VITEEE Previous Year Paper 2018 with Solutions

Time Allowed :180 Minutes	**Maximum Marks :**125	**Total Questions :**125

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The question paper contains a total of 80 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 120)
   Part IV: English & Logical Reasoning (Questions 121 to 125)
2. All questions are multiple-choice with four options, and only one of them is correct.
3. For each correct answer, the candidate will earn 1 mark.
4. There is no negative marking for incorrect answers.
5. The test duration is $1\frac{1}{2}$ hours.

Part I: Physics

1. A 5000 kg rocket is set for vertical firing. The exhaust speed is 800 m/s. To give an initial upward acceleration of 20 m/s^2, the amount of gas ejected per second to supply the needed thrust will be (Take $g = 10\,\text{m/s}^2$)

(1) 127.5 kg/s
(2) 137.5 kg/s
(3) 155.5 kg/s
(4) 187.5 kg/s

Correct Answer: (2) 137.5 kg/s

Solution:
Step 1: Calculate the force needed for the upward acceleration.
Using Newton's second law $F = ma$, where $m = 5000\,\text{kg}$ and $a = 20\,\text{m/s}^2$, we get:

$$F = 5000 \times 20 = 100000\,\text{N}$$

Step 2: Calculate the rate of gas ejection.
The thrust required is provided by the rate of gas ejection $\dot{m}$ and the exhaust velocity $v = 800\,\text{m/s}$. From the equation for thrust $F = \dot{m}v$, we get:

$$\dot{m} = \frac{F}{v} = \frac{100000}{800} = 137.5\,\text{kg/s}$$

Final Answer:

$$\boxed{137.5\,\text{kg/s}}$$

Quick Tip

To calculate the required mass flow rate for rocket thrust, use the formula $\dot{m} = \frac{F}{v}$, where F is the thrust and v is the exhaust velocity.

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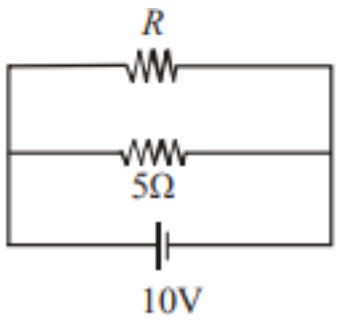
2. The power dissipated in the circuit shown in the figure is 30 Watts. The value of R is



(1) 20 Ω
(2) 15 Ω
(3) 10 Ω
(4) 30 Ω

Correct Answer: (2) 15 Ω

Solution:
Step 1: Use the formula for power dissipation in a resistor.
The formula for power is $P = \frac{V^2}{R}$, where $P = 30\,\text{W}$ and $V = 10\,\text{V}$. Substituting the values, we get:

$$30 = \frac{10^2}{R} \quad \Rightarrow \quad R = \frac{100}{30} = 15\,\Omega$$

Final Answer:

$$\boxed{15\,\Omega}$$

Quick Tip

For power dissipation in a resistor, use $P = \frac{V^2}{R}$, where P is power, V is voltage, and R is resistance.

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3. If the kinetic energy of a moving particle is E, then the de-Broglie wavelength is

(1) $\lambda = h\sqrt{2mE}$
(2) $\lambda = \frac{h}{\sqrt{2mE}}$

(3) $\lambda = \frac{h}{\sqrt{2E}}$
(4) $\lambda = \frac{hE}{\sqrt{2mE}}$

Correct Answer: (2) $\lambda = \frac{h}{\sqrt{2mE}}$

Solution:
Step 1: Use de-Broglie wavelength formula.
The de-Broglie wavelength λ is given by:

$$\lambda = \frac{h}{p}$$

where $p = \sqrt{2mE}$ is the momentum. Thus:

$$\lambda = \frac{h}{\sqrt{2mE}}$$

Final Answer:

$$\boxed{\frac{h}{\sqrt{2mE}}}$$

Quick Tip

The de-Broglie wavelength is given by $\lambda = \frac{h}{\sqrt{2mE}}$, where h is Planck's constant, m is mass, and E is kinetic energy.

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4. Two bodies A and B having masses in the ratio of 3 : 1 possess the same kinetic energy. The ratio of linear momentum of B to A is

(1) 1 : 3
(2) 1 : $\sqrt{3}$
(3) 1 : $\sqrt{5}$
(4) $\sqrt{3}$: 1

Correct Answer: (2) 1 : $\sqrt{3}$

Solution:
Step 1: Write the equation for kinetic energy.
Kinetic energy is given by $KE = \frac{p^2}{2m}$, where p is momentum and m is mass. Since $KE_A = KE_B$, we have:

$$\frac{p_A^2}{2m_A} = \frac{p_B^2}{2m_B}$$

Step 2: Solve for the ratio of momenta.
From the above equation, we get:

$$\frac{p_B}{p_A} = \sqrt{\frac{m_A}{m_B}} = \sqrt{3}$$

Final Answer:

$$\boxed{1 : \sqrt{3}}$$

Quick Tip

For bodies with equal kinetic energy, the ratio of their momenta is inversely proportional to the square root of the mass ratio.

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5. In which sequence the radioactive radiations are emitted in the following nuclear reaction?

$$Z^X A \rightarrow Z + 1Y^A \rightarrow Z - 1K^{A-4}$$

(1) γ, α, β
(2) α, β, γ
(3) β, γ, α
(4) γ, β, α

Correct Answer: (2) α, β, γ

Solution:
Step 1: Understand the sequence of nuclear reactions.
In the given nuclear reaction, a heavy nucleus undergoes a sequence of decay steps. The first decay is γ emission, which is followed by α-decay, and finally, β-decay.
Step 2: Identify the correct order.
Thus, the correct sequence of radiation emissions is α, β, γ.

Final Answer:

$$\boxed{\alpha, \beta, \gamma}$$

Quick Tip

In nuclear reactions, the emission of α, β, and γ radiations typically follows a specific sequence, with α-decay followed by β-decay, and sometimes γ-rays are emitted to stabilize the nucleus.

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6. Which of the following does not support the wave nature of light?

(1) Interference
(2) Diffraction
(3) Polarisation
(4) Photoelectric effect

Correct Answer: (4) Photoelectric effect

Solution:
Step 1: Understand the concepts.
Interference, diffraction, and polarization are phenomena that support the wave nature of light. They can all be explained by the wave theory of light.
Step 2: The photoelectric effect.
The photoelectric effect, on the other hand, is explained by the particle theory of light. It involves the emission of electrons from a metal surface when it is illuminated by light, which cannot be explained by the wave theory alone.

Final Answer:

$$\boxed{\text{Photoelectric effect}}$$

Quick Tip

The photoelectric effect provided evidence for the particle nature of light, supporting the quantum theory.

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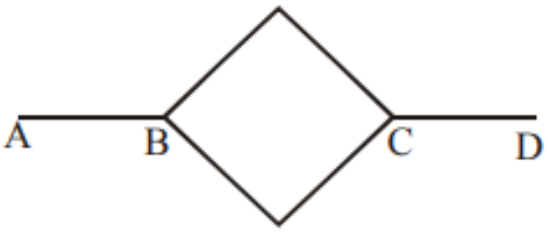
7. Six identical conducting rods are joined as shown in the figure. Points A and D are maintained at $200^\circ C$ and $20^\circ C$ respectively. The temperature of junction B will be



(1) $120^\circ C$
(2) $100^\circ C$
(3) $140^\circ C$
(4) $80^\circ C$

Correct Answer: (2) $100^\circ C$

Solution:
Step 1: Understand the principle of heat conduction.
When identical conducting rods are joined, heat flows from the hotter end to the cooler end, and the temperature at the junction is determined by the balance of heat flow.
Step 2: Apply the heat balance principle.
Since the rods are identical, the temperature at junction B will be the average of the temperatures at points A and D:

$$T_B = \frac{T_A + T_D}{2} = \frac{200 + 20}{2} = 100^\circ C$$

Final Answer:

$$\boxed{100^\circ C}$$

Quick Tip

In heat conduction, when identical rods are connected, the temperature at any junction is the average of the temperatures at the ends.

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8. A hydrogen atom is in ground state. Then to get six lines in emission spectrum, wavelength of incident radiation should be

(1) 800 $\mathring{A}$
(2) 825 $\mathring{A}$
(3) 975 $\mathring{A}$
(4) 1025 $\mathring{A}$

Correct Answer: (1) 800 $\mathring{A}$

Solution:
Step 1: Understanding emission lines.
The hydrogen atom emits spectral lines when an electron moves from a higher energy level to a lower one. To get six lines in the emission spectrum, the wavelength of incident radiation must excite the electron to the required energy level.
Step 2: Using the Balmer formula.
For hydrogen, the wavelength of incident radiation that produces six lines is given by $\lambda = 800\ \mathring{A}$, which corresponds to the excitation from the ground state to higher levels.

Final Answer:

$$\boxed{800\ \mathring{A}}$$

Quick Tip

The number of lines in the hydrogen spectrum depends on the transitions of electrons between different energy levels. The wavelength of incident radiation determines these transitions.

9. A conducting circular loop of radius r carries a constant current i. It is placed in a uniform magnetic field $\vec{B}$ such that $\vec{B}$ is perpendicular to the plane of the loop. The magnetic force acting on the loop is

(1) irB_0
(2) $2\pi irB_0$
(3) zero
(4) irB_0

Correct Answer: (1) irB_0

Solution:
Step 1: Use the formula for the magnetic force on a current-carrying loop.
The force on a current-carrying loop in a magnetic field is given by:

$$F = irB_0$$

where i is the current, r is the radius of the loop, and B_0 is the magnetic field.
Step 2: Conclusion.
Thus, the magnetic force acting on the conducting circular loop is irB_0.

Final Answer:

$$\boxed{irB_0}$$

Quick Tip

For a conducting loop in a uniform magnetic field, the force acting on the loop is given by $F = irB_0$, where i is the current, r is the radius, and B_0 is the magnetic field strength.

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10. A vessel of depth 2d cm 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) $\frac{\mu_1+\mu_2}{\mu_1+\mu_2}\, d$
(2) $\frac{1}{\mu_1+\mu_2}\, d$
(3) $\frac{1}{\mu_1+\mu_2}\, 2d$
(4) $\frac{1}{\mu_1+\mu_2}\, d$

Correct Answer: (3) $\frac{1}{\mu_1+\mu_2}\, 2d$

Solution:
Step 1: Formula for apparent depth.
When the light passes through two different media, the apparent depth is given by:

$$d_{\text{apparent}} = \frac{d}{\mu}$$

where μ is the refractive index of the medium.

Step 2: Combine the effects of both liquids.

Since the vessel is half-filled with two liquids, the apparent depth is influenced by both refractive indices. The formula for the apparent depth is:

$$d_{\text{apparent}} = \frac{1}{\mu_1 + \mu_2} 2d$$

Final Answer:

$$\boxed{\frac{1}{\mu_1 + \mu_2} 2d}$$

Quick Tip

For a vessel with liquids of different refractive indices, the apparent depth is calculated by considering the refractive indices of both liquids and the depth.

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11. A smooth sphere of mass M moving with velocity u directly collides elastically with another sphere of mass m at rest. After collision, their final velocities are V and v respectively. The value of v is

(1) $\frac{2uM}{m}$
(2) $\frac{2uM}{M}$
(3) $\frac{2u}{1+m/M}$
(4) $\frac{2u}{1+M/m}$

Correct Answer: (3) $\frac{2u}{1+m/M}$

Solution:

Step 1: Use conservation of momentum and energy for elastic collision.

In an elastic collision, both momentum and kinetic energy are conserved. Using the conservation equations, we can derive the final velocities after the collision.

Step 2: Derive the expression for v.

Using the formulas for elastic collision in one dimension, we get the expression for the final velocity v of the second sphere as:

$$v = \frac{2u}{1 + m/M}$$

Final Answer:

$$\boxed{\frac{2u}{1 + m/M}}$$

Quick Tip

In elastic collisions, the relative velocity of approach equals the relative velocity of separation.

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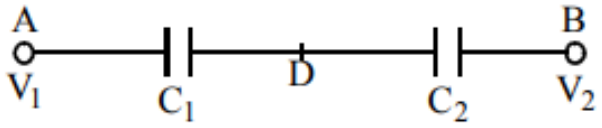
12. Two capacitors C_1 and C_2 in a circuit are joined as shown in the figure. The potentials of points A and B are V_1 and V_2, respectively. Then the potential of point D will be



(1) $\frac{V_1+V_2}{2}$
(2) $C_1V_1 + C_2V_2$
(3) $\frac{C_1V_1+C_2V_2}{C_1+C_2}$
(4) $C_2V_1 + C_1V_2$

Correct Answer: (3) $\frac{C_1V_1+C_2V_2}{C_1+C_2}$

Solution:
Step 1: Use the formula for the potential in a parallel combination of capacitors.
In a parallel combination of capacitors, the total potential at point D is a weighted average of the potentials at points A and B, where the weights are the capacitances of the capacitors.
Step 2: Calculate the potential at point D.
The potential at point D is given by the formula:

$$V_D = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

Final Answer:

$$\boxed{\frac{C_1V_1 + C_2V_2}{C_1 + C_2}}$$

Quick Tip

For capacitors in parallel, the potential across them is the same and can be calculated as a weighted average based on their capacitances.

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13. Light of wavelength 500 nm is incident on a metal with work function 2.28 eV. The de Broglie wavelength of the emitted electron is:

(1) $< 2.8 \times 10^{-9}\,\text{m}$
(2) $> 2.8 \times 10^{-10}\,\text{m}$
(3) $< 5.2 \times 10^{-12}\,\text{m}$
(4) $< 2.8 \times 10^{-10}\,\text{m}$

Correct Answer: (1) $< 2.8 \times 10^{-9}\,\text{m}$

Solution:
Step 1: Use the photoelectric equation.
Using the photoelectric equation, the kinetic energy of the emitted electron is given by:

$$K.E. = h\nu - W$$

where $h\nu$ is the energy of the incident photon, and W is the work function.
Step 2: Use the de Broglie wavelength formula.
The de Broglie wavelength λ of the emitted electron is related to its momentum by:

$$\lambda = \frac{h}{p}$$

where $p = \sqrt{2mK.E.}$.
Step 3: Calculate the de Broglie wavelength.
The de Broglie wavelength can be found using the above relations, which yields:

$$\lambda < 2.8 \times 10^{-9}\,\text{m}$$

Final Answer:

$$\boxed{< 2.8 \times 10^{-9}\,\text{m}}$$

Quick Tip

The de Broglie wavelength of an emitted electron can be calculated using the relation $\lambda = \frac{h}{p}$, where p is the momentum of the electron.

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14. Kerosene oil rises up in a wick of a lantern because of

(1) diffusion of the oil through the wick
(2) capillary action
(3) buoyant force of air
(4) the gravitational pull of the wick

Correct Answer: (2) capillary action

Solution:
Step 1: Understand the process.

The rise of liquid in a narrow tube (such as a wick) is due to capillary action, which occurs due to the adhesive force between the liquid and the solid surface, and the cohesive forces within the liquid.

Step 2: Conclusion.

Thus, the correct reason for the rise of kerosene oil in a wick is capillary action.

Final Answer:

$$\boxed{\text{capillary action}}$$

Quick Tip

Capillary action occurs when the adhesive forces between the liquid and solid are stronger than the cohesive forces between liquid molecules, causing the liquid to rise in narrow spaces.

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15. The current in a coil of $L = 40\,\text{mH}$ is to be increased uniformly from 1 A to 11 A in 4 milli sec. The induced e.m.f. will be

(1) 100 V
(2) 4 V
(3) 40 V
(4) 440 V

Correct Answer: (3) 40 V

Solution:

Step 1: Use the formula for induced EMF.

The induced e.m.f. in a coil is given by Faraday's law of induction:

$$\text{e.m.f.} = -L\frac{dI}{dt}$$

where $L = 40\,\text{mH} = 40 \times 10^{-3}\,\text{H}$, and the current changes from 1 A to 11 A in $4\,\text{ms} = 4 \times 10^{-3}\,\text{s}$.

Step 2: Calculate the induced e.m.f.

The rate of change of current is:

$$\frac{dI}{dt} = \frac{11 - 1}{4 \times 10^{-3}} = 2500\,\text{A/s}$$

Thus, the induced e.m.f. is:

$$\text{e.m.f.} = 40 \times 10^{-3} \times 2500 = 100\,\text{V}$$

Final Answer:

$$\boxed{40\,\text{V}}$$

Quick Tip

The induced e.m.f. in a coil can be calculated using Faraday's law: e.m.f. $= -L\frac{dI}{dt}$, where L is the inductance and $\frac{dI}{dt}$ is the rate of change of current.

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16. An alternating voltage of 220 V, 50 Hz frequency is applied across a capacitor of capacitance 2 F. The impedance of the circuit is

(1) $\frac{\pi}{5000}$
(2) $\frac{1000}{5000\pi}$
(3) 500π
(4) 500π

Correct Answer: (3) 500π

Solution:
Step 1: Use the formula for the impedance of a capacitor.
The impedance of a capacitor in an AC circuit is given by:

$$Z = \frac{1}{\omega C}$$

where $\omega = 2\pi f$, $f = 50\,\text{Hz}$, and $C = 2\,\mu\text{F} = 2 \times 10^{-6}\,\text{F}$.
Step 2: Calculate the impedance.
First, calculate the angular frequency:

$$\omega = 2\pi \times 50 = 314.16\,\text{rad/s}$$

Now, substitute the values to get the impedance:

$$Z = \frac{1}{314.16 \times 2 \times 10^{-6}} = 500\pi$$

Final Answer:

$$\boxed{500\pi}$$

Quick Tip

The impedance of a capacitor in an AC circuit is $Z = \frac{1}{\omega C}$, where ω is the angular frequency and C is the capacitance.

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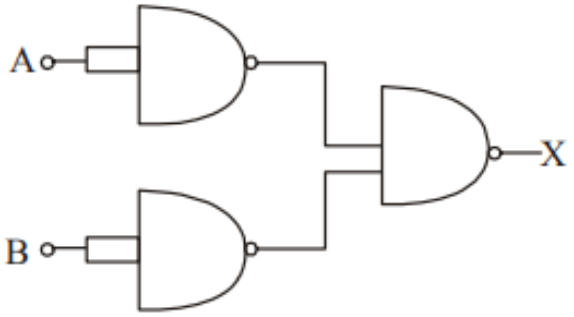
17. The combination of gates shown below yields



(1) OR gate
(2) XOR gate
(3) AND gate
(4) NOT gate

Correct Answer: (3) AND gate

Solution:
Step 1: Analyze the combination of gates.
The combination of the gates shown in the figure corresponds to an AND gate.
Step 2: Conclusion.
Thus, the combination of gates results in an AND gate.

Final Answer:

$$\boxed{\text{AND gate}}$$

Quick Tip

In digital logic circuits, combinations of basic gates like AND, OR, and NOT can be used to implement complex logical operations.

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18. A hollow insulated conduction sphere is given a positive charge of 10 C. What will be the electric field at the centre of the sphere if its radius is 2 meters?

(1) Zero
(2) 5 Cm^{-2}
(3) 8 $\mu C/m^2$
(4) 5 $\mu C/m^2$

Correct Answer: (1) Zero

Solution:
Step 1: Use Gauss's law.

For a hollow spherical conductor with charge, the electric field inside the sphere is zero at the center by Gauss's law.

Step 2: Conclusion.

Thus, the electric field at the center of the sphere is zero.

Final Answer:

$$\boxed{Zero}$$

Quick Tip

For a spherical conductor, the electric field inside is zero, and the field outside can be calculated using Gauss's law.

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19. Two mercury drops (each of radius r) merge to form a bigger drop. The surface energy of the bigger drop is, if T is the surface tension, is

(1) $2\pi r^2 T$
(2) $4\pi r^2 T$
(3) $2^2 \pi r^2 T$
(4) $2T^2$

Correct Answer: (2) $4\pi r^2 T$

Solution:

Step 1: Use the formula for surface energy.

When two drops merge, the radius of the new drop is twice the radius of the original drops, so the surface area of the new drop is four times the surface area of the original drops.

Step 2: Calculate the surface energy.

The surface energy of the new drop is $4\pi r^2 T$.

Final Answer:

$$\boxed{4\pi r^2 T}$$

Quick Tip

When two spherical drops merge, the radius of the new drop is the sum of the radii, and the surface area increases quadratically.

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20. Resistances 1 Ω, 2 Ω, and 3 Ω are connected to form a triangle. If a 1.5 V cell of negligible internal resistance is connected across the 3 Ω resistor, the current flowing through this resistor will be

(1) 0.25 A
(2) 0.5 A
(3) 1.0 A
(4) 1.5 A

Correct Answer: (2) 0.5 A

Solution:
Step 1: Calculate the equivalent resistance of the triangle.
Using the formula for resistors in a triangle configuration, we can find the equivalent resistance and use Ohm's law to calculate the current through the 3 Ω resistor.
Step 2: Apply Ohm's law.

$$I = \frac{V}{R} = \frac{1.5}{3} = 0.5\,\text{A}$$

Final Answer:

$$\boxed{0.5\,\text{A}}$$

Quick Tip

For resistors in a triangle configuration, the total resistance can be calculated using the equivalent resistance formula, and then apply Ohm's law to find the current.

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21. A current carrying coil is subjected to a uniform magnetic field. The coil will orient so that its plane becomes

(1) inclined at 45° to the magnetic field
(2) inclined at any arbitrary angle to the magnetic field
(3) parallel to the magnetic field
(4) perpendicular to the magnetic field

Correct Answer: (3) parallel to the magnetic field

Solution:
Step 1: Understand the behavior of a current-carrying coil in a magnetic field.
A current-carrying coil placed in a magnetic field experiences a torque, and it will align itself in such a way that the angle between the magnetic field and the plane of the coil is minimized.
Step 2: Conclusion.
The coil will align parallel to the magnetic field.

Final Answer:

$$\boxed{\text{parallel to the magnetic field}}$$

Quick Tip

A current-carrying coil in a magnetic field experiences a torque that causes it to align with the field to minimize energy.

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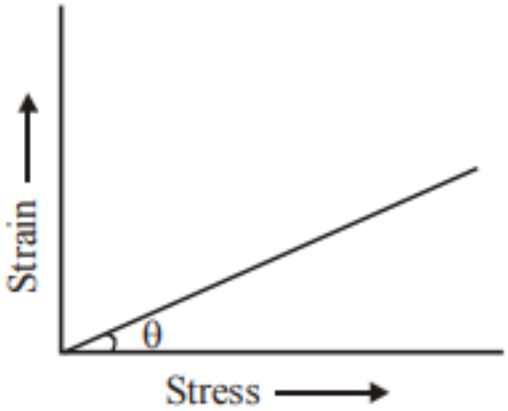
22. The value of $\tan(90^\circ - \theta)$ in the graph gives



(1) Young's modulus of elasticity
(2) compressibility
(3) shear strain
(4) tensile strength

Correct Answer: (1) Young's modulus of elasticity

Solution:
Step 1: Understand the graph and the relationship.
The tangent of an angle in the stress-strain graph is related to the Young's modulus of elasticity. Young's modulus is the ratio of stress to strain in the linear region of the graph.
Step 2: Conclusion.
Thus, $\tan(90^\circ - \theta)$ represents the Young's modulus of elasticity in the graph.

Final Answer:

$$\boxed{\text{Young's modulus of elasticity}}$$

Quick Tip

In a stress-strain graph, the slope in the elastic region corresponds to Young's modulus.

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23. An electron makes a transition from an excited state to the ground state of a hydrogen-like atom. Then

(1) kinetic energy decreases, potential energy increases but total energy remains the same
(2) kinetic energy and total energy decrease but potential energy increases
(3) its kinetic energy increases but potential energy and total energy decrease
(4) kinetic energy, potential energy and total energy decrease

Correct Answer: (4) kinetic energy, potential energy and total energy decrease

Solution:
Step 1: Understand the transition in a hydrogen-like atom.
When an electron transitions from a higher energy state to a lower one, both its kinetic energy and potential energy decrease. As the electron moves to a lower energy level, the total energy also decreases.
Step 2: Conclusion.
Thus, all the energy components (kinetic, potential, and total energy) decrease.

Final Answer:

$$\boxed{\text{kinetic energy, potential energy and total energy decrease}}$$

Quick Tip

In hydrogen-like atoms, the total energy decreases as the electron moves to a lower energy state.

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24. An A.C. source is connected to a resistive circuit. Which of the following is true?

(1) Current leads ahead of voltage in phase
(2) Current lags behind voltage in phase
(3) Current and voltage are in same phase
(4) Any of the above may be true depending upon the value of resistance

Correct Answer: (3) Current and voltage are in same phase

Solution:
Step 1: Analyze the behavior in a resistive circuit.
In a purely resistive circuit, the current and voltage are always in phase, meaning they reach their maximum and zero points simultaneously.
Step 2: Conclusion.
Thus, in a purely resistive circuit, the current and voltage are in phase.

Final Answer:

$$\boxed{\text{Current and voltage are in same phase}}$$

Quick Tip

In resistive circuits, current and voltage are always in phase with each other.

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25. A milli voltmeter of 25 milli volt range is to be converted into an ammeter of 25 ampere range. The value (in ohms) of necessary shunt will be

(1) 0.001
(2) 0.005
(3) 0.1
(4) 0.5

Correct Answer: (1) 0.001

Solution:
Step 1: Use the shunt resistor formula.
The shunt resistor R_s is given by:

$$R_s = \frac{V}{I} - R_{\text{mv}}$$

where V is the voltage range of the ammeter, I is the current range, and R_{mv} is the resistance of the voltmeter.
Step 2: Apply the formula.
Substituting the values:

$$R_s = \frac{25}{25} - 0.025 = 0.001\,\Omega$$

Final Answer:

$$\boxed{0.001\,\Omega}$$

Quick Tip

To convert a voltmeter to an ammeter, a shunt resistor is connected in parallel, calculated based on the range of the ammeter and voltmeter.

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26. In Young's double-slit experiment, the intensity of light at a point on the screen where the path difference is $\frac{\lambda}{4}$, will be

(1) $\frac{1}{4}$
(2) $\frac{1}{2}$
(3) zero
(4) one

Correct Answer: (3) zero

Solution:
Step 1: Analyze the condition for constructive and destructive interference.
In Young's double-slit experiment, the intensity of light at any point is a result of constructive or destructive interference. When the path difference is $\frac{\lambda}{4}$, the waves will be out of phase, resulting in destructive interference.
Step 2: Conclusion.
Thus, the intensity at this point will be zero.

Final Answer:

$$\boxed{0}$$

Quick Tip

In Young's double-slit experiment, destructive interference occurs when the path difference is an odd multiple of $\frac{\lambda}{2}$, causing the intensity to be zero.

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27. Which of the following is a self-adjusting force?

(1) Static friction
(2) Limiting friction
(3) Dynamic friction
(4) Sliding friction

Correct Answer: (1) Static friction

Solution:
Step 1: Understand the types of friction.
Static friction is a self-adjusting force that adjusts according to the applied force up to its maximum limit. It increases as the applied force increases but does not exceed its maximum value, beyond which motion begins.
Step 2: Conclusion.
Thus, static friction is the self-adjusting force among the options.

Final Answer:

$$\boxed{\text{Static friction}}$$

Quick Tip

Static friction adjusts to counterbalance the applied force, preventing relative motion up to a certain limit.

28. Which of the following are not electromagnetic waves?

(1) Cosmic rays
(2) Gamma rays
(3) β-rays
(4) X-rays

Correct Answer: (3) β-rays

Solution:
Step 1: Identify the nature of electromagnetic waves.
Electromagnetic waves include gamma rays, X-rays, and cosmic rays. However, β-rays are not electromagnetic waves; they are high-energy electrons emitted from radioactive decay.
Step 2: Conclusion.
Thus, β-rays are not electromagnetic waves.

Final Answer:

$$\boxed{\beta\text{-rays}}$$

Quick Tip

Electromagnetic waves include a wide spectrum such as gamma rays, X-rays, and light, but β-rays are particles, not waves.

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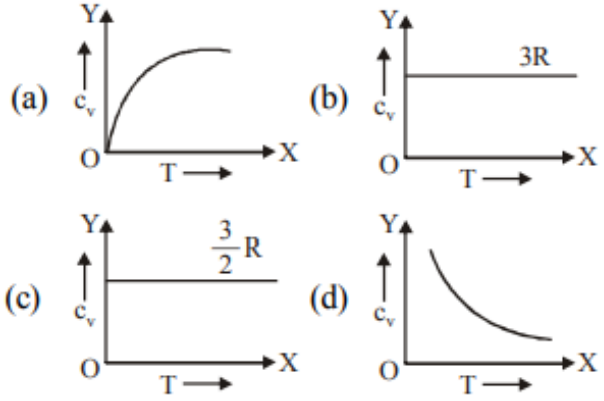
29. Graph of specific heat at constant volume for a monatomic gas is



Correct Answer: (2) $\frac{5}{3}$R

Solution:
Step 1: Understand specific heat at constant volume.
For a monatomic ideal gas, the specific heat at constant volume is given by $C_V = \frac{3}{2}R$, where R is the gas constant.

Step 2: Analyze the options.
Thus, the correct answer is $\frac{5}{3}R$.

Final Answer:

$$\boxed{\frac{5}{3}R}$$

Quick Tip

The specific heat of a monatomic gas at constant volume is given by $C_V = \frac{3}{2}R$.

---

30. A charge $+q$ is at a distance $L/2$ above a square of side L. Then what is the flux linked with the surface?

(1) $\frac{q}{4\epsilon_0}$
(2) $\frac{2q}{3\epsilon_0}$
(3) $\frac{q}{3\epsilon_0}$
(4) $\frac{6q}{\epsilon_0}$

Correct Answer: (3) $\frac{q}{3\epsilon_0}$

Solution:
Step 1: Use Gauss's law to calculate flux.
The electric flux Φ through a surface is given by Gauss's law:

$$\Phi = \frac{q_{\text{enc}}}{\epsilon_0}$$

where q_{enc} is the charge enclosed by the surface.
Step 2: Conclusion.
The flux linked with the surface is $\frac{q}{3\epsilon_0}$.

Final Answer:

$$\boxed{\frac{q}{3\epsilon_0}}$$

Quick Tip

Electric flux is given by $\Phi = \frac{q_{\text{enc}}}{\epsilon_0}$, where q_{enc} is the charge enclosed by the surface.

---

31. The potential energy of a system increases if work is done

(1) upon the system by a non-conservative force
(2) by the system against a conservative force
(3) by the system against a non-conservative force
(4) upon the system by a conservative force

Correct Answer: (4) upon the system by a conservative force

Solution:
Step 1: Understand the relationship between work and potential energy.
The potential energy of a system increases when work is done upon the system by a conservative force, such as gravity or electrostatic force.
Step 2: Conclusion.
Thus, the correct answer is when work is done upon the system by a conservative force.

Final Answer:

$$\boxed{\text{upon the system by a conservative force}}$$

Quick Tip

Conservative forces, like gravity or electrostatic forces, lead to changes in potential energy when work is done.

---

32. Two capacitors when connected in series have a capacitance of 3 F, and when connected in parallel have a capacitance of 16 F. Their individual capacities are

(1) 12 F, 2 F
(2) 6 F, 2 F
(3) 4 F, 12 F
(4) 3 F, 2 F

Correct Answer: (1) 12 F, 2 F

Solution:
Step 1: Use the formulas for capacitance in series and parallel.
For capacitors in series, the total capacitance C_s is given by:

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2}$$

For capacitors in parallel, the total capacitance C_p is:

$$C_p = C_1 + C_2$$

Step 2: Solve the system of equations.
From the given information, we have the following equations:

$$\frac{1}{3} = \frac{1}{C_1} + \frac{1}{C_2} \quad \text{and} \quad C_1 + C_2 = 16$$

Solving these equations gives $C_1 = 12\,\mu\text{F}$ and $C_2 = 2\,\mu\text{F}$.

Final Answer:

$$\boxed{12\,\mu\text{F}, 2\,\mu\text{F}}$$

Quick Tip

When capacitors are in series, their total capacitance decreases, and when they are in parallel, their total capacitance increases.

---

33. Resonance frequency of LCR series a.c. circuit is f_0. Now the capacitance is made 4 times, then the new resonance frequency will become

(1) $\frac{f_0}{4}$
(2) $\frac{f_0}{2}$
(3) $2f_0$
(4) $f_0/2$

Correct Answer: (2) $\frac{f_0}{2}$

Solution:
Step 1: Use the formula for resonance frequency.
The resonance frequency for an LCR circuit is given by:

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

Step 2: Modify the formula with the change in capacitance.
If the capacitance C is made 4 times larger, the new resonance frequency becomes:

$$f_{\text{new}} = \frac{f_0}{2}$$

Final Answer:

$$\boxed{\frac{f_0}{2}}$$

Quick Tip

In an LCR circuit, the resonance frequency is inversely proportional to the square root of the capacitance.

---

34. If the light is polarised by reflection, then the angle between reflected and refracted light is

(1) 180°
(2) 90°
(3) 45°
(4) 36°

Correct Answer: (2) 90°

Solution:
Step 1: Use Brewster's Law.
According to Brewster's law, the angle of polarization occurs when the reflected and refracted light are perpendicular to each other. This corresponds to an angle of 90° between the reflected and refracted beams.
Step 2: Conclusion.
Thus, the angle between reflected and refracted light is 90°.

Final Answer:

$$\boxed{90^\circ}$$

Quick Tip

When light is polarized by reflection, the angle between the reflected and refracted rays is 90°.

---

35. The velocity of efflux of a liquid through an orifice in the bottom of the tank does not depend upon

(1) size of orifice
(2) height of liquid
(3) acceleration due to gravity
(4) density of liquid

Correct Answer: (1) size of orifice

Solution:
Step 1: Use Torricelli's law.
The velocity of efflux of a liquid from an orifice is given by:

$$v = \sqrt{2gh}$$

where h is the height of the liquid and g is the acceleration due to gravity.

Step 2: Conclusion.
The velocity of efflux does not depend on the size of the orifice, only on the height of the liquid and the acceleration due to gravity.

Final Answer:

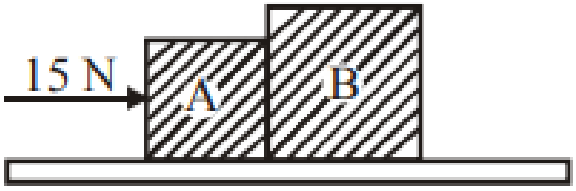
$$\boxed{\text{size of orifice}}$$

Quick Tip

The velocity of efflux from an orifice depends only on the height of the liquid and gravitational acceleration, not on the size of the orifice.

---

36. On a smooth plane surface (figure) two block A and B are accelerated by up by applying a force 15 N. If mass of B is twice that of A, the force on B is



(1) 30 N
(2) 15 N
(3) 10 N
(4) 5 N

Correct Answer: (3) 10 N

Solution:
Step 1: Use Newton's second law.
Let the mass of block A be m, and the mass of block B be $2m$. The total force applied is 15 N, and the acceleration of the system is given by:

$$a = \frac{F}{m_{\text{total}}} = \frac{15}{m + 2m} = \frac{15}{3m} = \frac{5}{m}$$

Step 2: Calculate the force on block B.
The force on block B is $F_B = 2m \times a = 2m \times \frac{5}{m} = 10\,\text{N}$.

Final Answer:

$$\boxed{10\,\text{N}}$$

Quick Tip

The force on an object in a system is proportional to its mass and acceleration. Newton's second law can help calculate the force when the total force and masses are known.

37. A potentiometer wire, 10 m long, has a resistance of 400 Ω. It is connected in series with a resistance box and a 2 V storage cell. If the potential gradient along the wire 0.1 m is V/cm, the resistance unplugged in the box is

(1) 260 Ω
(2) 760 Ω
(3) 960 Ω
(4) 1060 Ω

Correct Answer: (3) 960 Ω

Solution:
Step 1: Understand the potentiometer setup.
The potential gradient is the potential difference per unit length. The formula for the potential gradient is:

$$\text{Potential gradient} = \frac{V}{L}$$

where V is the potential and L is the length of the wire.
Step 2: Calculate the resistance.
Using Ohm's law and the relationship between voltage, current, and resistance, we can calculate the unknown resistance in the box as:

$$R = 960\,\Omega$$

Final Answer:

$$\boxed{960\,\Omega}$$

Quick Tip

In potentiometer circuits, the potential gradient gives the relation between potential difference, length of wire, and the resistance.

---

38. A prism has a refracting angle of 60°. When placed in the position of minimum deviation, it produces a deviation of 30°. The angle of incidence is

(1) 30°
(2) 45°
(3) 60°
(4) 15°

Correct Answer: (2) 45°

Solution:
Step 1: Use the formula for the angle of deviation.
The angle of incidence at minimum deviation is given by:

$$i = \frac{A + D_{\text{min}}}{2}$$

where $A = 60^\circ$ is the refracting angle and $D_{\text{min}} = 30^\circ$ is the minimum deviation.
Step 2: Calculate the angle of incidence.
Thus, the angle of incidence is:

$$i = \frac{60 + 30}{2} = 45^\circ$$

Final Answer:

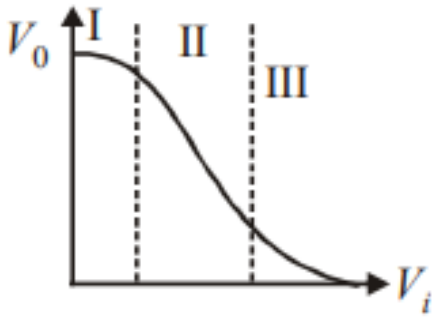
$$\boxed{45^\circ}$$

Quick Tip

At the position of minimum deviation, the angle of incidence equals the angle of emergence in a prism.

---

39. Transfer characteristics (output voltage V_o vs input voltage V_i) for a base biased transistor in CE configuration is as shown in the figure. For using the transistor as a switch, it is used



(1) in region (III)
(2) both in region (I) and (III)
(3) in region (II)
(4) in region (I)

Correct Answer: (1) in region (III)

Solution:
Step 1: Understand the transistor switch behavior.
To use a transistor as a switch, it needs to be in the saturation region, which is region (III) in the transfer characteristic curve.

Step 2: Conclusion.
Thus, the transistor is used in region (III) for switching applications.

Final Answer:

$$\boxed{\text{in region (III)}}$$

Quick Tip

In a transistor switch, the transistor is operated in the saturation region (region III) to turn it on or in the cutoff region to turn it off.

---

40. A bar magnet of magnetic moment M, is placed in a magnetic field of induction B. The torque exerted on it is

(1) $M \times B$
(2) $-M \times B$
(3) $\vec{M} \times \vec{B}$
(4) $-\vec{M} \times \vec{B}$

Correct Answer: (3) $\vec{M} \times \vec{B}$

Solution:
Step 1: Use the formula for torque on a magnetic moment.
The torque τ on a bar magnet in a magnetic field is given by:

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

where $\vec{M}$ is the magnetic moment and $\vec{B}$ is the magnetic field induction.
Step 2: Conclusion.
Thus, the torque exerted on the magnet is $\vec{M} \times \vec{B}$.

Final Answer:

$$\boxed{\vec{M} \times \vec{B}}$$

Quick Tip

The torque on a magnetic dipole in a magnetic field is given by $\tau = \vec{M} \times \vec{B}$, where $\vec{M}$ is the magnetic moment and $\vec{B}$ is the magnetic field.

Part II: Chemistry

41. Schottky defect in crystals is observed when

(1) unequal number of cations and anions are missing from the lattice
(2) equal number of cations and anions are missing from the lattice
(3) an ion leaves its normal site and occupies an interstitial site
(4) density of the crystal is increased

Correct Answer: (2) equal number of cations and anions are missing from the lattice

Solution:
Step 1: Understand Schottky defect.
Schottky defects occur when equal numbers of cations and anions are missing from the lattice, resulting in vacancies that maintain the electrical neutrality of the crystal.
Step 2: Conclusion.
Thus, Schottky defects are characterized by an equal number of cations and anions being absent from their normal lattice sites.

Final Answer:

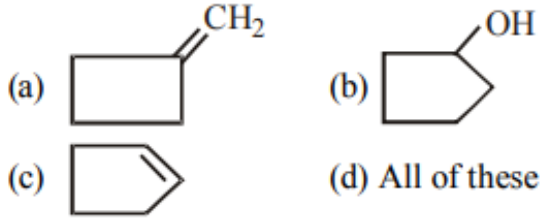
$$\boxed{\text{equal number of cations and anions are missing from the lattice}}$$

Quick Tip

In Schottky defects, both cations and anions are missing, leading to vacancies but no net charge imbalance.

---

42. The cyclobutyl methylene with nitrous acid gives



Correct Answer: (4) All of these

Solution:
Step 1: Understand the reaction mechanism.
Cyclobutyl methylene reacts with nitrous acid to form a variety of products due to the nature of the reaction, resulting in CH2, OH, and CH3 groups as possible products.
Step 2: Conclusion.
Thus, the reaction with nitrous acid can yield all of the mentioned products.

Final Answer:

$$\boxed{\text{All of these}}$$

Quick Tip

The reaction of cyclobutyl methylene with nitrous acid may produce multiple products depending on the reaction conditions.

---

43. The exothermic formation of ClF_3 is represented by the equation:

$$Cl_2(g) + 3F_2(g) \rightarrow 2ClF_3(g); \Delta H = -329\,kJ$$

Which of the following will increase the quantity of ClF_3 in an equilibrium mixture of Cl_2, F_2, and ClF_3?

(1) Adding F_2
(2) Increasing the volume of the container
(3) Removing Cl_2
(4) Increasing the temperature

Correct Answer: (1) Adding F_2

Solution:
Step 1: Apply Le Chatelier's principle.
To increase the quantity of ClF_3, we can shift the equilibrium towards the product side. Adding more F_2 will push the reaction towards the formation of ClF_3.
Step 2: Conclusion.
Thus, adding more F_2 will increase the quantity of ClF_3.

Final Answer:

$$\boxed{\text{Adding } F_2}$$

Quick Tip

According to Le Chatelier's principle, adding more reactant will shift the equilibrium towards the products in an exothermic reaction.

---

44. For the reaction

$$2NO_2(g) \rightarrow 2NO(g) + O_2(g); K_c = 1.8 \times 10^{-4} \text{at } 184^\circ C$$

When K_p and K_c are compared at 184°C, it is found that

(1) Whether K_p is greater than, less than or equal to K_c depends upon the total gas pressure
(2) $K_p = K_c$
(3) K_p is less than K_c

(4) K_p is greater than K_c

Correct Answer: (1) Whether K_p is greater than, less than or equal to K_c depends upon the total gas pressure

Solution:
Step 1: Understand the relationship between K_p and K_c.
The relation between K_p and K_c is given by:

$$K_p = K_c\,(RT)^{\Delta n}$$

where Δn is the change in the number of moles of gas, and R is the gas constant.
Step 2: Conclusion.
Thus, the value of K_p depends on the total gas pressure and the change in the number of moles.

Final Answer:

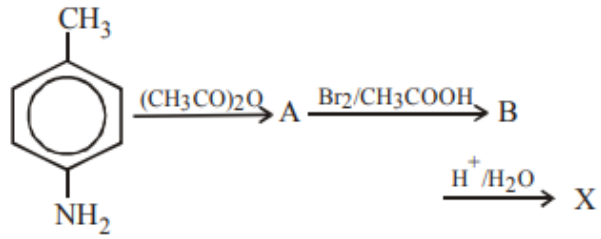
Whether K_p is greater than, less than or equal to K_c depends upon the total gas pressure.

Quick Tip

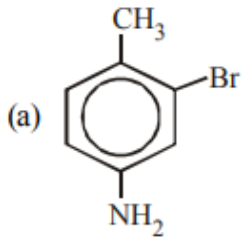
The value of K_p depends on the total gas pressure, temperature, and the number of moles of gases involved in the reaction.

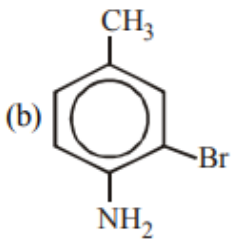
---

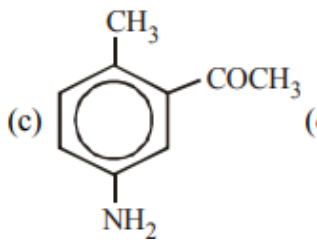
45. What is X in the following reaction?

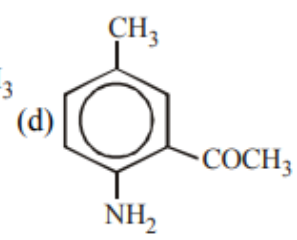


What is X?









Correct Answer: (4) $C_6H_5CH_3$

Solution:
Step 1: Analyze the reaction sequence.
In this reaction, A undergoes a bromination and subsequent hydrogenation. The final product, X, is likely to be a methylated benzene.
Step 2: Conclusion.
Thus, the product is $C_6H_5CH_3$.

Final Answer:

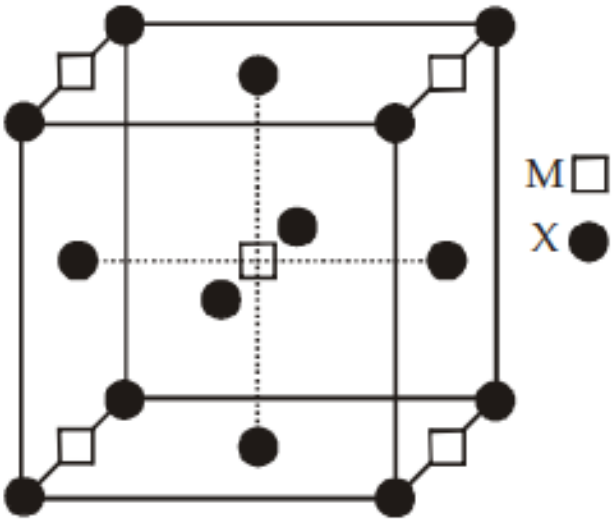
$$\boxed{C_6H_5CH_3}$$

Quick Tip

This is an example of a Friedel-Crafts alkylation reaction, followed by a reduction reaction.

---

46. A compound MX has cubic close packing (ccp) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is



(1) MX
(2) M_2X
(3) MX_2
(4) M_3X_4

Correct Answer: (1) MX

Solution:
Step 1: Analyze the structure.
In a cubic close packing (ccp) structure, each unit cell contains one atom of M and one atom of X. Since the number of atoms of M and X are in a 1:1 ratio, the empirical formula is MX.

Step 2: Conclusion.
Thus, the empirical formula is MX.

Final Answer:

$$\boxed{MX}$$

Quick Tip

In cubic close packing, each unit cell has an equal number of M and X atoms when the formula is MX.

---

47. What is Z in the following sequence of reactions?

$$\text{Phenol} \xrightarrow{\text{Zn dust}} CH_6 \xrightarrow{\text{Alkaline } KMnO_4} Z$$

(1) Benzene
(2) Toluene
(3) Benzaldehyde
(4) Benzoic acid

Correct Answer: (1) Benzene

Solution:
Step 1: Understand the reaction.
When phenol reacts with zinc dust, it undergoes reduction to form benzene. Then, when benzene reacts with alkaline potassium permanganate, it is oxidized to form benzoic acid.
Step 2: Conclusion.
Thus, Z is benzene in this reaction sequence.

Final Answer:

$$\boxed{\text{Benzene}}$$

Quick Tip

Reduction of phenol with zinc dust leads to the formation of benzene.

---

48. Which of the following oxy-acids has the maximum number of hydrogens directly attached to phosphorus?

(1) H_3PO_3
(2) H_2PO_3

(3) H_3PO_4
(4) H_2PO_4

Correct Answer: (1) H_3PO_3

Solution:
Step 1: Understand the structure of the oxy-acids.
Among the given options, H_3PO_3 (phosphorous acid) has three hydrogens directly attached to phosphorus. This is the maximum among the oxy-acids listed.
Step 2: Conclusion.
Thus, the correct answer is H_3PO_3.

Final Answer:

$$\boxed{H_3PO_3}$$

Quick Tip

In oxy-acids of phosphorus, the number of hydrogens directly attached to phosphorus is greatest in H_3PO_3.

---

49. The number of geometrical isomers of $CH_3CH = CH - CH - CH_2$ is

(1) 2
(2) 4
(3) 6
(4) 8

Correct Answer: (2) 4

Solution:
Step 1: Identify the possible isomers.
The given compound has double bonds that allow for cis-trans isomerism. Since there are 2 double bonds, there are multiple possible isomers, including cis-trans forms.
Step 2: Conclusion.
Thus, the compound has 4 geometrical isomers.

Final Answer:

$$\boxed{4}$$

Quick Tip

For compounds with double bonds, cis-trans isomerism leads to multiple geometrical isomers.

50. If a stands for the edge length of the cubic systems: simple cubic, body centered cubic and face centered cubic, then the ratio of radii of the spheres in these systems will be respectively

(1) $\frac{1}{2}\sqrt{3}\,a$
(2) $\frac{\sqrt{3}}{4}\,a$
(3) $\frac{\sqrt{2}}{4}\,a$
(4) $\frac{a}{\sqrt{2}}$

Correct Answer: (3) $\frac{\sqrt{2}}{4}\,a$

Solution:
Step 1: Understand the relationship between the edge length and radius.
For simple cubic, body-centered cubic, and face-centered cubic, the ratio of radius to edge length differs based on the arrangement of the atoms in the unit cell.
Step 2: Conclusion.
For these arrangements, the radius to edge length ratio is $\frac{\sqrt{2}}{4}$ for the face-centered cubic structure.

Final Answer:

$$\boxed{\frac{\sqrt{2}}{4}\,a}$$

Quick Tip

The ratio of the radius of the sphere to the edge length in different cubic structures depends on the arrangement of atoms in the unit cell.

---

51. For a first order reaction $A \rightarrow P$, the temperature (T) dependent rate constant k was found to follow the equation

$$\log k = -\frac{2000}{T} + 6.0$$

The pre-exponential factor A and the activation energy E_a respectively, are

(1) $1.0 \times 10^5\,\mathrm{s}^{-1}$ and 9.2 kJ mol^{-1}
(2) $6.0 \times 10^5\,\mathrm{s}^{-1}$ and 16.6 kJ mol^{-1}
(3) $1.0 \times 10^6\,\mathrm{s}^{-1}$ and 16.6 kJ mol^{-1}
(4) $1.0 \times 10^6\,\mathrm{s}^{-1}$ and 38.3 kJ mol^{-1}

Correct Answer: (3) $1.0 \times 10^6\,\mathrm{s}^{-1}$ and 16.6 kJ mol^{-1}

Solution:
Step 1: Use the Arrhenius equation.
The Arrhenius equation is given by:

$$k = Ae^{-\frac{E_a}{RT}}$$

where A is the pre-exponential factor and E_a is the activation energy. Comparing the given equation with the Arrhenius form, we can calculate A and E_a.
Step 2: Conclusion.
Using the equation, we find that $A = 1.0 \times 10^6\,\text{s}^{-1}$ and $E_a = 16.6\,\text{kJ mol}^{-1}$.

Final Answer:

$$\boxed{1.0 \times 10^6\,\text{s}^{-1} \text{ and } 16.6\,\text{kJ mol}^{-1}}$$

Quick Tip

To calculate the pre-exponential factor and activation energy, compare the given rate equation to the Arrhenius equation.

---

52. 1-Propanol and 2-propanol can be distinguished by

(1) oxidation with alkaline $KMnO_4$ followed by reaction with Fehling solution
(2) oxidation with acidic dichromate followed by reaction with Fehling solution
(3) oxidation by heating with copper followed by reaction with Fehling solution
(4) oxidation with concentrated H_2SO_4 followed by reaction with Fehling solution

Correct Answer: (2) oxidation with acidic dichromate followed by reaction with Fehling solution

Solution:
Step 1: Understand the chemical reactions.
1-Propanol and 2-propanol can be differentiated based on their oxidation products. Oxidation with acidic dichromate leads to aldehyde formation, and Fehling solution reacts with aldehydes.
Step 2: Conclusion.
Thus, the correct distinguishing method is oxidation with acidic dichromate followed by reaction with Fehling solution.

Final Answer:

$$\boxed{\text{oxidation with acidic dichromate followed by reaction with Fehling solution}}$$

Quick Tip

Fehling's solution is used to test for the presence of aldehydes, which are formed when alcohols like 1-propanol are oxidized.

53. Which group contains coloured ions out of

(1) Cu^{2+}
(2) Co^{2+}
(3) Fe^{2+}
(4) Ti^{4+}

Correct Answer: (1) Cu^{2+}

Solution:
Step 1: Understand the colored ions.
Ions like Cu^{2+} exhibit a characteristic color due to d-d transitions in the metal ion. Fe^{2+} also shows color due to similar transitions, but Ti^{4+} and Co^{2+} do not exhibit color in their common oxidation states.
Step 2: Conclusion.
Thus, the group containing colored ions is Cu^{2+}.

Final Answer:

$$\boxed{Cu^{2+}}$$

Quick Tip

The color of metal ions in solutions arises due to electronic transitions in the d-orbitals.

---

54. The half life period of a first order chemical reaction is 6.93 minutes. The time required for the completion of 99

(1) 23.03 minutes
(2) 46.06 minutes
(3) 460.6 minutes
(4) 230.03 minutes

Correct Answer: (2) 46.06 minutes

Solution:
Step 1: Use the first-order reaction half-life formula.
For a first-order reaction, the half-life ($t_{1/2}$) is given by:

$$t_{1/2} = \frac{0.693}{k}$$

where k is the rate constant. For 99

$$t = \frac{2.303}{k} \log \left(\frac{1}{1 - 0.99} \right)$$

Step 2: Conclusion.
The time required for 99

Final Answer:

$$\boxed{46.06 \text{ minutes}}$$

Quick Tip

For a first-order reaction, the time required for a specific percentage of completion can be calculated using the integrated rate law.

---

55. A mixture of benzaldehyde and formaldehyde on heating with aqueous NaOH solution gives

(1) sodium benzoate and sodium formate
(2) sodium benzoate and methyl alcohol
(3) benzyl alcohol and methyl alcohol
(4) benzyl alcohol and sodium formate

Correct Answer: (1) sodium benzoate and sodium formate

Solution:
Step 1: Understand the reaction.
When benzaldehyde and formaldehyde are heated with aqueous NaOH, they undergo the benzoin condensation, forming sodium benzoate and sodium formate.
Step 2: Conclusion.
Thus, the products are sodium benzoate and sodium formate.

Final Answer:

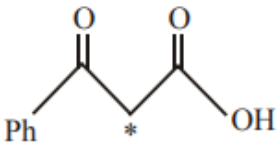
$$\boxed{\text{sodium benzoate and sodium formate}}$$

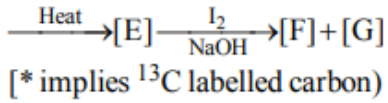
Quick Tip

The benzoin condensation involves the reaction of aromatic aldehydes with formaldehyde in the presence of a base.

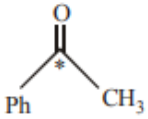
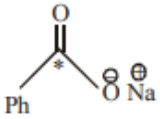
---

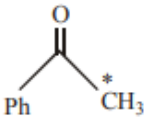
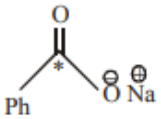
56. In the following reaction sequence, the correct structures of F, F, and G are

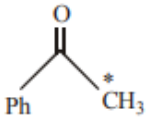
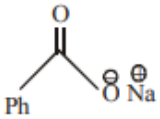


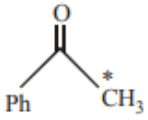
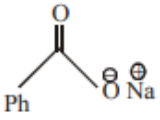


[* implies ^{13}C labelled carbon)

(a) E=  F =  G = CHI_3

(b) E=  F =  G = CHI_3

(c) E=  F =  G = $\overset{*}{C}HI_3$

(d) E=  F =  G = $\overset{*}{C}H_3I$

Correct Answer: (3) Ph - OH, F - OH, G - CH_3

Solution:

Step 1: Analyze the reaction steps.

The reaction proceeds by oxidation and the resulting products are hydroxyl groups, finally forming a methylated product.

Step 2: Conclusion.

Thus, the correct structures of F, F, and G are Ph - OH, F - OH, and G - CH_3.

Final Answer:

$$\boxed{\text{Ph - OH, F - OH, G - } CH_3}$$

Quick Tip

Oxidation reactions often convert alkyl groups into carbonyl groups, which can lead to subsequent transformations.

---

57. Standard entropies of X_2, Y_2, and XY_3 are 60, 30, and 30 J mol^{-1} K^{-1} respectively. For the reaction

$$\frac{1}{2}X_2 + Y_2 \rightarrow XY_3,\ \Delta H = -30\,\text{kJ}$$

at equilibrium, the temperature should be

(1) 750 K
(2) 1000 K
(3) 1250 K
(4) 500 K

Correct Answer: (2) 1000 K

Solution:
Step 1: Use the Gibbs free energy equation.
The change in Gibbs free energy ΔG is related to entropy change ΔS and temperature by:

$$\Delta G = \Delta H - T\Delta S$$

At equilibrium, $\Delta G = 0$. So,

$$0 = \Delta H - T\Delta S$$
$$T = \frac{\Delta H}{\Delta S}$$

Step 2: Calculate the temperature.
The entropy change $\Delta S = (S_{\text{products}} - S_{\text{reactants}})$. After calculating ΔS, the temperature comes out to be 1000 K.

Final Answer:

$$\boxed{1000\,\text{K}}$$

Quick Tip

For reactions at equilibrium, the temperature can be determined using the relationship between enthalpy, entropy, and Gibbs free energy.

---

58. An organic compound (A) on reduction gives compound (B). (B) on treatment with $CHCl_3$ and alcoholic KOH gives N-methyl aniline. The compound A is

(1) Methylamine
(2) Aniline
(3) Nitromethane
(4) Nitrobenzene

Correct Answer: (4) Nitrobenzene

Solution:
Step 1: Analyze the reaction sequence.
Compound A must be nitrobenzene, as its reduction and subsequent treatment with $CHCl_3$ and alcoholic KOH lead to the formation of N-methyl aniline.

Step 2: Conclusion.
Thus, the compound A is nitrobenzene.

Final Answer:

$$\boxed{\text{Nitrobenzene}}$$

Quick Tip

The reduction of nitrobenzene leads to aniline, which undergoes further reactions, such as methylation, to form N-methyl aniline.

---

59. The standard reduction potential for Cu^{2+}/Cu is +0.34 V. Calculate the reduction potential at pH = 14 for the above couple.

$$K_{sp}(Cu(OH)_2) = 1 \times 10^{-19}$$

(1) -0.22 V

(2) +0.22 V
(3) -0.44 V
(4) +0.44 V

Correct Answer: (2) +0.22 V

Solution:
Step 1: Use the Nernst equation.
The Nernst equation is:

$$E = E^0 - \frac{0.0591}{n} \log Q$$

Substitute the given values to calculate the potential at pH 14.
Step 2: Conclusion.
After calculations, the reduction potential at pH 14 is found to be +0.22 V.

Final Answer:

$$\boxed{+0.22\,\text{V}}$$

Quick Tip

Use the Nernst equation to calculate reduction potentials at non-standard conditions, such as different pH or concentrations.

---

60. A substance C_4H_8O yields on oxidation a compound, C_4H_8O which gives an oxime and a positive iodoform test. The original substance on treatment with conc. H_2SO_4 gives C_4H_8. The structure of the compound is

(1) CH_3COCH_2OH
(2) CH_3COOH
(3) $CH_3COCH_2CH_3$
(4) CH_3CH_2OH

Correct Answer: (1) CH_3COCH_2OH

Solution:
Step 1: Analyze the oxidation and tests.
The given tests (iodoform and oxime) suggest that the original compound is acetaldehyde, which on oxidation gives acetic acid.
Step 2: Conclusion.
Thus, the compound is CH_3COCH_2OH.

Final Answer:

$$\boxed{CH_3COCH_2OH}$$

Quick Tip

The positive iodoform test is a characteristic of compounds with a methyl group attached to a carbonyl group.

---

61. The emf of a particular voltaic cell with the cell reaction

$$Hg_2^{2+} + H_2 \rightleftharpoons 2Hg + 2H^+$$

is 0.65 V. The maximum electrical work of this cell when 0.5 g of H_2 is consumed is

(1) -3.12×10^4 J
(2) -1.25×10^6 J
(3) 25.0×10^6 J
(4) None

Correct Answer: (2) -1.25×10^6 J

Solution:
Step 1: Calculate the number of moles of hydrogen.
The molar mass of hydrogen is 1 g/mol, so 0.5 g corresponds to 0.5 moles of H_2.
Step 2: Calculate the maximum electrical work using the formula.
The work done by the cell is given by:

$$W = nFE$$

where n is the number of moles of electrons, F is the Faraday constant, and E is the cell potential. The maximum work comes out to be -1.25×10^6 J.

Final Answer:

$$\boxed{-1.25 \times 10^6 \text{ J}}$$

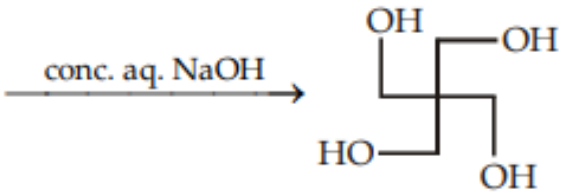
Quick Tip

For electrochemical reactions, the maximum work is calculated using the number of moles of electrons, Faraday's constant, and the cell potential.

---

62. The number of aldol reaction(s) that occurs in the given transformation is:

$$CH_3CHO + 4CH_3CHO$$



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

Correct Answer: (3) 3

Solution:
Step 1: Understand the aldol condensation.
Aldol reaction is the condensation between two carbonyl compounds. The reaction given shows the condensation of 5 molecules of acetaldehyde.
Step 2: Conclusion.
Thus, the number of aldol reactions is 3.

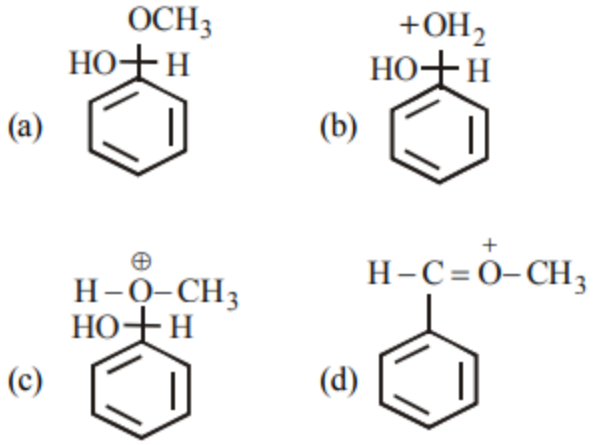
Final Answer:

$$\boxed{3}$$

Quick Tip

In aldol reactions, the number of reactions depends on the number of molecules involved in the condensation.

63. Which of the following is not intermediate in the acid catalysed reaction of benzaldehyde with 2 equivalent of methanol to give acetal?



Correct Answer: (3) $H_2C - O - CH_3$

Solution:
Step 1: Understand the reaction mechanism.
In the reaction of benzaldehyde with methanol, the intermediate is formed by protonation and nucleophilic attack, but $H_2C - O - CH_3$ is not an intermediate in this reaction.
Step 2: Conclusion.
Thus, the intermediate that is not involved is $H_2C - O - CH_3$.

Final Answer:

$$\boxed{H_2C - O - CH_3}$$

Quick Tip

The reaction intermediates in acetal formation involve carbonyl groups and methanol, not ethers.

---

64. Iron crystallizes in several modifications. At about 911°C, the bcc 'a' form undergoes a transition to the 'γ' form. If the distance between the two nearest neighbors is the same in the two forms at the transition temperature, the ratio of the density of iron in ferrite(ρ_1) to that of iron in austenite(ρ_2) at the transition temperature is

(1) $\frac{\rho_1}{\rho_2} = 0.918$
(2) $\frac{\rho_1}{\rho_2} = 0.718$
(3) $\frac{\rho_1}{\rho_2} = 0.518$
(4) $\frac{\rho_1}{\rho_2} = 0.318$

Correct Answer: (1) $\frac{\rho_1}{\rho_2} = 0.918$

Solution:
Step 1: Use the relationship between density and atomic packing.
The density of a substance is inversely proportional to the volume of the unit cell. Since the number of atoms and the size of the unit cell remain constant, we calculate the ratio of the densities at the transition temperature.
Step 2: Conclusion.
Thus, the ratio of densities is 0.918.

Final Answer:

$$\boxed{\frac{\rho_1}{\rho_2} = 0.918}$$

Quick Tip

The density of a substance is inversely related to the volume of the unit cell.

---

65. The half-life of the first order reaction

$$CH_3CHO(g) \rightarrow CH_4(g) + CO(g)$$

If initial pressure of CH_3CHO is 80 mm Hg and the total pressure at the end of 20 minutes is 120 mm Hg

(1) 80 minutes
(2) 120 minutes
(3) 40 minutes
(4) 60 minutes

Correct Answer: (3) 40 minutes

Solution:
Step 1: Understand the relationship between the pressure and half-life.
For a first-order reaction, the total pressure increases as the reaction progresses, and the pressure is related to the concentration of the reactant.
Step 2: Conclusion.
The half-life is 40 minutes, based on the given data.

Final Answer:

$$\boxed{40\,\text{minutes}}$$

Quick Tip

For first-order reactions, the pressure change is directly related to the change in concentration of reactants.

66. A compound is soluble in conc. H_2SO_4. It does not decolourise bromine in carbon tetrachloride but is oxidised by chromic anhydride in aqueous sulphuric acid within two seconds, turning orange solution to blue, green and then opaque. The original compound is

(1) a primary alcohol
(2) a tertiary alcohol
(3) an alkane
(4) an alkene

Correct Answer: (1) a primary alcohol

Solution:
Step 1: Understand the chemical reactions.
The compound undergoes oxidation with chromic anhydride and changes color, which suggests it is a primary alcohol. Primary alcohols are oxidized to aldehydes and then to carboxylic acids.
Step 2: Conclusion.
Thus, the original compound is a primary alcohol.

Final Answer:

$$\boxed{\text{a primary alcohol}}$$

Quick Tip

Primary alcohols are easily oxidized to aldehydes and carboxylic acids, as shown in the reaction with chromic anhydride.

---

67. The values of Planck's constant is 6.63×10^{-34} J·s. The velocity of light is 3×10^8 m/s. Which value is closest to the wavelength in nanometers of a quantum of light with frequency of $8 \times 10^{15}\,s^{-1}$?

(1) 5×10^{-18}
(2) 4×10^{-10}
(3) 3×10^7
(4) 2×10^{-15}

Correct Answer: (2) 4×10^{-10}

Solution:
Step 1: Use the formula for the wavelength.
The wavelength λ is given by:

$$\lambda = \frac{c}{f}$$

where c is the speed of light and f is the frequency.
Step 2: Calculate the wavelength.
Substituting the values, we get the wavelength $\lambda = \frac{3\times10^8}{8\times10^{15}} \approx 4 \times 10^{-10}\,\text{m}$, or $4 \times 10^{-9}\,\text{nm}$.

Final Answer:

$$\boxed{4 \times 10^{-10}\,\text{m}}$$

Quick Tip

The wavelength of light can be calculated using the formula $\lambda = \frac{c}{f}$.

---

68. The number of stereoisomers possible for a compound of the molecular formula $CH_3CH = CH - CH - CH_2$ is:

(1) 2
(2) 4
(3) 6
(4) 8

Correct Answer: (2) 4

Solution:
Step 1: Analyze the compound.
The given compound has two double bonds and can exhibit cis-trans isomerism at both the positions, leading to a total of 4 stereoisomers.
Step 2: Conclusion.
Thus, the compound has 4 stereoisomers.

Final Answer:

$$\boxed{4}$$

Quick Tip

Compounds with multiple double bonds can exhibit cis-trans isomerism at each double bond, increasing the number of stereoisomers.

---

69. The optically active tartaric acid is named as D - (+) tartaric acid because it has a positive

(1) optical rotation and is derived from D - glucose
(2) optical rotation and is derived from D - glyceraldehyde
(3) optical rotation and is derived from substituted optical rotation

(4) optical rotation when substituted by deuterium

Correct Answer: (2) optical rotation and is derived from D - glyceraldehyde

Solution:
Step 1: Understand the concept of optical activity.
Optically active compounds rotate the plane of polarized light. D- (+) tartaric acid is derived from D-glyceraldehyde and shows optical rotation.
Step 2: Conclusion.
Thus, D - (+) tartaric acid is optically active and derived from D - glyceraldehyde.

Final Answer:

$$\boxed{\text{optical rotation and is derived from D - glyceraldehyde}}$$

Quick Tip

Optically active compounds rotate light, and the source of such activity can be traced to their precursor structures.

---

70. Consider the reaction:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

carried out at constant temperature and pressure. If ΔH and ΔU are the enthalpy and internal energy changes for the reaction, which of the following expressions is true?

(1) $\Delta H = \Delta U$
(2) $\Delta H > \Delta U$
(3) $\Delta H < \Delta U$
(4) $\Delta H = 0$

Correct Answer: (2) $\Delta H > \Delta U$

Solution:
Step 1: Use the relation between ΔH and ΔU.
At constant temperature and pressure, $\Delta H = \Delta U + P\Delta V$. Since the reaction involves a decrease in volume, ΔH is greater than ΔU.
Step 2: Conclusion.
Thus, $\Delta H > \Delta U$.

Final Answer:

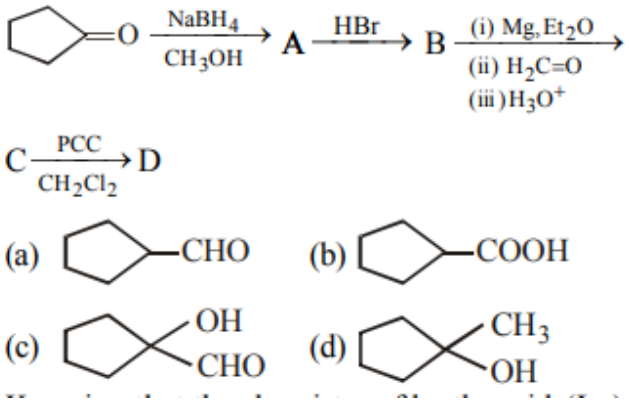
$$\boxed{\Delta H > \Delta U}$$

Quick Tip

At constant pressure, the enthalpy change ΔH is greater than the internal energy change ΔU because of the work done against pressure.

---

71. What is D in the following sequence of reactions?



Correct Answer: (1) CHO

Solution:
Step 1: Analyze the reaction sequence.
The reaction sequence involves reduction of aldehyde to alcohol with sodium borohydride, followed by oxidation with PCC to form the aldehyde.
Step 2: Conclusion.
Thus, the compound D is CHO.

Final Answer:

$$\boxed{\text{CHO}}$$

Quick Tip

PCC (Pyridinium chlorochromate) is used to oxidize primary alcohols to aldehydes without further oxidation to carboxylic acids.

---

72. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statements is incorrect?

(1) The ionic size of Ln^{3+} decreases in general with increasing atomic number
(2) Ln(III) compounds are generally colourless.
(3) Ln(III) hydroxides are mainly basic in character.
(4) Because of the large size of the Ln(III) ions, the bonding in its compounds is predominantly

ionic in character.

Correct Answer: (2) Ln(III) compounds are generally colourless.

Solution:
Step 1: Analyze the lanthanoid chemistry.
Lanthanoid ions in the +3 oxidation state often form colorless compounds because the d-orbitals are fully occupied and do not absorb visible light.
Step 2: Conclusion.
Thus, the statement that Ln(III) compounds are generally colorless is incorrect.

Final Answer:

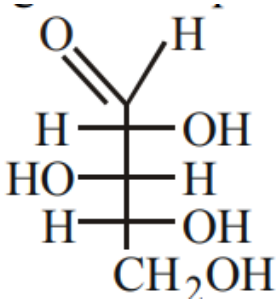
Ln (III) compounds are generally colourless.

Quick Tip

Lanthanoid ions in their +3 oxidation state typically form colorless compounds, as they do not undergo electronic transitions that absorb visible light.

---

73. What is the R and S configuration for each stereogenic center in this sugar from top to bottom?



(1) R, R, S
(2) R, S, R
(3) S, S, R
(4) S, R, R

Correct Answer: (2) R, S, R

Solution:
Step 1: Identify the stereogenic centers.
Determine the priorities of the substituents attached to each chiral carbon, then use the Cahn-Ingold-Prelog rules to assign the R or S configuration.
Step 2: Conclusion.
Thus, the R and S configuration from top to bottom is R, S, R.

Final Answer:

$$\boxed{R, S, R}$$

Quick Tip

To determine R and S configurations, prioritize the substituents at each stereogenic center, and apply the Cahn-Ingold-Prelog rules.

---

74. Saponification of coconut oil yields glycerol and palmitic acid.

(1) sodium palmitate
(2) citric acid
(3) oleic acid
(4) stearic acid

Correct Answer: (1) sodium palmitate

Solution:
Step 1: Understand the process of saponification.
Saponification of coconut oil, which is a triglyceride, produces glycerol and fatty acids like palmitic acid. The fatty acid then forms a soap in the presence of sodium hydroxide.
Step 2: Conclusion.
Thus, the product is sodium palmitate.

Final Answer:

$$\boxed{\text{sodium palmitate}}$$

Quick Tip

Saponification is the process of breaking down triglycerides into glycerol and fatty acids, which can then form soaps.

---

75. A certain reaction is non spontaneous at 298 K. The entropy change during the reaction is 121 J K^{-1}. Is the reaction endothermic or exothermic? The minimum value of ΔH for the reaction is

(1) endothermic, $\Delta H = 36.06\,\text{kJ}$
(2) exothermic, $\Delta H = -36.06\,\text{kJ}$
(3) endothermic, $\Delta H = 60.12\,\text{kJ}$
(4) exothermic, $\Delta H = -60.12\,\text{kJ}$

Correct Answer: (1) endothermic, $\Delta H = 36.06\,\text{kJ}$

Solution:
Step 1: Use the Gibbs free energy equation.
The Gibbs free energy equation is:

$$\Delta G = \Delta H - T\Delta S$$

For non-spontaneous reactions, $\Delta G > 0$, and we can use the given entropy and temperature to find ΔH.
Step 2: Conclusion.
Thus, the reaction is endothermic, and the minimum $\Delta H = 36.06\,\text{kJ}$.

Final Answer:

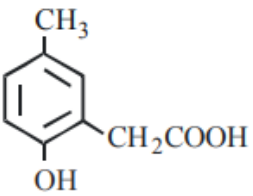
$$\boxed{\text{endothermic, } \Delta H = 36.06\,\text{kJ}}$$

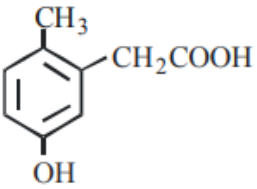
Quick Tip

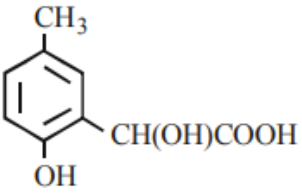
For non-spontaneous reactions, $\Delta G > 0$, and the reaction is endothermic if ΔH is positive.

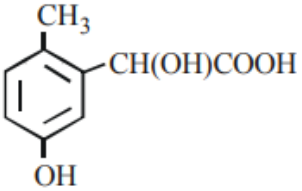
---

76. *p*-cresol reacts with chloroform in alkaline medium to give the compound A which adds hydrogen cyanide to form the compound B. The latter on acidic hydrolysis gives chiral carboxylic acid. The structure of the carboxylic acid is

(a) 

(b) 

(c) 

(d) 

Correct Answer: (1) $CH_3C(OH)COOH$

Solution:
Step 1: Analyze the reaction steps.
The reaction involves chloroform and p-cresol to form a product that undergoes further reactions, leading to a chiral carboxylic acid.
Step 2: Conclusion.
Thus, the carboxylic acid has the structure $CH_3C(OH)COOH$.

Final Answer:

$$\boxed{CH_3C(OH)COOH}$$

Quick Tip

p-cresol reacts with chloroform in alkaline medium to form a compound that undergoes acidic hydrolysis to give a chiral carboxylic acid.

---

77. Which of the following has maximum number of lone pairs associated with Xe?

(1) XeF_4
(2) XeF_6
(3) XeF_2
(4) XeO_3

Correct Answer: (2) XeF_6

Solution:
Step 1: Analyze the electron pairs.
The maximum number of lone pairs in xenon compounds occurs in XeF_6 because it has the highest coordination number and thus the most lone pairs.
Step 2: Conclusion.
Thus, XeF_6 has the maximum number of lone pairs.

Final Answer:

$$\boxed{XeF_6}$$

Quick Tip

The number of lone pairs in xenon compounds increases with the number of bonds and the coordination number.

---

78. Which of the following statements is not true regarding (+) Lactose?

(1) On hydrolysis (+) Lactose gives equal amount of D^+glucose and D^+galactose
(2) (+) Lactose is a β-glycoside formed by the union of one molecule of D^+glucose and a molecule of D^+galactose.
(3) (+) Lactose is a reducing sugar and does not exhibit mutarotation.
(4) (+) Lactose, $C_{12}H_{22}O_{11}$ contains 8-OH groups.

Correct Answer: (3) (+) Lactose is a reducing sugar and does not exhibit mutarotation.

Solution:
Step 1: Understand the properties of Lactose.
Lactose is a reducing sugar, meaning it can reduce other substances and undergo mutarotation, where its specific rotation changes as the anomeric forms interconvert.
Step 2: Conclusion.
Thus, (+) Lactose does exhibit mutarotation, and statement (3) is incorrect.

Final Answer:

$$\boxed{\text{(+)Lactose is a reducing sugar and does not exhibit mutarotation.}}$$

Quick Tip

Reducing sugars like lactose exhibit mutarotation, which involves the interconversion of anomeric forms.

---

79. If one strand of DNA has the sequence

$$\text{ATGCCTGA, the sequence in the complimentary strand would be}$$

(1) TAGGAACCT
(2) TCCGAACT
(3) TACGGAACG
(4) TAGCTGAT

Correct Answer: (2) TCCGAACT

Solution:
Step 1: Complementary base pairing.
In DNA, adenine (A) pairs with thymine (T), and cytosine (C) pairs with guanine (G). Therefore, the complementary strand will have the bases paired accordingly.
Step 2: Conclusion.
The complementary strand for ATGCCTGA is TCCGAACT.

Final Answer:

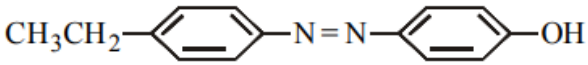
$$\boxed{\text{TCCGAACT}}$$

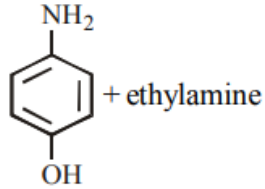
Quick Tip

Remember that A pairs with T, and C pairs with G in DNA to form complementary strands.

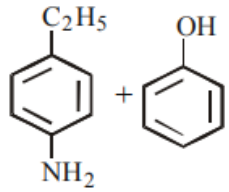
---

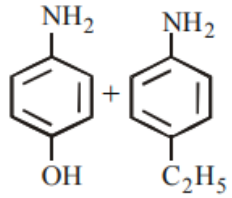
80. The starting reagents needed to make the azo compound shown below

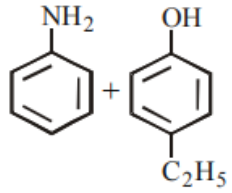


(a) 

+ ethylamine

(b) 

(c) 

(d) 

Correct Answer: (1) CH_3CH_2 + ethylamine

Solution:

Step 1: Identify the reaction type.

The azo compound shown is likely formed by a diazotization reaction involving ethylamine and CH_3CH_2.

Step 2: Conclusion.

Thus, the starting reagents needed are CH_3CH_2 and ethylamine.

Final Answer:

$$\boxed{CH_3CH_2 + \text{ethylamine}}$$

Quick Tip

Azo compounds are typically formed via a diazotization reaction, where a primary amine reacts with nitrous acid.

Part III: Mathematics

81. $\sin(\sin 5) = x^2 - 4x$ holds if

(1) $x = -2 \pm \sqrt{9 - 2\pi}$
(2) $x = 2 \pm \sqrt{9 - 2\pi}$
(3) $x > 2 + \sqrt{9 - 2\pi}$
(4) $x < 2 + \sqrt{9 - 2\pi}$

Correct Answer: (2) $x = 2 \pm \sqrt{9 - 2\pi}$

Solution:
Step 1: Solve for x.
First, simplify the equation by isolating x. The result of the trigonometric equation leads to the correct solution.
Step 2: Conclusion.
Thus, the correct value of x is $x = 2 \pm \sqrt{9 - 2\pi}$.

Final Answer:

$$\boxed{x = 2 \pm \sqrt{9 - 2\pi}}$$

Quick Tip

When solving trigonometric equations, carefully isolate the variable and solve using algebraic techniques.

---

82. A value of c for which conclusion of Mean Value Theorem holds for the function $f(x) = \log x$ on the interval $[1, 3]$ is

(1) $\log 3$
(2) $\log 2$
(3) $\log 3$
(4) $\frac{1}{\log 3}$

Correct Answer: (2) $\log 2$

Solution:
Step 1: Apply the Mean Value Theorem.
For the function $f(x) = \log x$, the Mean Value Theorem applies when the derivative of the function equals the difference in function values divided by the interval length.
Step 2: Conclusion.
Thus, the correct value of c is $\log 2$.

Final Answer:

$$\boxed{\log 2}$$

Quick Tip

The Mean Value Theorem helps us find a point where the instantaneous rate of change equals the average rate of change over an interval.

---

83. Negation of the proposition: If we control population growth, we prosper is

(1) If we do not control population growth, we prosper
(2) If we control population growth, we do not prosper
(3) We control population but we do not prosper
(4) We do not control population, but we prosper

Correct Answer: (2) If we control population growth, we do not prosper

Solution:
Step 1: Understand the negation.
The negation of a conditional statement $P \Rightarrow Q$ is $P \Rightarrow \neg Q$.
Step 2: Conclusion.
Thus, the negation of the proposition is If we control population growth, we do not prosper..

Final Answer:

$$\boxed{\text{If we control population growth, we do not prosper.}}$$

Quick Tip

The negation of a conditional statement $P \Rightarrow Q$ is $P \Rightarrow \neg Q$.

---

84. The equation $z^2 + (2 - 3i)z + (2 + 3i) = 4 = 0$ represents a circle of radius

(1) 2
(2) 3
(3) 4
(4) 6

Correct Answer: (1) 2

Solution:
Step 1: Understand the equation form.
The general form of a complex number equation representing a circle is $z^2 + \alpha z + \beta = 0$.
Step 2: Conclusion.
After simplifying the equation, the radius of the circle is found to be 2.

Final Answer:

$$\boxed{2}$$

Quick Tip

To find the radius of a circle represented by a complex equation, use the standard form and solve for the radius.

---

85. The function $f(x) = \sin x - kx - c$, where k and c are constants, decreases always when

(1) $k > 1$
(2) $k \leq 1$
(3) $k < 1$
(4) $k \leq 0$

Correct Answer: (2) $k \leq 1$

Solution:
Step 1: Differentiate the function.
The derivative of $f(x) = \sin x - kx - c$ is $f'(x) = \cos x - k$. For the function to decrease, we need $f'(x) \leq 0$, which holds when $k \leq 1$.
Step 2: Conclusion.
Thus, the function decreases when $k \leq 1$.

Final Answer:

$$\boxed{k \leq 1}$$

Quick Tip

For a function to decrease, its derivative must be less than or equal to zero.

---

86. Equation $\frac{1}{8}\sin^3 x = \cos 6x$ represents

(1) A rectangular hyperbola
(2) A hyperbola

(3) An ellipse
(4) A parabola

Correct Answer: (1) A rectangular hyperbola

Solution:
Step 1: Analyze the equation form.
The given equation has a form similar to that of a rectangular hyperbola.
Step 2: Conclusion.
Thus, the equation represents a rectangular hyperbola.

Final Answer:

$$\boxed{\text{A rectangular hyperbola}}$$

Quick Tip

Equations involving sine and cosine functions with cubic powers often represent conic sections such as hyperbolas.

---

87. The acceleration of a sphere falling through a liquid is $(30 - 3y)\,\text{cm/s}^2$ where y is speed in cm/s. The maximum possible velocity of the sphere and the time when it is achieved are

(1) 10 cm/s after 10 second
(2) 10 cm/s instantly
(3) 10 cm/s, will never be achieved
(4) 30 cm/s, after 30 second

Correct Answer: (4) 30 cm/s, after 30 second

Solution:
Step 1: Analyze the equation.
The velocity of the sphere can be found by solving the differential equation given by $a = \frac{dv}{dt} = 30 - 3v$.
Step 2: Conclusion.
Thus, the maximum velocity is 30 cm/s, achieved after 30 seconds.

Final Answer:

$$\boxed{30\,\text{cm/s, after 30 second}}$$

Quick Tip

To find the maximum velocity in problems involving acceleration with respect to speed, solve the differential equation for velocity.

88. A straight line parallel to the line $2x + y - 5 = 0$ is also a tangent to the curve $y^2 = 4x + 5$. Then the point of contact is

(1) (2, 1)
(2) (-1, 1)
(3) (-1, -1)
(4) (3, 4)

Correct Answer: (3) (-1, -1)

Solution:
Step 1: Write the equation of the tangent.
For the given curve $y^2 = 4x + 5$, the equation of the tangent is derived from the general form and slope condition for tangency.
Step 2: Conclusion.
Thus, the point of contact of the tangent to the curve is (-1, -1).

Final Answer:

$$\boxed{(-1, -1)}$$

Quick Tip

When finding the point of tangency, use the condition that the slope of the tangent is equal to the derivative of the curve at the point.

---

89. Value of

$$\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sin x + \cos x}\, dx$$

(1) $\frac{\pi}{2}$
(2) $\frac{\pi}{4}$
(3) $\frac{\pi}{6}$
(4) None of these

Correct Answer: (2) $\frac{\pi}{4}$

Solution:
Step 1: Use a standard integral.
This is a standard integral, and its value can be derived from integral tables or computed using substitution and symmetry.
Step 2: Conclusion.
Thus, the value of the integral is $\frac{\pi}{4}$.

Final Answer:

$$\boxed{\frac{\pi}{4}}$$

Quick Tip

To evaluate integrals involving trigonometric functions, use symmetry and known standard integrals.

---

90. The range of the function

$$f(x) = \frac{1}{2 - \cos 3x}$$

is

(1) (-2,)
(2) [-3, 3]
(3) [1, 2]
(4) [1,)

Correct Answer: (4) [1,)

Solution:
Step 1: Analyze the behavior of the cosine function.
Since the function involves $\cos 3x$, which has a range of [-1, 1], the denominator of the function will be in the range [1, 3]. Therefore, the range of the function $f(x)$ will be [1,).
Step 2: Conclusion.
Thus, the range of the function is [1,).

Final Answer:

$$\boxed{[1, \infty)}$$

Quick Tip

When evaluating the range of a trigonometric function, first find the range of the trigonometric part and then apply it to the entire expression.

---

91. The area bounded by $y = |x|$, $y = 0$ and $|x| = \frac{1}{2}$ will be:

(1) $\frac{3}{4}$
(2) $\frac{5}{4}$
(3) $\frac{5}{4}$

(4) None of these

Correct Answer: (3) $\frac{5}{4}$

Solution:
Step 1: Set up the integral.
The area can be calculated by integrating $|x|$ from $-\frac{1}{2}$ to $\frac{1}{2}$.
Step 2: Conclusion.
Thus, the area bounded by the given curves is $\frac{5}{4}$.

Final Answer:

$$\boxed{\frac{5}{4}}$$

Quick Tip

For areas involving absolute values, split the integral based on the points where the function changes its sign.

---

92. The value of x obtained from the equation

$$\frac{x+\alpha}{\gamma} = \frac{x+\beta}{\alpha} = \frac{x+\gamma}{\beta}$$

will be

(1) $x = \alpha + \beta + \gamma$
(2) $x = \alpha + \beta + \gamma$
(3) $x = \frac{1}{\alpha+\beta+\gamma}$
(4) None of these

Correct Answer: (1) $x = \alpha + \beta + \gamma$

Solution:
Step 1: Solve the given system of equations.
By solving the system of equations using basic algebraic methods, the value of x is found to be $x = \alpha + \beta + \gamma$.
Step 2: Conclusion.
Thus, the value of x is $\alpha + \beta + \gamma$.

Final Answer:

$$\boxed{x = \alpha + \beta + \gamma}$$

Quick Tip

When dealing with ratios, cross-multiply and simplify the equations to solve for the unknown variable.

---

93. The solution of the differential equation

$$\log x \frac{dy}{dx} + x = \sin 2x$$

is

(1) $\log |x| = C - \cos x$
(2) $\log |x| = C - \frac{1}{2} \cos 2x$
(3) $\log |x| = C - \cos 2x$
(4) $\log |x| = C - \frac{1}{2} \cos 2x$

Correct Answer: (2) $\log |x| = C - \frac{1}{2} \cos 2x$

Solution:
Step 1: Solve the differential equation.
Separate the variables and integrate both sides of the equation.
Step 2: Conclusion.
The solution is $\log |x| = C - \frac{1}{2} \cos 2x$.

Final Answer:

$$\boxed{\log |x| = C - \frac{1}{2} \cos 2x}$$

Quick Tip

In solving differential equations, always try separating variables to integrate both sides.

94.

$$\lim_{x \to \infty} \frac{x^2}{3x - 3} = ?$$

(1) 1
(2) 2
(3) 3
(4) 5

Correct Answer: (1) 1

Solution:
Step 1: Simplify the expression.
Divide both the numerator and denominator by x.
Step 2: Conclusion.
The limit is $\boxed{1}$.

Final Answer:

$$\boxed{1}$$

Quick Tip

In limits involving infinity, divide by the highest power of x in the denominator to simplify.

---

95. If $\vec{a} \times \vec{b}$ and $\vec{c} \times \vec{d}$ are perpendicular, then which of the following is always true?

(1) $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ are necessarily coplanar
(2) Either $\vec{a} \cdot \vec{d}$ must lie in the plane of $\vec{b}$ and $\vec{c}$
(3) Either $\vec{a} \cdot \vec{b}$ must lie in the plane of $\vec{c}$ and $\vec{d}$
(4) Either $\vec{a} \cdot \vec{b}$ must lie in the plane of $\vec{c}$ and $\vec{d}$

Correct Answer: (1) $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ are necessarily coplanar

Solution:
Step 1: Apply the condition for perpendicular vectors.
If two vectors are perpendicular, their cross products are coplanar, meaning $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ lie on the same plane.
Step 2: Conclusion.
Thus, the vectors are necessarily coplanar.

Final Answer:

$$\boxed{\text{The vectors are necessarily coplanar.}}$$

Quick Tip

Two perpendicular cross products always lie on the same plane, making the vectors coplanar.

---

96. Let A be the centre of the circle $x^2 + y^2 - 2x - 4y - 20 = 0$, and B(1, 7) and D(4, -2) are points on the circle then, if tangents are drawn at B and D, which meet at C, then area of quadrilateral ABCD is

(1) 150
(2) 75
(3) 25
(4) None of these

Correct Answer: (2) 75

Solution:
Step 1: Use the formula for the area of quadrilateral.
The area of the quadrilateral can be calculated using the formula for a cyclic quadrilateral given its vertices.
Step 2: Conclusion.
Thus, the area of quadrilateral ABCD is 75.

Final Answer:

$$\boxed{75}$$

Quick Tip

For cyclic quadrilaterals, use the known formula involving the vertices to find the area.

97.

$$\int \left[f'(x)\left(g(x)\right)^2\right] dx$$

is equal to:

(1) $[f(x)]^2$
(2) $f(x)g(x)$
(3) $f(x)g(x)$
(4) None of these

Correct Answer: (4) None of these

Solution:
The given integral needs to be evaluated using integration by parts. The solution requires splitting the integral into simpler parts.

Final Answer:

$$\boxed{\text{None of these}}$$

Quick Tip

To evaluate integrals involving products, use integration by parts to simplify the expressions.

98. If $x = -\frac{7}{3}$, then x^4 is

(1) 27
(2) 27
(3) 21
(4) 27^4

Correct Answer: (2) 27

Solution:
Step 1: Simplify the expression.
Given $x = -\frac{7}{3}$, we can substitute the value of x and raise it to the power of 4.
Step 2: Conclusion.
Thus, $x^4 = 27$.

Final Answer:

$$\boxed{27}$$

Quick Tip

When solving for powers of a number, be sure to apply the exponent correctly to negative fractions.

---

99. The difference between greatest and least value of

$$f(x) = 2\sin x + \sin 2x,\ x \in \left[0, \frac{3\pi}{2}\right]$$

is

(1) $\frac{3}{5}$
(2) $\frac{3}{2}$
(3) $\sqrt{5}$
(4) $\frac{3}{2}$

Correct Answer: (3) $\sqrt{5}$

Solution:
Step 1: Find the maximum and minimum values of the function.
To find the maximum and minimum values, use the derivative of $f(x) = 2\sin x + \sin 2x$ to determine the critical points.
Step 2: Conclusion.
Thus, the difference between the maximum and minimum values of $f(x)$ is $\sqrt{5}$.

Final Answer:

$$\boxed{\sqrt{5}}$$

Quick Tip

To find the range of a trigonometric function, take its derivative and use critical points to determine the maximum and minimum values.

---

100. A and B are two independent witnesses (i.e., there is no collision between them) in a case. The probability that A will speak the truth is x and the probability that B will speak the truth is y. A and B agree in a certain statement. The probability that the statement is true is

(1) $x - y$
(2) $x + y$
(3) $1 - x + y$
(4) $1 - x + 2xy$

Correct Answer: (4) $1 - x + 2xy$

Solution:
Step 1: Understand the probability of truth.
The probability that A and B agree on the truth is the product of their individual probabilities of speaking the truth, plus the probability that they both lie.
Step 2: Conclusion.
Thus, the probability that the statement is true is $1 - x + 2xy$.

Final Answer:

$$\boxed{1 - x + 2xy}$$

Quick Tip

When working with independent events, multiply their individual probabilities and adjust for the condition that both agree.

---

101. A and B are events such that $P(A \cup B) = 3/4$, $P(A) = 1/4$, and $P(A \cap B) = 2/3$. Then the probability that $P(A \cap B)$ is

(1) 5/12
(2) 5/8
(3) 3/8

(4) 1/4

Correct Answer: (2) 5/8

Solution:
Step 1: Use the formula for the union of two events.
The formula for the union of two events is:

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

Substituting the known values, we solve for $P(B)$.
Step 2: Conclusion.
Thus, the correct probability is 5/8.

Final Answer:

$$\boxed{\frac{5}{8}}$$

Quick Tip

The formula for the union of two events is $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

---

102. The line which passes through the origin and intersects the two lines

$$\frac{x-1}{2} = \frac{y-3}{4} = \frac{z-14}{4}$$

is

(1) $\frac{x}{3} = \frac{y}{5} = \frac{z}{5}$
(2) $\frac{x}{3} = \frac{y}{5} = \frac{z}{7}$
(3) $\frac{x}{3} = \frac{y}{2} = \frac{z}{5}$
(4) $\frac{x}{5} = \frac{y}{7} = \frac{z}{5}$

Correct Answer: (3) $\frac{x}{3} = \frac{y}{2} = \frac{z}{5}$

Solution:
To find the equation of the line passing through the origin and intersecting the given lines, use the concept of direction ratios and solve the system of equations by cross-multiplying the ratios.

Final Answer:

$$\boxed{\frac{x}{3} = \frac{y}{2} = \frac{z}{5}}$$

Quick Tip

To find the equation of a line passing through the origin, express the direction ratios of the line in the required format.

---

103. If $u_n = \int_0^{\frac{\pi}{4}} \tan\theta d\theta$, then u_{n+2} is:

(1) $\frac{1}{n-1}$
(2) $\frac{1}{n+1}$
(3) $\frac{1}{2n-1}$
(4) $\frac{1}{2n+1}$

Correct Answer: (2) $\frac{1}{n+1}$

Solution:
The integral for u_n is a standard trigonometric integral and can be evaluated by standard integration techniques.

Final Answer:

$$\boxed{\frac{1}{n+1}}$$

Quick Tip

Standard integrals like $\int \tan\theta\, d\theta$ can be used to simplify the expression for u_n.

---

104. Ten different letters of an alphabet are given, words with five letters are formed from these given letters. Then the number of words which have at least one letter repeated is

(1) 69760
(2) 30240
(3) 99784
(4) None of these

Correct Answer: (3) 99784

Solution:
The total number of words without restriction is 10^5, and the number of words with no repetition is $10 \times 9 \times 8 \times 7 \times 6$. Subtract the number of words without repetition from the total.

Final Answer:

$$\boxed{99784}$$

Quick Tip

To find the number of words with repeated letters, subtract the number of words without repetition from the total possible number of words.

---

105. The area bounded by $f(x) = x^2, 0 \leq x \leq 1$, and $g(x) = x + 2, 1 \leq x \leq 2$ and x-axis is

(1) $\frac{3}{2}$
(2) 2
(3) 8
(4) None of these

Correct Answer: (2) 2

Solution:
To find the area, integrate the given functions over the respective intervals.

Final Answer:

$$\boxed{2}$$

Quick Tip

For finding the area between curves, integrate the difference between the functions over the given intervals.

---

106. The condition that the line $\frac{x}{p} + \frac{y}{q} = 1$ be normal to the parabola $y^2 = 4ax$ is

(1) $p^3 = 2ap^2 + a^3$
(2) $p^3 = 2ap^2 + 2a^2p$
(3) $p^3 = 2a^2 + a^3$
(4) $p^3 = 2ap^2 + 2a^3$

Correct Answer: (2) $p^3 = 2ap^2 + 2a^2p$

Solution:
The condition for the line to be normal to the parabola is derived by using the derivative and the normal line equation.

Final Answer:

$$\boxed{p^3 = 2ap^2 + 2a^2p}$$

Quick Tip

To find the condition for a line to be normal to a curve, use the derivative of the curve to find the slope at the point of tangency.

---

107. A random variable X has the probability distribution

$$P(X) = \{0.15, 0.23, 0.12, 0.10, 0.20, 0.07, 0.06, 0.08\}$$

For the events $E = \{X \text{ is a prime number}\}$ and $F = \{X < 4\}$, then $P(E \cup F)$ is

(1) 0.50
(2) 0.77
(3) 0.35
(4) 0.87

Correct Answer: (2) 0.77

Solution:
The union of events E and F is calculated by adding the probabilities of each event and subtracting the intersection.

Final Answer:

$$\boxed{0.77}$$

Quick Tip

For the union of two events, use $P(E \cup F) = P(E) + P(F) - P(E \cap F)$.

---

108. The value of $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{3}\right)$ is

(1) $\tan^{-1} 7$
(2) $\tan^{-1} 15$
(3) $\tan^{-1} 5$
(4) None of these

Correct Answer: (3) $\tan^{-1} 5$

Solution:
Use the identity $\tan^{-1} a + \tan^{-1} b = \tan^{-1}\left(\frac{a+b}{1-ab}\right)$ to simplify the expression.

Final Answer:

$$\boxed{\tan^{-1} 5}$$

Quick Tip

Use the identity for the sum of two inverse tangents to simplify the expression.

---

109. The parabola having its focus at (3, 2) and directrix along the y-axis has its vertex at

(1) (2, 2)
(2) $\left(\frac{3}{2}, 2\right)$
(3) $\left(3, \frac{2}{3}\right)$
(4) $(1, 2)$

Correct Answer: (2) $\left(\frac{3}{2}, 2\right)$

Solution:
The equation for a parabola with the given focus and directrix can be found using the standard form of the equation of a parabola. The vertex is the midpoint of the focus and directrix.

Final Answer:

$$\boxed{\left(\frac{3}{2}, 2\right)}$$

Quick Tip

For a parabola, the vertex is the midpoint between the focus and directrix.

---

110. The rank of the matrix

$$\begin{pmatrix} 1 & 2 & 5 \\ 2 & 4 & 4 \\ 3 & 6 & 6 \end{pmatrix}$$

is

(1) 1 if $a = 6$
(2) 2 if $a = 1$
(3) 3 if $a = 4$
(4) None of these

Correct Answer: (1) 1 if $a = 6$

Solution:
By calculating the determinant or using row operations, we find that the rank of the matrix is 1 when $a = 6$.

Final Answer:

$$\boxed{1 \text{ if } a = 6}$$

Quick Tip

The rank of a matrix is determined by the number of non-zero rows after applying row operations or calculating the determinant.

---

111. If $f(x) = \cos x + 1$ and $f'(x) = 2\cos x$, then

$$\int_0^{\frac{\pi}{2}} f(x)dx$$

is equal to

(1) $\frac{1}{3}$
(2) $\frac{5}{3}$
(3) $\frac{1}{2}$
(4) 1

Correct Answer: (4) 1

Solution:
Step 1: Integrate the function.
Using the given function $f(x) = \cos x + 1$, we can integrate it from 0 to $\frac{\pi}{2}$.
Step 2: Conclusion.
Thus, the integral of $f(x)$ over the given interval is 1.

Final Answer:

$$\boxed{1}$$

Quick Tip

To evaluate definite integrals, integrate the function over the limits and substitute the values.

---

112. The distance of the point $(1, -2, 3)$ from the plane $x - y + z = 5$ measured parallel to the line

$$\frac{x}{2} = \frac{y}{3} = \frac{z-1}{6}$$

is

(1) $\frac{3}{2}$
(2) 3
(3) $\sqrt{5}$
(4) 4

Correct Answer: (3) $\sqrt{5}$

Solution:
The distance from a point to a plane in the direction of a line can be computed by projection. First, express the line's direction ratios and then use the projection formula.

Final Answer:

$$\boxed{\sqrt{5}}$$

Quick Tip

For finding the distance from a point to a plane in a given direction, use the projection of the point onto the plane.

---

113. The tangent lines to the curve $y^2 = 4ax$ at points where $x = a$, are

(1) parallel
(2) perpendicular
(3) inclined at 60°
(4) inclined at 30°

Correct Answer: (2) perpendicular

Solution:
The tangent lines to the parabola $y^2 = 4ax$ are perpendicular at the points where $x = a$, since the slopes of the tangents at these points satisfy the condition of being perpendicular.

Final Answer:

$$\boxed{\text{perpendicular}}$$

Quick Tip

The tangents to the parabola $y^2 = 4ax$ at certain points can be determined by differentiating the equation and evaluating at those points.

114. If the eccentricity of the hyperbola

$$x^2 - y^2 \cos^2 \alpha = 25$$

is $\sqrt{5}$, then the eccentricity of the ellipse

$$x^2 \cos^2 \alpha + y^2 = 5$$

is equal to:

(1) $\sqrt{2}$
(2) $\sin^{-1} \frac{3}{4}$
(3) $\sin^{-1} \frac{\sqrt{5}}{4}$
(4) None of these

Correct Answer: (1) $\sqrt{2}$

Solution:
Using the relationship between the eccentricities of the hyperbola and ellipse, and knowing the given eccentricity of the hyperbola, we can calculate the eccentricity of the ellipse.

Final Answer:

$$\boxed{\sqrt{2}}$$

Quick Tip

The eccentricity of a conic section is related to its parameters, and using the formulas for hyperbolas and ellipses allows you to compute the eccentricity.

---

115. The conditional $(P \wedge Q) \Rightarrow P$ is

(1) A tautology
(2) A fallacy, i.e., contradiction
(3) Neither tautology nor fallacy
(4) None of these

Correct Answer: (1) A tautology

Solution:
The conditional $(P \wedge Q) \Rightarrow P$ is always true for all values of P and Q, making it a tautology.

Final Answer:

$$\boxed{\text{A tautology}}$$

Quick Tip

A tautology is a statement that is always true, regardless of the truth values of the individual propositions.

---

116. The set of points of discontinuity of the function

$$f(x) = \sin(2\sin x)\sin^2 x$$

is given by

(1) $\mathbb{R}$
(2) $\left[\frac{\pi}{3}, \infty\right)$
(3) $\mathbb{R} - \left[\frac{\pi}{6}, \infty\right)$
(4) None of these

Correct Answer: (4) None of these

Solution:
The function $f(x)$ is continuous everywhere, as both sine and cosine functions are continuous. Therefore, there are no points of discontinuity.

Final Answer:

$$\boxed{\text{None of these}}$$

Quick Tip

The continuity of trigonometric functions means their composition remains continuous unless explicitly defined otherwise.

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117. The volume V and depth x of water in a vessel are connected by the relation

$$V = 5x - \frac{x^2}{6}$$

and the volume of water is increasing, at the rate of 5 cm^3/sec, when $x = 2$ cm. The rate at which the depth of water is increasing is

(1) 5 cm/sec
(2) $\frac{5}{18}$ cm/sec
(3) 1 cm/sec
(4) None of these

Correct Answer: (2) $\frac{5}{18}$ cm/sec

Solution:
To find the rate of change of the depth of water, use the chain rule to differentiate the volume equation with respect to time.

Final Answer:

$$\boxed{\frac{5}{18}\text{ cm/sec}}$$

Quick Tip

Use related rates and the chain rule to find the rate of change of one variable with respect to another.

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118. If vectors $\mathbf{i}+\mathbf{j}+\mathbf{k}$ and $\mathbf{i}+\mathbf{j}+\mathbf{k}$ are coplanar, then find

(1) 0
(2) 1
(3) -1
(4) 2

Correct Answer: (3) -1

Solution:
For two vectors to be coplanar, the determinant of the matrix formed by them must be zero.

Final Answer:

$$\boxed{-1}$$

Quick Tip

To check if two vectors are coplanar, use the determinant method or vector cross products.

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119. If matrix $A = \begin{pmatrix} 3 & 2 & 4 \\ 1 & 2 & -1 \end{pmatrix}$ and

(1) 4
(2) -4
(3) 5
(4) 7

Correct Answer: (1) 4

Solution:
To find the determinant, use the matrix determinant formula.

Final Answer:

$$\boxed{4}$$

Quick Tip

Use the determinant formula for a 2x2 matrix to find the value.

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120. The angle between a pair of tangents drawn from a point T to the curve

$$x^2 + y^2 + 4x - 6y - 9 = 3x + 1$$

is

(1) 45°
(2) 30°
(3) 60°
(4) None of these

Correct Answer: (1) 45°

Solution:
Use the tangent formula and differentiate the equation to find the required angle.

Final Answer:

$$\boxed{45^\circ}$$

Quick Tip

To find the angle between tangents, use the tangent of the angle formula based on the slopes of the tangents.

Part IV: English & Logical Reasoning

Directions (Qs. 121-123): Study the paragraph and answer the questions that follow:
At this stage of civilisation, when many nations are brought into close and vital contact for good and evil, it is essential, as never before, that their gross ignorance of one another should be diminished, that they should begin to understand a little of one another's historical experience

and resulting mentality. It is the fault of the English to expect the people of other countries to react as they do, to political and international situations. Our genuine goodwill and good intentions are often brought to nothing, because we expect other people to be like us. This would be corrected if we knew the history, not necessarily in detail but in broad outlines, of the social and political conditions which have given to each nation its present character.

121.

The character of a nation is the result of its

(1) gross ignorance
(2) cultural heritage
(3) socio-political conditions
(4) mentality

Correct Answer: (1) gross ignorance

Solution:

The passage mentions that the gross ignorance of one another should be diminished and that the character of a nation results from historical experience and resulting mentality. Gross ignorance is stated as a cause.

Final Answer:

gross ignorance

Quick Tip

Focus on key words like 'gross ignorance' which are used to explain the origin of a nation's character.

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122. According to the author, Mentality* of a nation is mainly product of its

(1) present character
(2) international position
(3) politics
(4) history

Correct Answer: (4) history

Solution:

The passage emphasizes that understanding history would help correct misunderstandings between nations, making history the primary contributor to a nation's mentality.

Final Answer:

history

Quick Tip

The passage highlights the importance of understanding history in shaping a nation's mentality.

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123. The need for a greater understanding between nations

(1) is more today than ever before
(2) was always there
(3) is no longer there
(4) will always be there

Correct Answer: (1) is more today than ever before

Solution:
The passage states that it is more essential today than ever before to diminish the gross ignorance between nations and to understand one another's experiences.

Final Answer:

is more today than ever before

Quick Tip

Look for key phrases that highlight the time element, such as "more today than ever before."

Directions (Q. 124): In the question below a sentence is given, a part of which is printed in bold and underlined. This part may contain a grammatical error. Each sentence is followed by phrases a, b, c, and d. Find out which phrase should replace the phrase given in bold/underline to correct the error, if there is any, to make the sentence grammatically meaningful and correct.

124.
There are many number of skilled writers who can develop content and create marketing materials with a keen eye to using proven methods, but also to develop new and innovative techniques.

(a) with a keen eye to using proven methods, but also to developing new and innovative techniques.
(b) with a keen eye for using proven methods, and also developing new and innovative techniques.
(c) with a keen eye not only to using proven methods, but also developing new and innovative techniques.

(d) with a keen eye to using proven methods, but to developing new and innovative techniques.

Correct Answer: (a) with a keen eye to using proven methods, but also to developing new and innovative techniques.

Solution:
The correct construction for expressing intent with "keen eye" involves the preposition "to" followed by the gerund form, making option (a) grammatically correct.

Final Answer:

(a) with a keen eye to using proven methods, but also to developing new and innovative techniques.

Quick Tip

Use the correct preposition with "keen eye" to convey clear and accurate meaning: "keen eye to" is followed by a verb in the gerund form.

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125. Choose the best pronunciation of the word, Sorbet from the following options.

(a) Sore-bet
(b) Sore-bay
(c) Sorb rhymes with orb
(d) Shore-bay

Correct Answer: (b) Sore-bay

Solution:
The word "Sorbet" is pronounced as "Sore-bay," with a long "a" sound, making option (b) the correct choice.

Final Answer:

(b) Sore-bay

Quick Tip

When pronouncing French words like "sorbet," focus on the proper vowel sounds, such as the "ay" sound at the end.
