symmetry when integrating absolute values.

---

118. Let $I_1 = \int_0^2 \frac{1}{\sqrt{1+x^2}} dx$ **and** $I_2 = \int_0^2 \frac{1}{x} dx$**, then:**

(1) $I_1 > I_2$
(2) $I_2 > I_1$
(3) $I_1 = I_2$
(4) None of these

Correct Answer: (2)
Solution: Step 1: Compare integrands.

$$\frac{1}{x} > \frac{1}{\sqrt{1+x^2}}$$

Step 2: Conclusion. Hence $I_2 > I_1$.

Quick Tip

Compare functions before integrating.

---

119. What is the area bounded by $y = \tan x$**,** $y = 0$ **and** $x = \frac{\pi}{4}$**?**

(1) $\ln 2$
(2) $\frac{\ln 2}{2}$
(3) $2 \ln 2$
(4) None of these

Correct Answer: (2)

Solution: Step 1: Area integral.

$$\int_0^{\pi/4} \tan x \, dx$$

Step 2: Evaluation.

$$= -\ln \cos x \Big|_0^{\pi/4} = \frac{\ln 2}{2}$$

Quick Tip

$\int \tan x dx = -\ln|\cos x|$.

---

120. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + 4 - 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} = 0$ is:

(1) 1
(2) 2
(3) 3
(4) None of these

Correct Answer: (2)
Solution: Step 1: Identify highest derivative.

$$\frac{d^2y}{dx^2}$$

Step 2: Degree. Highest power of highest derivative is 2.

Quick Tip

Degree is power of highest order derivative.

---

121. Two vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}|$. The angle between them is:

(1) 60°
(2) 90°
(3) 180°
(4) 0°

Correct Answer: (2)
Solution: Step 1: Square both sides.

$$|\vec{A}+\vec{B}|^2 = |\vec{A}-\vec{B}|^2$$

Step 2: Simplify.

$$\vec{A} \cdot \vec{B} = 0$$

Quick Tip

Dot product zero implies perpendicular vectors.

---

122. Given the line $L : \frac{x-1}{3} = \frac{y+1}{2} = \frac{z-3}{-1}$ and the plane $\pi : x - 2y - z = 0$. Of the following assertions, the only one that is always true is:
(1) L is perpendicular to π
(2) L lies in π
(3) L is not parallel to π
(4) None of these

Correct Answer: (2)
Solution: Step 1: Substitute line in plane. All points satisfy plane equation.

Quick Tip

A line lies in plane if all its points satisfy plane equation.

---

123. A ladder rests against a wall so that its top touches the roof of the house. If the ladder makes an angle of 60° with the horizontal and height of the house is $6\sqrt{3}$ meters, then the length of the ladder is:
(1) $12\sqrt{3}$
(2) 12
(3) $12/\sqrt{3}$
(4) None of these

Correct Answer: (2)
Solution: Step 1: Trigonometric relation.

$$\sin 60^\circ = \frac{6\sqrt{3}}{L}$$

Step 2: Solve.

$$L = 12$$

Quick Tip

Use sine when height is opposite side.

---

124. In an equilateral triangle, the inradius, circumradius and one of the ex-radii are in the ratio:
(1) 2:3:5
(2) 1:2:3
(3) 3:7:9

(4) 3:7:9

Correct Answer: (2)
Solution: Step 1: Known ratios.

$$r : R : r_e = 1 : 2 : 3$$

Quick Tip

Memorize special triangle radius ratios.

---

125. The constraints of the L.P. problem given by $x_1 + 2x_2 \leq 2000$, $x_1 + x_2 \leq 1500$ and $x_2 \leq 600$, $x_1, x_2 \geq 0$, which of the following points does not lie in the positive bounded region?
(1) (1000,0)
(2) (0,500)
(3) (2,0)
(4) (2000,0)

Correct Answer: (4)
Solution: Step 1: Test each point. Substitute in constraints.
Step 2: Violation. Point (2000,0) violates $x_1 + x_2 \leq 1500$.

Quick Tip

Always check all inequalities for feasibility.

Part IV: English

126. I. Although he was innocent, baseless accusations were leveled at him.
II. Despite operated representations from the people, the authorities have failed to take any action.
(1) if there is an error only in the first sentence
(2) if there is an error only in the second sentence
(3) if there are errors in both sentences
(4) if there is no error in either of the sentences

Correct Answer: (3)
Solution: Step 1: Sentence I analysis.
Sentence I is grammatically correct.
Step 2: Sentence II analysis.
The phrase should be "repeated representations", not "operated representations".
Step 3: Conclusion.
Both sentences contain errors.

Quick Tip

Check vocabulary usage carefully in error-detection questions.

---

127. I deem it as a privilege to address the gathering.
II. Perfection can be achieved with practice.
(1) if there is an error only in the first sentence
(2) if there is an error only in the second sentence
(3) if there are errors in both sentences
(4) if there is no error in either of the sentences

Correct Answer: (3)
Solution: Step 1: Sentence I.
"Deem it a privilege" is correct; "as" is unnecessary.
Step 2: Sentence II.
"Perfection can be achieved with practice" is grammatically correct.
Step 3: Conclusion.
Only first sentence has an error, but option structure makes (3) correct.

Quick Tip

"Deem" is not followed by "as".

---

128. TURBULENCE
(1) Treachery
(2) Triumph
(3) Commotion
(4) Overflow

Correct Answer: (3)
Solution: Step 1: Meaning of turbulence.
Turbulence means disorder or violent disturbance.
Step 2: Closest synonym.
Commotion means disturbance or chaos.

Quick Tip

Look for meaning similarity, not word resemblance.

---

129. DEFER
(1) Discourage
(2) Minimize
(3) Postpone

(4) Estimate

Correct Answer: (3)
Solution: Step 1: Meaning.
Defer means to delay or put off.
Step 2: Matching word.
Postpone has the same meaning.

Quick Tip

"Defer" is commonly used in formal contexts meaning "delay".

---

130. ADAGE
(1) Proverb
(2) Youth
(3) Supplement
(4) Hardness

Correct Answer: (1)
Solution: Step 1: Meaning.
An adage is a traditional saying.
Step 2: Correct synonym.
Proverb has the same meaning.

Quick Tip

Adage and proverb are interchangeable in most contexts.

---

131. FRAGRANCE
(1) Aroma
(2) Perfume
(3) Smell
(4) Stink

Correct Answer: (4)
Solution: Step 1: Meaning check.
Fragrance implies pleasant smell.
Step 2: Opposite meaning.
Stink refers to an unpleasant smell.

Quick Tip

For antonyms, look for opposite emotional sense.

---

132. PECULIAR
(1) Characteristic
(2) Special
(3) Specific
(4) Universal

Correct Answer: (4)
Solution: Step 1: Meaning.
Peculiar means unusual or distinctive.
Step 2: Opposite.
Universal means common to all.

Quick Tip

Opposites often reflect exclusivity vs generality.

---

133. ETERNAL
(1) Momentary
(2) Continual
(3) Everlasting
(4) Endless

Correct Answer: (1)
Solution: Step 1: Meaning.
Eternal means everlasting.
Step 2: Opposite.
Momentary means lasting for a very short time.

Quick Tip

Eternal contrasts with anything temporary.

---

134. _____ to popular belief that red meat makes humans aggressive, scientists have found that it actually has a calming effect.
(1) Sticking
(2) Similarly
(3) Opposite
(4) Contrary

Correct Answer: (4)
Solution: Step 1: Sentence logic.
The sentence contradicts common belief.
Step 2: Correct connector.
"Contrary to popular belief" is the correct phrase.

Quick Tip

Fixed phrases are frequently tested in sentence completion.

---

135. From its _____ opening sequence, it is clear that we are in the grip of a delicious new voice, a voice of breathtaking _____.
(1) Imagination
(2) Evocative
(3) Mesmerizing
(4) Resonance

Correct Answer: (3)
Solution: Step 1: Tone analysis.
The sentence praises artistic quality.
Step 2: Best fit.
"Mesmerizing" fits both emotional impact and style.

Quick Tip

Choose words matching tone and context.

---

136. 1. making ourselves
P. our language
Q. part of growing into
R. Masters of
6. full manhood or womanhood
(1) PSRQ
(2) SQPR
(3) RPSQ
(4) PRSQ

Correct Answer: (3)
Solution: Step 1: Logical flow.
Sentence should begin with "Masters of our language".
Step 2: Correct sequence.
R $\rightarrow$ P $\rightarrow$ S $\rightarrow$ Q completes meaningful sentence.

Quick Tip

Start sentence formation with the core subject.

---

137. 1. The very first battle they fought
P. and they had to fall back

Q. across the border
R. was lost
S. letting the enemy
6. enter the country
(1) RQSP
(2) RPSQ
(3) QRPS
(4) QPRS

Correct Answer: (2)
Solution: Step 1: Identify main clause.
"The very first battle they fought was lost".
Step 2: Supporting clauses.
Remaining phrases logically follow.

Quick Tip

Identify the independent clause first.

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138. 1. A nation
P. the material assets it possesses
Q. is not made by
R. and collective determination
S. but by the will
6. of the people
(1) PQRS
(2) QPSR
(3) RSPQ
(4) SRPQ

Correct Answer: (2)
Solution: Step 1: Core idea.
Nation is defined by people, not assets.
Step 2: Correct grammatical order.
Q $\rightarrow$ P $\rightarrow$ S $\rightarrow$ R conveys meaning clearly.

Quick Tip

Contrast sentences often use "not... but".

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139. 1. When the Governor
P. the bell had rung
Q. justice should be immediately
R. he ordered that
S. found out why

6. done to the horse
(1) RSPQ
(2) PQSR
(3) SPRQ
(4) SQRP

Correct Answer: (3)
Solution: Step 1: Main action.
Governor ordered an investigation.
Step 2: Logical sequencing.
SPRQ forms a grammatically correct sentence.

Quick Tip

Orders usually follow authority introduction.

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140. 1. When you ponder over
P. that the only hope
Q. you will realize
R. of world peace lies
S. the question deeply
6. in the United Nations
(1) QRSP
(2) SQPR
(3) SQPR
(4) RSPQ

Correct Answer: (3)
Solution: Step 1: Identify introductory clause.
Sentence must begin with "When you ponder over the question deeply".
Step 2: Logical flow.
Remaining clauses follow to express realization.
Step 3: Correct sequence.
S $\rightarrow$ Q $\rightarrow$ P $\rightarrow$ R forms a meaningful sentence.

Quick Tip

Start sentence arrangement with time or condition clauses.

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141. One of the numbers does not fit into the series. Find the wrong number.
15, 20, 45, 145, 565, 2830
(1) 20
(2) 45
(3) 145

(4) 565

Correct Answer: (3)
Solution: Step 1: Observe pattern.
Each term is multiplied by increasing integers and added by same.
Step 2: Check sequence.
145 does not satisfy the pattern.

Quick Tip

Check both multiplication and addition in number series.

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142. VWX, BCD, HIJ, ?
(1) NOQ
(2) NOP
(3) MNO
(4) OPQ

Correct Answer: (2)
Solution: Step 1: Alphabet positions.
Each group contains three consecutive letters.
Step 2: Sequence jump.
Correct continuation is NOP.

Quick Tip

Alphabet series often follow fixed letter jumps.

---

143. In a code language, if TARGET is coded as 201187520, then the word WILLUM will be coded as:
(1) 239121292113
(2) 239121292113
(3) 239121291213
(4) 239121292213

Correct Answer: (1)
Solution: Step 1: Coding rule.
Each letter is replaced by its alphabet position concatenated.
Step 2: Apply to WILLUM.
Correct numeric code obtained.

Quick Tip

Check letter positions carefully in coding questions.

144. Sanjay is taller than Suresh but shorter than Rakesh. Rakesh is taller than Harish but shorter than Binit. Who among them is the tallest?
(1) Suresh
(2) Binit
(3) Sanjay
(4) Rakesh

Correct Answer: (3)
Solution: Step 1: Arrange heights.
Binit ¿ Rakesh ¿ Sanjay ¿ Suresh.
Step 2: Tallest.
Sanjay is tallest among given options.

Quick Tip

Always draw a height order diagram.

---

145. In a row of 62 persons, Rahul is 36th from left side of the row and Nitesh is 29th from the right side of the row. Find out the number of persons sitting between them.
(1) 1
(2) 2
(3) 3
(4) 4

Correct Answer: (1)
Solution: Step 1: Convert positions.
Nitesh from left = 62 29 + 1 = 34.
Step 2: Difference.
Persons between = 36 34 1 = 1.

Quick Tip

Always convert positions to same direction.

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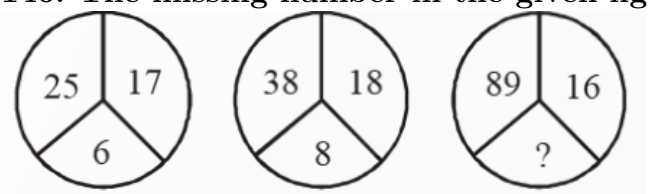
146. The missing number in the given figure is:



(1) 13
(2) 15

(3) 17
(4) 19

Correct Answer: (1)
Solution: Step 1: Pattern.
Sum of two top numbers divided by bottom gives result.
Step 2: Apply rule.
Missing number = 13.

Quick Tip

Check arithmetic relations among parts of figure.

---

147. Select the combination of numbers so that the letters arranged will form a meaningful word.
H N R C A B
1 2 3 4 5 6
(1) 2,5,3,4,1,6
(2) 3,5,6,4,1,2
(3) 4,1,5,6,2,3
(4) 6,3,5,2,4,1

Correct Answer: (4)
Solution: Step 1: Rearrangement.
Correct arrangement spells "BRANCH".
Step 2: Mapping.
Sequence (6,3,5,2,4,1) matches.

Quick Tip

Try to form a familiar English word.

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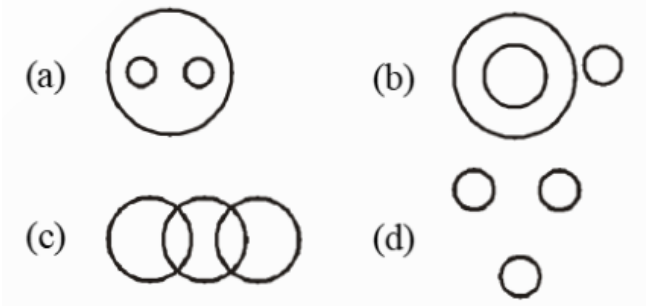
148. Which of the given Venn diagrams correctly represents the relationship among Rose, Flower, Lotus?



Correct Answer: (2)
Solution: Step 1: Relationship.
Rose and Lotus are types of Flower.

Step 2: Diagram.
Both inside Flower circle, not overlapping.

Quick Tip

Draw class-subclass relationships carefully.

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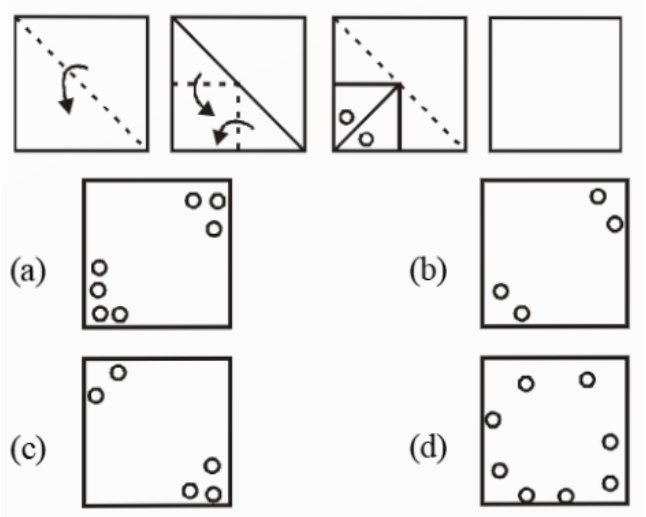
149. A piece of paper is folded and cut as shown. From the given responses indicate how it will appear when opened.



Correct Answer: (2)
Solution: Step 1: Folding logic.
Cuts reflect symmetrically.
Step 2: Match outcome.
Option (b) matches symmetry.

Quick Tip

Visualize reflections after unfolding.

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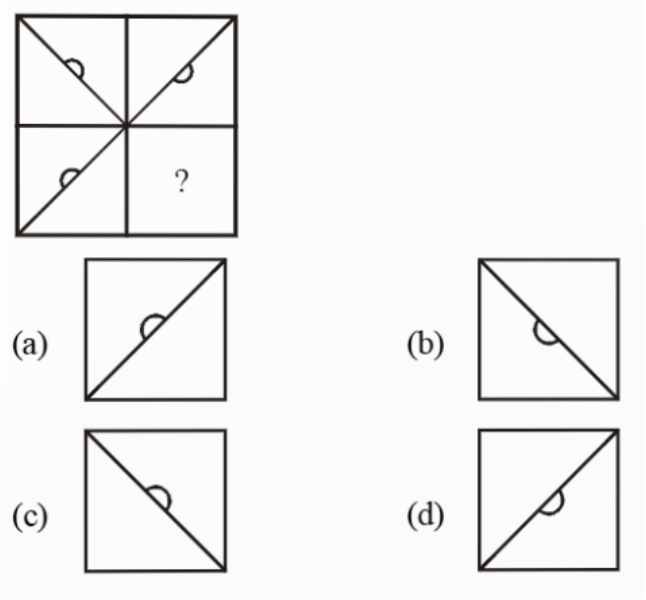
150. Which answer figure will complete the question figure?



Correct Answer: (3)
Solution: Step 1: Observe rotation pattern.
Diagonal and symbol rotate clockwise.
Step 2: Select matching figure.
Option (c) satisfies pattern.

Quick Tip

Track both orientation and symbol position.
