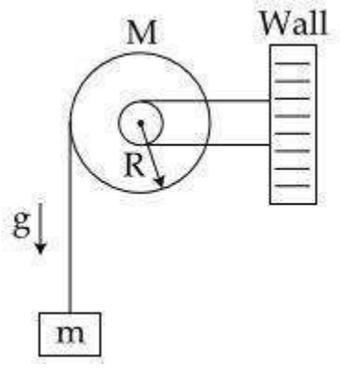
BITSAT 2021

SAMPLE PAPERS (PHYSICS, CHEMISTRY, MATHS)

Physics

Q.1 A uniform disc of radius R and mass M is free to rotate only about its axis. A string is wrapped over its rim and a body of mass m is tied to the free end of the string as shown in the gure. The body is released from rest. Then the acceleration of the body is :



Option 1: $\frac{2Mg}{2M+m}$

Option 2: $\frac{2Mg}{2M+m}$

Option 3: $\frac{2Mg}{m+2M}$

Option 4: $\frac{2Mg}{m+2M}$

Correct Answer:

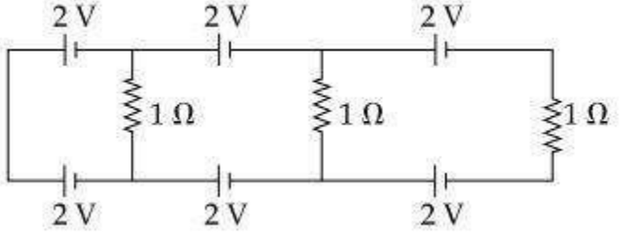
Solution:

$$a = \frac{forward\ force - backward\ force}{total\ mass}$$

$$a = \frac{mg - 0}{m + \frac{I}{R^2}} \quad \Rightarrow \quad a = \frac{mg}{m + \frac{1}{2}\frac{MR^2}{R^2}}$$

$$a = \frac{2mg}{2m + M} \qquad \left[\because\ I_c = \frac{1}{2}mR^2\right]$$

Q. 2



In the above circuit the current in each resistance is :

Option 1:
1 A

Option 2:
0.25 A

Option 3:
0.5 A

Option 4:
0 A

Correct Answer:
0 A

Solution:

The potential di erence in each loop is zero

∴ No current will ow or current in each resistance is zero

Q. 3 A magnetic needle of magnetic moment 6.7×10−2 Am2 and moment of inertia 7.5×10−6 kg m2 is performing simple harmonic oscillations in a magnetic eld of 0.01 T. Time taken for 10 complete oscillations is :

Option 1:
6.65 s

Option 2:
8.89 s

Option 3:
6.98 s

Option 4:
8.76 s

Correct Answer:
6.65 s

Solution:
As we learned in

The time period of Oscillating Bar Magnet -

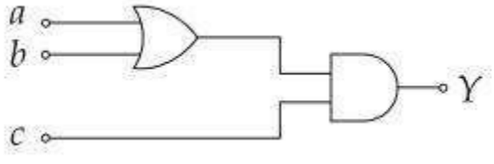
$$T = 2\pi\sqrt{\frac{I}{MB}}$$

Using

$$I = 7.5 \times 10^{-6} Am^2$$
$$M = 6.7 \times 10^{-2} kgm^2$$
$$B = 0.1T$$

we get T = 6.65 s

Q. 4 To get an output of 1 from the circuit shown in gure the input must be :



Option 1:
a = 0, *b* = 1, *c* = 0

Option 2:
a = 1, *b* = 0, *c* = 0

Option 3:
$a = 1, b = 0, c = 1$

Option 4:
$a = 0, b = 0, c = 1$

Correct Answer:
$a = 1, b = 0, c = 1$

Solution:

To get an output of 1, from the NAND gate both input should be 1.

$\therefore$ C = 1

Now Resultant of a & b should be 1.

$$\therefore \left.\begin{array}{c} a = 1, b = 0 \\ or \\ a = 0, b = 1 \\ or \\ a = 1, b = 1 \end{array}\right\} and\ C = 1$$

So the Correct option is 3.

Q. 5 A person trying to lose weight by burning fat lifts a mass of 10 kg upto a height of 1 m 1000 times. Assume that the potential energy lost each time he lowers the mass is dissipated. How much fat will he use up considering the work done only when the weight is lifted up ? Fat supplies 3.8×107 J of energy per kg which is converted to mechanical energy with a 20% e ciency rate. Take g = 9.8 ms−2 :

Option 1:
2.45×10−3 kg

Option 2:
6.45×10−3 kg

Option 3:
9.89×10−3 kg

Option 4:
12.89×10−3 kg

Correct Answer:
12.89×10−3 kg

Solution:
As we discussed in

If only conservative forces act on a system, total mechnical energy remains constant -

$$K + U = E\,(constant)$$

$$\Delta K + \Delta U = 0$$

$$\Delta K = -\Delta U$$

-

Total work done by the person in lifting the weigh = mgh

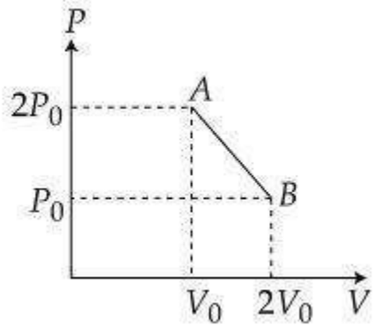
$$= 10 \times\ 9.8 \times\ 1 \times\ 1000$$

$$=\ 98 \times\ 10^3 J$$

Total mechanical energy produced by burning 1 kg fat $= (3.8 \times 10^7) \times 0.20 = 7.6 \times 10^6 J$

Total fat burn

Q.6 'n' moles of an ideal gas undergoes a process A→B as shown in the gure. The maximum temperature of the gas during the process will be :



Option 1:
$\frac{9P_0V_0}{4nR}$

Option 2:
$\frac{3P_0V_0}{2nR}$

Option 3:
$\frac{9P_0V_0}{2nR}$

Option 4:
$\frac{9P_0V_0}{nR}$

Correct Answer:
$\frac{9P_0V_0}{4nR}$

Solution:

At any point between A & B we can write relation between P & V by using equation of straight line

$$V - V_0 = \frac{}{P_0}(P - 2P_6)$$

$$P\left(\frac{-V_0}{P_0}\right) + 2V_0 = V - V_0$$

$$P = \frac{-P_0}{V_0}(V - 3V_0)$$

From ideal gas equation

PV = nRT

$$\Rightarrow \quad \frac{nRT}{V} = \frac{-P_0}{V_0}(V - 3V_0)$$

$$T = \frac{-P_0}{nRV_0}(V^2 - 3V_0V)$$

For temperature to be maximum at any point $\frac{dT}{dV} = 0$

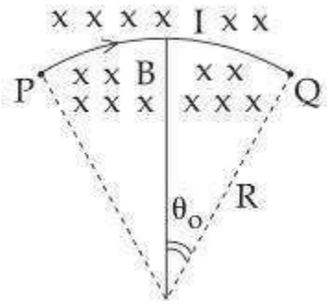
$$\Rightarrow \quad 2V - 3V_0 = 0$$

$$\therefore \quad V = \frac{3V_0}{2}$$

$$\therefore \quad T_{max} = \frac{-P_0}{nRV_0}\left(\frac{9}{4}V_0^2 - \frac{9}{2}V_0^2\right) = -\frac{P_0}{nRV_0}.\frac{-9}{4}V_0^2 = \frac{9}{4}\frac{P_0V_0}{nR}$$

Correct option is 1.

Q. 7 A wire carrying current I is tied between points P and Q and is in the shape of a circular arch of radius R due to a uniform magnetic eld B (perpendicular to the plane of the paper, shown by xxx) in the vicinity of the wire. If the wire subtends an angle at the centre of the circle (of which it forms an arch) then the tension in the wire is :



Option 1:
IBR

Option 2:
$\frac{IBR}{\sin\Theta_0}$

Option 3:
$\frac{IBR}{2\sin\Theta_0}$

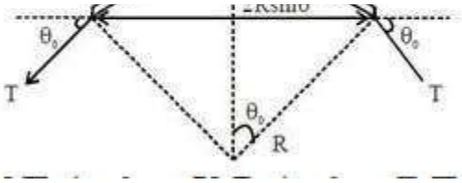
Option 4:
$\frac{IBR\,\Theta_0}{\sin\Theta_0}$

Correct Answer:
IBR

Solution:
As we learned in

Total magnetic force -

$\underset{F}{\rightarrow} = i(\underset{L}{\rightarrow} \times \underset{B}{\rightarrow})$



For the arc to be in equilibrium, $F = 2T\sin\theta_0$

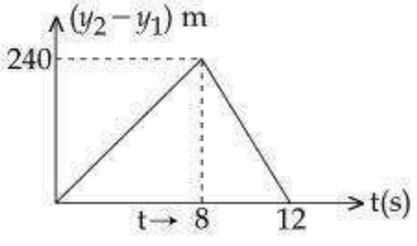
$\Rightarrow F = I(2R\sin\theta_0) \times B \therefore$

$2T\sin\theta_0 = I2R\sin\theta_0 \times B$

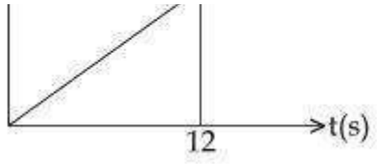
$\Rightarrow T = IRB$

Q. 8 Two stones are thrown up simultaneously from the edge of a cli 240 m high with initial speed of 10 m/s and 40 m/s respectively. Which of the following graph best represents the time variation of relative position of the second stone with respect to the rst? (Assume stones do not rebound after hitting the ground and neglect air resistance, take g=10 m/s2

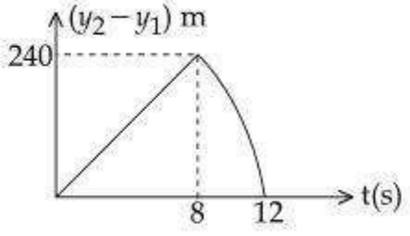
Option 1:



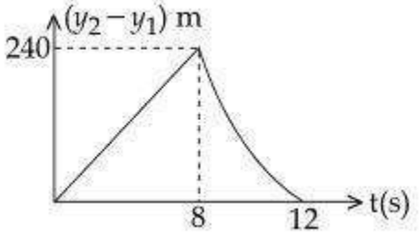
Option 2:



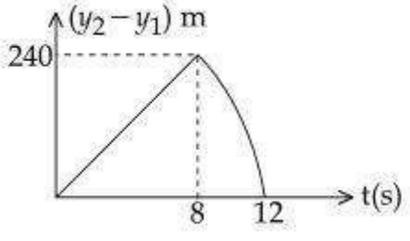
Option 3:



Option 4:



Correct Answer:



Solution:

As we discussed in

2nd equation or Position- time equation -

$\vec{\ }$ Displacement

$u \rightarrow$ Initial velocity

$a \rightarrow$ acceleration

$t \rightarrow$ time

For stone 1 - - - $y_1 = 10t - \frac{1}{2}gt^2$

For stone 2 - - - $y_2 = 40t - \frac{1}{2}gt^2$

$\Delta y = y_1 - y_2 = 40t - \frac{1}{2}gt^2 - 10t + \frac{1}{2}gt^2 = 30t$

$\Delta y = 30t$

After 8 second stone 1 reaches ground

$y_1 = -240m$

$\therefore \Delta y = y_2 - y_1$

$= 40t - \frac{1}{2}gt^2 + 240$

Therefore it will be a parabolic curve.

Correct option is 3.

Q.9

Given in the gure are two blocks A and B of weight 20 N and 100 N, respectively. These are being pressed against a wall by a force F as shown. If the coe cient of friction between the blocks is 0.1 and between block B and the wall is 0.15, the frictional force applied by the wall on block B is :

Option 1:
100 N

Option 2:
80 N

Option 3:
120 N

Option 4:
150 N

Correct Answer:
120 N

Solution:
Solution

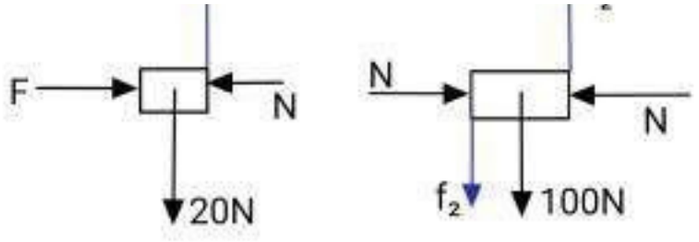
Given -

Weights of blocs A and B respectively are 20N and 100N.

As the blocks are at rest, both the block must be in equilibrium.

Let the Friction force between the blocks be f1 and between block B and wall be f2 .

F.B.D of the blocks-



From F.B.D-

$F = N$
$f_1 = 20$
$f_2 = f_1 + 100$
$\Rightarrow f_2 = 20 + 100 = 120N$

Q.10 From a solid sphere of mass M and radius R a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its center and perpendicular to one of its faces is :

Option 1:
$\frac{MR^2}{32\sqrt{2}\pi}$

Option 2:
$\frac{MR^2}{16\sqrt{2}\pi}$

Option 3:
$\frac{4MR^2}{9\sqrt{3}\pi}$

Option 4:
$\frac{4MR^2}{3\sqrt{3}\pi}$

Correct Answer:

Solution:

$$a = \frac{2}{\sqrt{3}}R$$

$$\frac{M}{M'} = \frac{\frac{4}{3}\pi R^3}{a^3} = \frac{\frac{4}{3}\pi R^3}{\left(\frac{2}{\sqrt{3}}R\right)^3} \Rightarrow \frac{M}{M'} = \frac{\frac{4}{3}\pi R^3}{\frac{8}{3\sqrt{3}}R^3} = \frac{4\pi}{3} \times \frac{3\sqrt{3}}{8}$$

$$\frac{M}{M'} = \frac{\sqrt{3}\pi}{2} \Rightarrow M' = \frac{2M}{\sqrt{3}\pi}$$

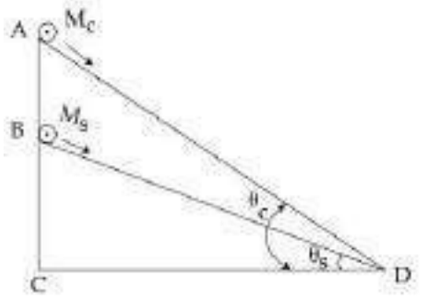
$\therefore$ M.O.I. of the cube about the given axis.

$$I = \frac{M'a^2}{6} = \frac{\frac{2M}{\sqrt{3}\pi} \times \left(\frac{2}{\sqrt{3}}R\right)^2}{6} = \frac{4MR^2}{9\sqrt{3}\pi}$$

Q. 11 A cylinder of mass Mc and sphere of mass Ms are placed at points A and B of two inclines, respectively.

(See Figure). If they roll on the incline without slipping such that their accelerations are the same, then

The ratio $\frac{\sin\Theta_c}{\sin\Theta_s}$ is



Option 1:

$\sqrt{\frac{8}{7}}$

Option 2:

$\sqrt{\frac{15}{14}}$

Option 3:

$\frac{8}{7}$

Option 4:

$\frac{15}{14}$

Correct Answer:

Solution:
Acceleration along inclined plane

$$a = \frac{g\sin\theta}{1+\frac{K^2}{R^2}}$$

For sphere

$$K^2 = 2/5R^2 \Rightarrow a_s = \frac{g\sin\theta_s}{1+2/5}$$

$$a_s = (5/7)g\sin\theta_s$$

For cylinder

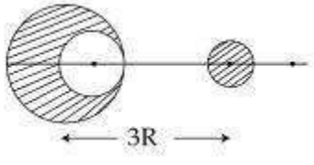
$$K^2 = 1/2R^2 \Rightarrow a_c = \frac{g\sin\theta_c}{1+1/2}$$

$$a_c = 2/3g\sin\theta_c$$

$$a_s = a_c \Rightarrow 5/7(g\sin\theta_s) = 2/3(g\sin\theta_c)$$

$$\frac{\sin\theta_c}{\sin\theta_s} = 15/14$$

Q. 12 From a sphere of mass M and radius R, a smaller sphere of radius $\frac{R}{2}$ is carved out such that the cavity made in the original sphere is between its centre and the periphery. (See gure). For the con guration in the gure where the distance between the centre of the original sphere and the removed sphere is 3R, the gravitational force between the two spheres is :



Option 1:

Option 2:

$\frac{41GM^2}{450R^2}$

Option 3:

$\frac{59GM^2}{450R^2}$

Option 4:

$\frac{GM^2}{225R^2}$

Correct Answer:

$\frac{41GM^2}{3600R^2}$

Solution:

As we discussed in

Newton's Law of Gravitation -

$$F \alpha \frac{m_1 m_2}{r^2}$$

$$F = \frac{G m_1 m_2}{r^2}$$

$F \rightarrow$ Force

$g \rightarrow$ Gravitalional constant

$m_1, m_2 \rightarrow$ Masses

$r \rightarrow$ Distance between masses

- wherein

Force is along the line joining the two masses

Volume of removed sphere

$V_{removed} = \frac{4}{3}\pi(\frac{R}{2})^3 = \frac{4}{3}\pi R^3(\frac{1}{8})$

Volume of the sphere (remaining)

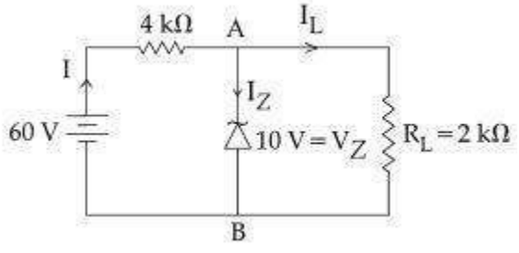
$V_{remain} = \frac{4}{3}\pi R^3 - \frac{4}{3}\pi R^3(\frac{1}{8}) = \frac{4}{3}\pi R^3(\frac{7}{8})$

Therefore the mass of removed sphere and remaining sphere are at respectively $\frac{1}{8}M$ and $\frac{7}{8}M$

$$F_{net} = \frac{GM\frac{M}{8}}{9R^2} - \frac{G\frac{M}{8} \times \frac{1}{8}M}{(\frac{25}{4}R)^2} = \frac{41}{3600}\frac{GM^2}{R^2}$$

Q. 13 A Zener diode is connected to a battery and a load as shown below :

The currents I, IZ and IL are respectively



Option 1:
5 mA, 5 mA, 10 mA

Option 2:
15 mA, 7.5 mA, 7.5 mA

Option 3:
12.5 mA, 5 mA, 7.5 mA

Option 4:
12.5 mA, 7.5 mA, 5 mA

Correct Answer:
12.5 mA, 7.5 mA, 5 mA

Solution:
In the given gure

Voltage across RL= 2K ω is same as that across zener dioxide i.e 10V

$$\therefore I_L = \frac{V_Z}{R_L} = \frac{10V}{2X10^3} = 5mA$$

Total applied potential = 60 V

$\therefore$ Potential di erence across 4K ω will be 50 V

Current through 4Kω = $\frac{50V}{4 \times 10^3 \Omega}$

$$I = 12.5mA$$

$\therefore$ Current through diode

$$I_Z = I - I_L = 12.5mA - 5mA = 7.5mA$$

Q. 14 The electric eld in a region of space is given by, $\vec{E} = E_0\,\hat{i} + 2E_0\,\hat{j}$ where E0=100 N/C. The ux of this eld through a circular surface of radius 0.02 m parallel to the Y-Z plane is nearly :

Option 1:
0.125 Nm2/C

Option 2:
0.02 Nm2/C

Option 3:
0.005 Nm2/C

Option 4:
3.14 Nm2/C

Correct Answer:
0.125 Nm2/C

Solution:

$\underset{E}{\rightarrow} = E_0\hat{i} + 2E_0\hat{J}$

$E_0 = 100W/C$

$\vec{E} = 100\hat{i} + 200\hat{J}$

$A = \pi r^2 = \frac{22}{7} \times 0.02 \times 0.02$

$A = 1.25 \times 10^{-3}\hat{i}m^2$

$\therefore$ New ux $\therefore \phi = EAcos\theta$

$\phi = (100\hat{i} + 200\hat{J}).1.25 \times 10^{-3}\hat{i}cos\theta$

where $\theta = 0$

$\phi = 1.25 \times 10^{-1}Nm^2/c$

$= 0.125Nm^2/C$

Q. 15 A ray of light is incident from a denser to a rarer medium. The critical angle for total internal re ection is Θ_{iC} and the Brewster's angle of incidence is Θ_{iB}, such that $\sin\Theta_{iC}/\sin\Theta_{iB} = \eta = 1.28$. The relative refractive index of the two media is :

Option 1:
0.2

Option 2:
0.4

Option 3:
0.8

Option 4:
0.9

Correct Answer:
0.8

Solution:

$$\sin\theta_{ic} = \frac{\mu_r}{\mu_d}$$

μ_r = refractive index of the rarer medium.

μ_d = refractive index of the rarer medium.

In the case of Brewster's angle

$$r = 90 - \theta_{iB}$$

From Brew's law: $\mu_d . \sin\theta_{iB} = \mu_r . \sin r$

$$\frac{\sin\theta_{iB}}{\cos\theta_{iB}} = \frac{\mu_r}{\mu_d} \text{ or } \tan\theta_{iB} = \frac{\mu_r}{\mu_d}$$

$$\sin\theta_{iB} = \frac{\mu_r}{\sqrt{\mu_r^2 + \mu_d^2}} ....(2)$$

$$\because \frac{\sin\theta_{ic}}{\sin\theta_{iB}} = 1.28$$

$$\mu_1^2 + \mu_d^2 = 1.638\mu_d^2$$

$$or \;\; 0.638\mu d^2 = \mu_r^2$$

$$\frac{\mu_r}{\mu_d} = \sqrt{0.638} = 0.8$$

Q. 16 A circular loop of radius 0.3 cm lies parallel to a much bigger circular loop of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A ows through the smaller loop, then the ux linked with bigger loop is:

Option 1:
6.610-9 weber

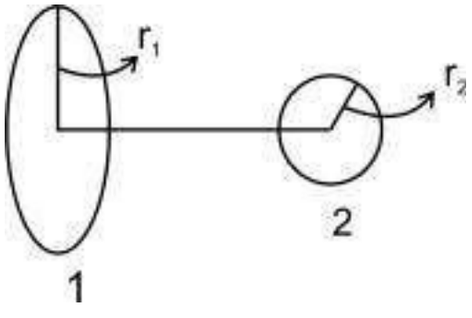
Option 2:
9.110-11 weber

Option 3:
610-11 weber

Option 4:
3.310-11 weber

Correct Answer:
9.110-11 weber

Solution:



$$M_{12} = M_{21}$$

Here we will calculate ux through smaller loop due to bigger loop

$$B_{21} = \frac{\mu_0 I_1 r_1^2}{2(r_1^2 + x^2)^{3/2}}$$

But $\phi_{21} = M_{21} I_1$

$$\frac{\mu_0 \pi r_1^2 r_2^2}{2(x^2 + r_1^2)^{3/2}} = M_{12}$$

$$\phi_{12} = M_{12} I_2 = 4.55 \times 10^{-11} \times 2 = 9.1 \times 10^{-11} Wb$$

Q. 17 A projectile is given an initial velociy of $\left(\hat{i} + 2\hat{j}\right) m/s$, where $\hat{i}$ is along the ground and $\hat{j}$ is along the vertical. If g = 10m/s2 , the equation of its trajectory is :

Option 1:
$4y = 2x - 25x^2$

Option 2:
$y = x - 5x^2$

Option 3:
$y = 2x - 5x^2$

Option 4:
$4y = 2x - 5x^2$

Correct Answer:
$y = 2x - 5x^2$

Solution:
By 2nd equation or Position- time equation -

$$s = ut + \frac{1}{2}at^2$$

Displacement

Initial velocity

$a \rightarrow$ acceleration

$t \rightarrow$ time

From question $\vec{v} = \hat{i} + 2\hat{j}$

$x = t - (i)$

$y = 2t - \frac{1}{2}(10t2) - (ii)$

$\therefore$ from equations (I) and (II)

$y = 2x - 5x^2$

Q. 18 Dimensions of $\frac{1}{\mu_0 \varepsilon_0}$, where symbols have their usual meaning, are

Option 1:
$[L^{-1}T]$

Option 2:
$[L^{-2}T^2]$

Option 3:
$[L^2T^{-2}]$

Option 4:
$[LT^{-1}]$

Correct Answer:
$[L^2T^{-2}]$

Solution:
The permittivity of free space -

and,

The dimension of permeability of free space (μ_o)- $M^1L^1T^{-2}A^{-2}$

So,

The dimension of the required quantity is : L^2T^{-2}

Q. 19 Energy required to move a body of mass *m* from an orbit of radius 2R to 3R is

Option 1:
$GMm/12R^2$

Option 2:
$GMm/3R^2$

Option 3:
$GMm/8R$

Option 4:
$GMm/6R$

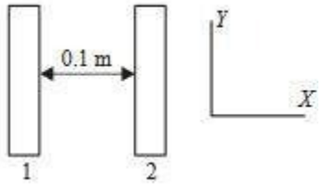
Correct Answer:
$GMm/6R$

Solution:

E = $(P.E)_{3R} - (P.E)_{2R}$

$$= -\frac{GmM}{3R} - \left(-\frac{GmM}{2R}\right) = +\frac{GmM}{6R}$$

Q. 20 Two insulating plates are both uniformaly charged in such a way that the potential di erence between them is (i.e. plate 2 is at a higher potential) The plates are separated by and can be treated as in nitely large. An electron is released from rest on the inner surface of plate 1 . What is its speed when it hits plate 2 ?



$(e = 1.6 \times 10^{-19} C, m_e = 9.11 \times 10^{-31} kg)$

Option 1:
Option 1:
$32 \times 10^{-19} m/s$

Option 2:
Option 2:
$2.65 \times 10^{6} m/s$

Option 3:
Option 3:
$7.02 \times 10^{12} m/s$

Option 4:
Option 4:
$1.87 \times 10^{6} m/s$

Correct Answer:
Correct Answer:
$2.65 \times 10^{6} m/s$

Solution:
An electron on plate 1 has electrostatic potentia energy. When it moves, potential energy is converted into kinetic energy

$$\therefore \quad Kinetic\ energy = Electrostatic\ potential\ energy$$

$$or \quad \frac{1}{2}mv^2 = e\Delta V$$

$$or \quad v = \sqrt{\frac{2e \times \Delta V}{m}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 20}{9.11 \times 10^{-31}}}$$

The correct answer is 2.

Q. 21 When the current changes from +2 A to –2 A in 0.05 second, an e.m.f. of 8 V is induced in a coil. The coe cient of self induction of the coil is

Option 1:
0.2 H

Option 2:
0.4 H

Option 3:
0.8 H

Option 4:
0.1 H

Correct Answer:
0.1 H

Solution:

$$L = \frac{-\varepsilon}{\Delta I/\Delta t} = \frac{-8 \times 0.05}{-4} = 0.1H$$

Q. 22 The resistance R of a wire is given by relation $R = \rho l/\pi r^2$. Percentage error in the measurement of ρ, l and r is 1%, 2% and 3% respectively. Then the percentage error in the measurement of R is

Option 1:
6%

Option 2:
9%

Option 3:
8%

Option 4:
10%

Correct Answer:
9%

Solution:
As we learnt in

Percentage error in the value of x -

$$x = \frac{(\Delta a + \Delta b)}{a + b} \times 100\%$$

- wherein

Δa = absolute error in measurement of a

Δb = absolute error in measurement of b

Δx = absolute error in measurement of x

$$R = \frac{\rho l}{\pi r^2}$$

$$\frac{\Delta R}{R} \times 100 = \left(\frac{\Delta \rho}{\rho} + \frac{\Delta l}{l} + \frac{2\Delta r}{r} \right) \times 100$$

$$= (1 + 2 + 2 \times 3) \times 100$$

Q. 23 A 140 gm baseball with a velocity of 25.0 m/s is hit by a baseball bat and leaves at 30.0 m/s in the opposite direction. If the ball was in contact with the bat for 12.0 ms, what is the average force on the ball?

Option 1:
750 N

Option 2:
642 N

Option 3:
550 N

Option 4:
482 N

Correct Answer:
642 N

Solution:
Perfectly Elastic Collision -

Law of conservation of momentum and that of Kinetic Energy hold good.

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

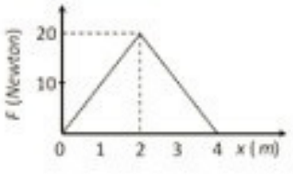
$$m_1, m_2 : masses$$

$$u_1, v_1 : initial\ and\ final\ velocity\ of\ the\ mass\ m_1$$

$$u_2, v_2 : initial\ and\ final\ velocity\ of\ the\ mass\ m_2$$

$$\vec{F} = \frac{140 \times 10 \quad \times 55}{12 \times 10^{-3}} = \frac{140 \times 55}{12} = 641.6 = 642N$$

Q. 24 The graph between the resistive force F acting on a body and the distance covered by the body is shown is shown in the gure. The mass of the body is 60 kg and the initial velocity is 3m/s. When the distance covered by the body is 4m, its kinetic energy will be



Option 1:
250 J

Option 2:
230 J

Option 3:
200 J

Option 4:
220 J

Correct Answer:
230 J

Solution: As we learnt in

Kinetic energy -

$$k = \frac{1}{2}mv^2$$

- wherein

$v \rightarrow velocity$

kinetic Energy is never negative

$$K = \frac{1}{2}mV^2 = \frac{1}{2} \times 60 \times 3^2 = \frac{1}{2} \times 60 \times 9$$

$$K = \frac{540}{2} = 270J$$

Work done against resistance force = Area between F-x graph $= \frac{1}{2} \times 4 \times 20 = 40J$

$\therefore$ Final K.E. = 270 - 40 = 230 J

Q. 25 Two simple pendulums of length 5 m and 20 m respectively are given small linear displacement in one direction at the same time. They will again be in the phase when the pendulum of shorter length has completed how many oscillations

Option 1:
5

Option 2:
2

Option 3:
1

Option 4:
3

Correct Answer:
2

Solution:

As we learnt in

Time period of oscillation of simple pendulum -

$$T = 2\pi\sqrt{\frac{l}{g}}$$

- wherein

l = length of pendulum

g = acceleration due to gravity.

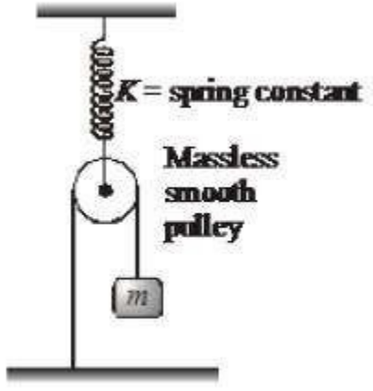
$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$N_S \times 2\pi\sqrt{\frac{5}{g}} = N_L \times 2\pi\sqrt{\frac{20}{g}}$$

$$\therefore N_S = 2N_L \quad where \;\; N_L = 1$$

$$\therefore N_S = 2$$

Q. 26 The angular frequency of small oscillations of the system shown in the gure is



Option 1:
√(K / 2m)

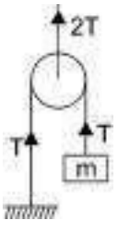
Option 2:
√(2K / m)

Option 3:
√(K / 4m)

Option 4:
√(4K / m)

Correct Answer:
√(K / 4m)

Solution:



$$k_{eq} = k\left|\frac{T_b}{T_s}\right|^2$$

$$k_{eq} = k(\frac{T}{2T})^2$$

$$k_{eq} = \frac{K}{4}$$

$$T = 2\pi\sqrt{\frac{4m}{k}}$$

$$w = \frac{2\pi}{T}$$

$$= \sqrt{\frac{k}{4m}}$$

Q. 27 If 10% of a radioactive material decays in 5 days, then the amount of the original material left after 20 days is approximately:

Option 1:
60%

Option 2:
65%

Option 3:
70%

Option 4:
75%

Correct Answer:
65%

Solution:
As we learnt in

Number of nuclei after disintegration -

$N = N_0 e^{-\lambda t}$ or $A = A_0 e^{-\lambda t}$

- wherein

Number of nucleor activity at a time is exponentional function

$Initially\ N_1 = 0.90 N_0 = N_0 . e^{-\lambda t_1}$

$t_1 = 5 days$

$\Rightarrow e^{-5\lambda} = 0.90 .....(1)$

$at\ t = t_2 = 20\ days$

$N = N_0 . e^{-20\lambda} = N_0 (e^{-5\lambda})^4$

$N = N_0 . (0.90)^4 = 0.65 N_0$

$\therefore$ 65% original matter will left after 20 days.

Q. 28 An ideal gas heat engine operates in a Carnot's cycle between and . It absorbs 6 × J at high temperature. The amount of heat converted into work is

Option 1:
4.8 x 10^4 J

Option 2:
2.4 x 10^4 J

Option 3:
1.6 x 10^4 J

Option 4:
1.2 x 10^4 J

Correct Answer:
1.2 x 10^4 J

Solution:

$$\eta(efficiency) = 1 - \frac{T_2}{T_1} = \frac{W}{Q_1}$$

$$\Rightarrow W = \left(1 - \frac{T_2}{T_1}\right).Q_1$$

$$= (1 - \frac{400}{500}) \times 6 \times 10^4 J$$

$$= \frac{1}{5} \times 6 \times 10^4 J = 1.2 \times 10^4 J$$

Correct option is 4.

Q. 29 If R = universal gas constant, the amount of heat needed to raise the temperature of 2 mole of an ideal monoatomic gas from 273K to 373K when no work is done

Option 1:
100R

Option 2:
200R

Option 3:
300R

Option 4:
150R

Correct Answer:
300R

Solution:
Change in internal energy

$$\Delta U = n\frac{f}{2}R\Delta T$$

(Always)

f is degree of freedom

So,

When no work is done.

$$Q = \Delta U = nC_v\Delta T$$

$$= 2 \times (\frac{3R}{2}) \times 100 = 300R$$

Q. 30 Water rises in a capillary tube to a certain height such that the upward force due to surface tension is balanced by 75 × 10-4 N, forces due to the weight of the liquid. If the surface tension of water is 6 × 10-2 N/m, the inner-circumference of the capillary must be

Option 1:

Option 2:
$0.50 \times 10^{-2} m$

Option 3:
$6.5 \times 10^{-2} m$

Option 4:
$12.5 \times 10^{-2} m$

Correct Answer:
$12.5 \times 10^{-2} m$

Solution:

Total upward force =circumference $\times sur\,face\,tension$

$$= circumference \times 6 \times 10^{-2}$$

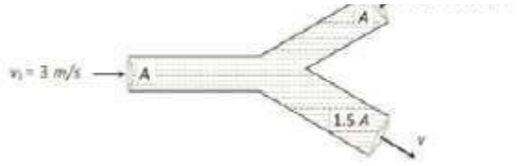
Total upward force = weight of the liquid

$$= circumference \times 6 \times 10^{-2} = 75 \times 10^{-4}$$

$$circumference = \frac{75 \times 10^{-4}}{6 \times 10^{-2}}$$

$$= 12.5 \times 10^{-2} m$$

Q. 31 An incompressible liquid ows through a horizontal tube as shown in the following g. Then the velocity v of the uid is



Option 1:
3.0 m/s

Option 2:
1.5 m/s

Option 3:
1.0 m/s

Option 4:
none of these

Correct Answer:
1.0 m/s

Solution:

$A_1V_1 = A_2V_2 \qquad A_1 = A_2 = A$

$AV_1 = AV_2 + 1.5AV$

$A \times 3 = A \times 1.5 + 1.5AV$

$\therefore V = 1\ ms^{-1}$

Q. 32 In Young's experiment, the wavelength of red light is 7.8×10^{-5} cm and that of blue light 5.2×10^{-5} cm. The value of n for which (n + 1) the blue bright band coincides with nth red band is:

Option 1:
4

Option 2:
3

Option 3:
2

Option 4:
1

Correct Answer:
2

Solution:

In YDSE

y_n =Distance of n^{th} maxima $= \frac{n\lambda D}{d}$

$\lambda_R = 7.8 * 10^{-5}\ cm$ (For red)

$y_{n,R} = \frac{n\lambda_R D}{d}$

$\lambda_b = 5.2 * 10^{-5}\ cm$ (For Blue)

$y_{n+1,b} = \frac{(n+1)\lambda_b . D}{d}$

As, these two coincide,

$$\frac{\lambda_R}{\lambda_b} = 1 + \frac{1}{n}$$

$$\frac{\lambda_R}{\lambda_b} = \frac{3}{2}$$

n=2

Q. 33 A simple pendulum has a time period T in vacuum. Its time period when it is completely immersed in a liquid of density one-eight of the density of the material of the bob is

Option 1:

$\sqrt{\frac{7}{8}}T$

Option 2:

$\sqrt{\frac{5}{8}}T$

Option 3:

$\sqrt{\frac{3}{8}}T$

Option 4:

$\sqrt{\frac{8}{7}}T$

Correct Answer:

$\sqrt{\frac{8}{7}}T$

Solution:

In vacuum,

Let V be the volume and P be the desity of the mass of the bob.

Net downward force acting on the bob inside the liquid

= weight - upthrust

$$= Vpg - V\frac{p}{8}g = \frac{7}{8}Vpg$$

So, time period of the bob inside the liquid

$$\therefore T_1 = 2\pi\sqrt{\frac{l}{\frac{7}{8}g}} = 2\pi\sqrt{\frac{l}{g}} \times \sqrt{\frac{8}{7}} = \sqrt{\frac{8}{7}}T$$

Q. 34 The ratio of densities of nitrogen and oxygen is 14:16. The temperature at which the speed of sound in nitrogen will be same at that in oxygen at $55°C$ is

Option 1:
$35°C$

Option 2:
$48°C$

Option 3:
$65°C$

Option 4:
$14°C$

Correct Answer:
$14°C$

Solution:

As we learnt

(since given the velocities are same)

$V \quad M \quad T_O \quad M_O$

$$\Rightarrow \frac{T_N}{273+55} = \frac{14}{16} = \frac{7}{8}$$

$$\Rightarrow T_N = 287K = 14^oC$$

Q. 35 Intensity level of a sound of intensity I is 30 dB. The ratio $\frac{I}{I_0}$ is (where I_0 is the threshold for hearing)

Option 1:
3000

Option 2:
1000

Option 3:
300

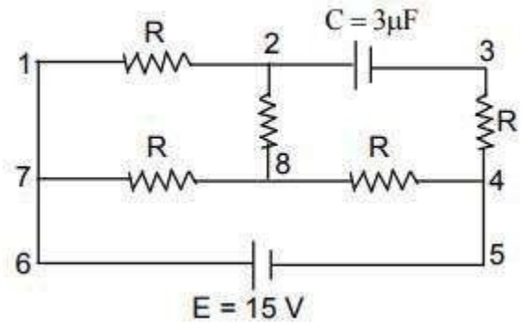
Option 4:
30

Correct Answer:
1000

Solution:

$$L = 10log_{10}\left[\frac{I}{I_o}\right] = 30 \Rightarrow \frac{I}{I_o} = 10^3$$

Q. 36 In the circuit shown, the battery is ideal, with emf E = 15 V and it sends a current I in the circuit. All resistors are identical and each resistor has resistance R = 3Ω. The potential di erence across the capacitor in steady state is Vc =



Option 1:
0V

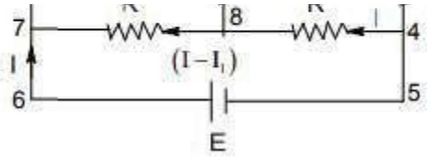
Option 2:
9V

Option 3:
12V

Option 4:
15V

Correct Answer:
12V

Solution:



In steady state, no current passes through the branch that contains a fully charged capacitor, because a fully charged capacitor is a dc blocking element. Hence the circuit becomes

$$\text{For Loop } 1284561$$
$$-2I_1R - IR + E = 0$$
$$\Rightarrow \quad 6I_1 + 3I = 15 \ldots (1)$$
$$\text{For Loop } 784567$$
$$-(I - I_1)R - IR + E = 0$$
$$-2IR + I_1R + E = 0$$
$$\Rightarrow \quad 3I_1 - 6I = -15$$
$$\Rightarrow \quad \frac{3I_1}{2} - 3I = \frac{15}{2} \ldots (2)$$

$$\text{Add } (1) \text{ and } (2), \text{ we get}$$
$$\left(\frac{3}{2} + 6\right) I_1 = 15 - \frac{15}{2}$$
$$\Rightarrow \quad \left(\frac{3+12}{2}\right) I_1 = \frac{30-15}{2}$$
$$\Rightarrow \quad 15I_1 = 15$$
$$\Rightarrow I_1 = 1A$$
$$\Rightarrow \quad 6 + 3I = 15$$
$$\Rightarrow 31 = 9$$
$$\Rightarrow I = 3\text{A}$$

$$\text{For Loop } 23482$$
$$V_C + I(3) + I_1(3) = 0$$
$$\Rightarrow \quad V_C = 9 + 3 = 12\text{V}$$

Q. 37 The $K \cdot E$ of the photoelectron is E when the incident wavelength is λ. To increse the $K \cdot E$ of the electron to 2E, the incident wavelength must be

Option 1:

Option 2:

$\frac{\lambda}{2}$

Option 3:

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

Option 4:

$\frac{hc\lambda}{Ec + h\lambda}$

Correct Answer:

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

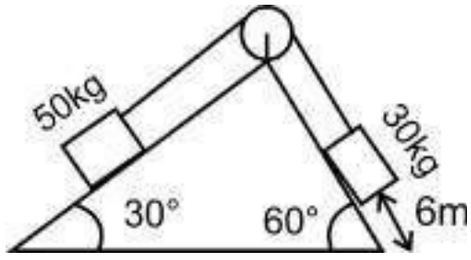
Solution:

$E = \frac{hc}{\lambda} - \phi_0$

similarly $\Rightarrow 2E = \frac{hc}{\lambda'} - \phi_0$

solving we get $\lambda' = \frac{hc\lambda}{E\lambda + hc}$

Q. 38 Two blocks of masses 50 Kg and 30 Kg connected by a massless string pass over a tight frictionless , pulley and rest on two smooth planes inclined at angles nad reaspectively with horizontal as shown in the gure .If the system is released from rest then nd time taken by 30 Kg block to reach the ground



Option 1:
20 sec

Option 2:
30 sec

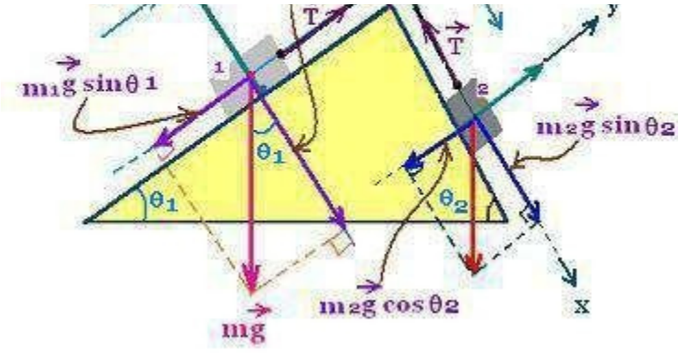
Option 3:
10 sec

Option 4:
50 sec

Correct Answer:
10 sec

Solution:
As we have learned

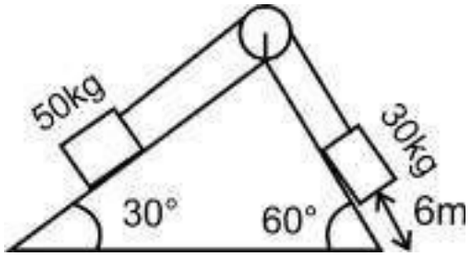
Double inclined plane with di erent angles -



- wherein

$$a = \frac{(m_2\ sin\theta_2 - m_1\ sin\theta_1)g}{m_1 + m_2}$$

$$T = \frac{m_1 m_2 (sin\theta_1 + sin\theta_2)\ g}{m_1 + m_2}$$



$$T - 50g\sin 30 = 50a....(1)$$
$$30g\sin 60 - T = 30a.....(2)$$

Adding (1) and (2)

$$a = \frac{30g\sin 60 - 50g\sin 30}{80} = 0.12m/s$$

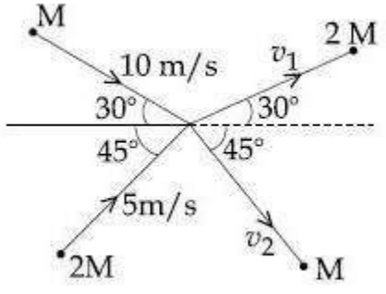
Now

$0 = 1/2 \times 0 + (1/2) * 0.12 \times t$

$$t^2 = \frac{6 \times 2}{0.12} = 100$$

$$t = 10sec$$

Q. 39 Two particles , of masses M and 2M , moving as shown , with speeds of 10 m/s and 5 m/s , collide elastically at the origin.After the collision , they move along the indicated directions with speeds V_1 and V_2, respectively. The values of V_1 and V_2 are approximately :



Option 1:
6.5 m/s and 6.3 m/s

Option 2:
3.2 m/s and 6.3 m/s

Option 3:
6.5 m/s and 3.2 m/s

Option 4:
3.2 m/s and 12.6 m/s

Correct Answer:
6.5 m/s and 6.3 m/s

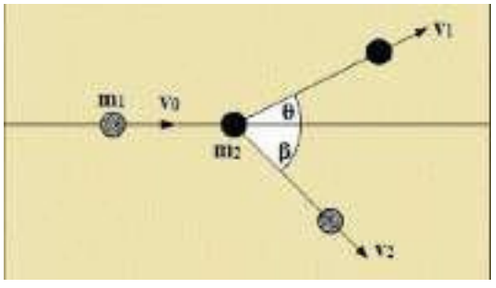
Solution:

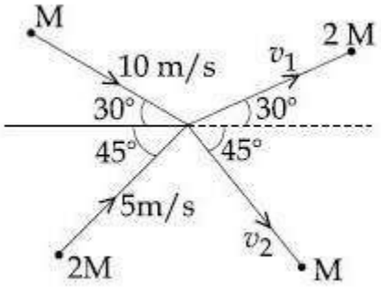
Elastic Collision in 2 dimension -

$$\vec{P}_i = \vec{P}_f$$

$$m_1 v_0 \hat{i} = (m_1 v_1 \cos\Theta + m_2 v_2 \cos\beta)\hat{i} + (m_1 v_1 \sin\Theta - m_2 v_2 \sin\beta)\hat{j}$$

- wherein





u_1 $\quad u_{1x} = 10 \times \dfrac{\sqrt{3}}{2}\hat{i}$

$\quad u_{1y} = 10 \times \dfrac{1}{2}\hat{j} = -5\hat{j}$ $\qquad M_1 = M$

u_2 $\quad u_{2x} = \dfrac{5}{\sqrt{2}}\hat{i}$

V_1 $\quad v_{1x} = v_1 \times \frac{\sqrt{3}}{2}\hat{i}$

$\quad v_{1y} = v_1 \times \frac{1}{2}\hat{j}$

V_2 $\quad v_{2x} = v_2 \times \frac{1}{\sqrt{2}}\hat{i}$

$\quad v_{2y} = \frac{v_2}{\sqrt{2}}(-\hat{j})$

$$\Delta P_x = 0 => m \times (\frac{10\sqrt{3}}{2}) + (2m \times \frac{5}{\sqrt{2}}) = 2m(\frac{\sqrt{3}}{2})v_1 + m(\frac{v_2}{\sqrt{2}})$$

$$=> 5\sqrt{3} + 5\sqrt{2} = \sqrt{3}v_1 + \frac{v_2}{\sqrt{2}} \text{.....(1)}$$

$$\Delta P_y = 0 => -m \times (5) + (2m \times \frac{5}{\sqrt{2}}) = 2m(\frac{v_1}{2}) - m(\frac{v_2}{\sqrt{2}})$$

$$=> 5\sqrt{2} - 5 = v_1 - \frac{v_2}{\sqrt{2}} \text{.....(2)}$$

On adding (1) and (2)

$$5(\sqrt{3} - 1) + 10\sqrt{2} = (\sqrt{3} + 1)v_1$$

$$=> v_1 = \frac{5(\sqrt{3} - 1 + 10\sqrt{2})}{\sqrt{3} + 1} \approx 6.5\ m/s$$

$$=> v_2 \approx 6.3\ m/s$$

Q. 40

Consider a solid sphere of Radius R and mass density ρ_0. The minimum density of a liquid in which it will oat is :

Option 1:
$\frac{2\rho_0}{5}$

Option 2:
$\frac{\rho_0}{5}$

Option 3:
$\frac{2\rho_0}{3}$

Option 4:
$\frac{\rho_0}{3}$

Correct Answer:
$\frac{2\rho_0}{5}$

Solution:

As
Buoyant force-

- The buoyant force is given as

Where FB=Buoyant force

ρ= density of the uid

V= Volume of the solid body immersed in the liquid or Volume of the uid displaced

So

Applying force balance

$$\rho_l \times \frac{4}{3}\pi R^3 = \rho_o(4\pi)\int r^2\left(1-\frac{r^2}{R^2}\right)dr$$

$$\Rightarrow \rho_l \times \frac{4}{3}\pi R^3 = \rho_o(4\pi)\left[\frac{r^3}{3}-\frac{r^5}{5R^2}\right]_0^R$$

$$\Rightarrow \rho_l \times \frac{4}{3}\pi R^3 = \rho_o(4\pi)\left[\frac{R^3}{3}-\frac{R^3}{5}\right]$$

$$\Rightarrow \rho_l \times \frac{4}{3}\pi R^3 = \rho_o(4\pi)\left[\frac{2R^3}{15}\right]$$

$$\Rightarrow \rho_l = \frac{2}{5}\rho_o$$

So the correct option is 1.

Q. 41 Read the following passage and answer the question that follows: History cannot be altered and its myriad paths would follow their own destined course. However, it would not be entirely futile to indulge our imagination in picturing the course of history if such and such an event had not taken place. One such occurrence is the British colonization of India. The British colonized India gradually and established their rule over the country for more than a century. If the British colonization had not happened at all, where would we be today?

To begin with, we would not have suffered all that we did under the British in the process of winning freedom from them. Today, India's history bears the scars of British colonialism and exploitation that the memory finds hard to erase. The country was forced to undergo humiliation in terms of its pride besides suffering political, economic and social exploitation. In colonized India, the people were stripped of their rights in every sense. They could not participate in the political and economic development of their own country. They were denied the right to form their own government and run the administration of their country. The country's primary institutions including those related to judiciary, defense and law were run by outsiders who did not care about the welfare of the nation and its people. The people's attempt to win their rights only brought about suffering and death. It was not only loss of wealth and prosperity that the masses had to endure; thousands of people lost their lives in the fight for freedom from the British yoke. The country's nationalist leaders paid a heavy price in their attempt to secure freedom for India. All this would not have happened if the British had not come to reign in India.

Which of the following is inferable?

Option 1:
The British were dogmatic

Option 2:
The British carried out certain atrocities on Indians

Option 3:
The British deprived Indians of their right to speak

Option 4:
Nothing can be inferred

Option 5:
The struggle for freedom also led to death of people

Correct Answer:
The British were dogmatic

Solution:
Only being dogmatic of the British finds a basis in the passage. Their dogmatic nature manifested in their atrocious behaviour.

Q. 42 Read the following passage and answer the question that follows: History cannot be altered and its myriad paths would follow their own destined course. However, it would not be entirely futile to indulge our
imagination in picturing the course of history if such and such an event had not taken place. One such occurrence is the British colonization of India. The British colonized India gradually and established their rule over the country for more than a century. If the British colonization had not happened at all, where would we be today?
To begin with, we would not have suffered all that we did under the British in the process of winning freedom from them. Today, India's history bears the scars of British colonialism and exploitation that the memory finds hard to erase. The country was forced to undergo humiliation in terms of its pride besides suffering political, economic and social exploitation. In colonized India, the people were stripped of their rights in every sense. They could not participate in the political and economic development of their own country. They were denied the right to form their own government and run the administration of their country. The country's primary institutions including those related to judiciary, defense and law were run by outsiders who did not care about the welfare of the nation and its people. The people's attempt to win their rights only brought about suffering and death. It was not only loss of wealth and prosperity that the masses had to endure; thousands of people lost their lives in the fight for freedom from the British yoke. The country's nationalist leaders paid a heavy price in their attempt to secure freedom for India. All this would not have happened if the British had not come to reign in India.

Which of the following is synonymous to prosperity?

Option 1:
Indignity

Option 2:
Resources

Option 3:
Affluence

Option 4:
Growth

Option 5:
Penury

Correct Answer:
Affluence

Solution:
Here, the word is related to the richness of Indians.

Q. 43 Read the following passage and answer the question that follows: History cannot be altered and its myriad paths would follow their own destined course. However, it would not be entirely futile to indulge our imagination in picturing the course of history if such and such an event had not taken place. One such occurrence is the British colonization of India. The British colonized India gradually and established their rule over the country for more than a century. If the British colonization had not happened at all, where would we be today?

To begin with, we would not have suffered all that we did under the British in the process of winning freedom from them. Today, India's history bears the scars of British colonialism and exploitation that the memory finds hard to erase. The country was forced to undergo humiliation in terms of its pride besides suffering political, economic and social exploitation. In colonized India, the people were stripped of their rights in every sense. They could not participate in the political and economic development of their own country. They were denied the right to form their own government and run the administration of their country. The country's primary institutions including those related to judiciary, defense and law were run by outsiders who did not care about the welfare of the nation and its people. The people's attempt to win their rights only brought about suffering and death. It was not only loss of wealth and prosperity that the masses had to endure; thousands of people lost their lives in the fight for freedom from the British yoke. The country's nationalist leaders paid a heavy price in their attempt to secure freedom for India. All this would not have happened if the British had not come to reign in India.

Which of the following is true in accordance with the passage?

Option 1:
None of these

Option 2:
The British were hasty to kill Indians

Option 3:
Indian people were resilient

Option 4:
The British envisaged Indians as poor

Option 5:
The British only plundered India
Correct Answer:
Indian people were resilient
Correct Answer:

Solution:
Read the line: “thousands of people lost their lives in the fight for freedom from the British yoke”. Thus, it is clear that Indians were resilient.

Q. 44 Read the following passage and answer the question that follows History cannot be altered and its myriad paths would follow their own destined course. However, it would not be entirely futile to indulge our
imagination in picturing the course of history if such and such an event had not taken place. One such occurrence is the British colonization of India. The British colonized India gradually and established their rule over the country for more than a century. If the British colonization had not happened at all, where would we be today?
To begin with, we would not have suffered all that we did under the British in the process of winning freedom from them. Today, India’s history bears the scars of British colonialism and exploitation that the memory finds hard to erase. The country was forced to undergo humiliation in terms of its pride besides suffering political, economic and social exploitation. In colonized India, the people were stripped of their rights in every sense. They could not participate in the political and economic development of their own country. They were denied the right to form their own government and run the administration of their country. The country’s primary institutions including those related to judiciary, defense and law were run by outsiders who did not care about the welfare of the nation and its people. The people’s attempt to win their rights only brought about suffering and death. It was not only loss of wealth and prosperity that the masses had to endure; thousands of people lost their lives in the fight for freedom from the British yoke. The country’s nationalist leaders paid a heavy price in their attempt to secure freedom for India. All this would not have happened if the British had not come to reign in India.

Which of the following is true?

Option 1:
The British were imperialistic in nature
Option 2:
None of these
Option 3:
The British buttressed the Indians

Option 4:
The British did not want Indians to be educated
Option 5:
The Indians never mutinied
Option 5:
Correct Answer:
The British were imperialistic in nature
Correct Answer:

Solution:
Refer to: “In colonized India, the people were stripped of their rights in every sense. They could not participate in the political and economic development of their own country”. This is done by imperialistic powers

Chemistry

Q. 1 For the estimation of nitrogen, 1.4 g of an organic compound was digested by Kjeldahl method and the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 mL of $\frac{M}{10}$ sodium hydroxide for complete neutralization. The percentage of nitrogen in the compound is :

Option 1:
Option 1:
6%

Option 2:
Option 2:
10%

Option 3:
Option 3:
3%

Option 4:
Option 4:
5%

Correct Answer:
Correct Answer:
10%

Solution:
We know,

% N =

milliequivalents of acid consumed = $60 \times \frac{}{10} \times 2 - 20 \times \frac{}{10} \times 1$

=10

% N= $\frac{1.4 \times 10}{1.4}$= 10 %

Hence, the option number (2) is correct.

Q.2 The reason for double helical structure of DNA is the operation of :

Option 1:
Electrostatic attractions

Option 2:
van der Waals forces

Option 3:
Dipole - Dipole interactions

Option 4:
Hydrogen bonding

Correct Answer:
Correct Answer:
Hydrogen bonding

Solution:
As learnt in
The double-helical structure of DNA is the operation of hydrogen bonding.

Hence, the option number (4) is correct.

Q.3 An aqueous solution of potash alum gives

Option 1:
Two types of ions

Option 2:
Only one type of ion

Option 3:
Four types of ions

Option 4:
Three types of ions

Correct Answer:
Three types of ions

Solution:
As we have learned

Double Salt -

Dissociates into simple ions completely when dissolved in water

- wherein

eg:

$$KCl \cdot MgCl_2.6H_2O$$

$$KCl \cdot MgCl_2.6H_2O \rightarrow K^+Cl^-, Mg^{2+}$$

Potash alum is a mixed salt of K_2SO_4 and $Al_2(SO_4)_3$ and on dissolving, it gives all three ion and Al^{3+}, K^+, SO_4^{2-} of which it is made.

Therefore, **option (4) is correct.**

Q.4 The coordination number of a metal in coordination compounds is

Option 1:
Same as primary valency

Option 2:
Sum of primary and secondary valencies

Option 3:
Same as secondary valency

Option 4:
None of these

Correct Answer:
Same as secondary valency

Solution:
As we have learned

Coordination number -

No. of ligands which are bounded directly to metal

- wherein

eg: $[Ni\ (NH_3)_4]^{2+}$

Coordination No. $(CN) = 4$

eg: $[Co\ (en)_3]^{3+}$

Coordination No. $(CN) = 6$

en is bidentate

According to modern view, primary valency of complex compound is its oxidation number while secondary valency is the co-ordination number.

Therefore, option (3) is correct.

Q. 5 Which complex has square planar structure?

Option 1:
$Ni(CO)_4$

Option 2:
$[NiCl_4]^{2-}$

Option 3:
$[Ni(H_2O)_6]^{2+}$

Option 4:
$[Cu(NH_3)_4]^{2+}$

Correct Answer:
$[Cu(NH_3)_4]^{2+}$

Solution:
As we have learned

Coordination Sphere -

The central atom/ion and the ligands attached to metal are enclosed in square bracket and this collectively termed as coordination sphere

- wherein

eg:

$K_4\left[Fe\left(CN\right)_6\right]$

Counter ion

Coordination sphere

$[Cu(NH_3)_4]^{2+}$ is *dsp*2 hybridised and thus has square planer structure.

Therefore, Option(4) is correct

Q. 6 Apart from +3 oxidation state, other stable oxidation states shared by *f*-block elements is/are:

Option 1:
+2 only

Option 2:
+2 and +4

Option 3:
+4 only

Option 4:
none of these

Correct Answer:
+2 and +4

Solution:
As we have learned

Valence characteristics of f- block elements -

– They are all metals.

– They show variable valency.The +3 is the most important oxidation state.Few elements show +2 and +4 oxidation states.

-

+2 and +4 oxidation state are also shown by *f*-block elements.

Therefore, **Option(2) is correct.**

Q. 7 The reason for good thermal conductance of metal is:

Option 1:
Transport of energy

Option 2:
Free electron and frequent collision of atoms

Option 3:
Lattice defects

Option 4:
Capacity to absorb energy

Correct Answer:
Free electron and frequent collision of atoms

Solution:
As we have learned

Thermal conductivity of metals -

On heating a part of the metal, the kinetic energy of the electron in that region increase. The energised electron moves rapidly to the cooler part and gives their excess kinetic energy to other electrons in the cooler part of the metal.Thus heat is conducted through metal.
-

For good conductors, there must be free electrons present in the metal.

Therefore, **Option(2) is correct.**

Q. 8 The metallic lustre of potassium is explained by:

Option 1:
Di usion of K^+ ions

Option 2:
Oscillation of mobile free electrons

Option 3:
Existence of body centred cubic lattice

Option 4:
Existence of free protons

Correct Answer:
Oscillation of mobile free electrons

Solution:
As we have learned

Metallic Lustre -

It is due to delocalised mobile electrons.The loosely bound electron absorbs energy from light and starts vibrating at a frequency equal to that of incident light.The vibrating electron emits EM wave and it gives shining appearance known as metallic lustre.
-

When light falls on potassium, the free electrons starts oscillating at their mean position and gets excited to higher energy level. These electrons come back to the ground state by emitting light which spread in all directions.
Therefore, **Option(2) is correct.**

Q. 9 The electronic con gurations of four elements are given below: Arrange these elements in the correct order of the magnitude (without signs) of their electron gain enthalpy?

1)2s22sp5
2)3s23p5
3)2s22p4
4)3s23p4

Option 1:
1<2<3<4

Option 2:
2<1<4<3

Option 3:
1<3<4<2

Option 4:
3<4<1<2

Correct Answer:
3<4<1<2

Solution:
Elements with half or full- lled orbitals are more stable. Energy is required to add an electron since they do not accept electron easily.

Electronic con guration 1,2, 3 & 4 represents F, Cl ,O & S

Left to right in a period then $\Delta_{eg}H$ becomes more negative

Top to bottom in a group then $\Delta_{eg}H$ becomes less negative

Correct order is: O < S < F < Cl

So, order is 3 < 4 < 1 < 2

Hence, option number (4) is correct.

Q. 10 In which of the following thermodynamical process, temperature remains constant?

Option 1:
Isochoric

Option 2:
Isobaric

Option 3:
Isothermal

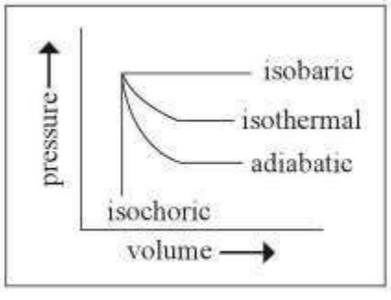
Option 4:
Adiabatic

Correct Answer:
Isothermal

Solution:
As we have learnt,

Types of Thermodynamic Process

Processes are of the following types



1. Isothermal Process

Here the temperature is kept constant during each step of the process. Example,

- It is achieved by using a thermostatic control.
- Heat can be absorbed or evolved here that is, can be exchanged with the surroundings. Example, Freezing, melting, evaporation, condensation.

2. Isobaric Process

Here the pressure is kept constant $(\Delta P = 0)$ during each step of the process.

Example, Expansion of gas in an open system.

- Vaporization and heating of water up to its boiling point occurs at the same atmospheric pressure.

3. Isochoric Process

Here volume is kept constant. $(\Delta V = 0)$ during each step of the process.

Example, Heating of substance in a closed vessel (system) or non-expanding chamber.

4. Adiabatic Process

- Here no exchange of heat takes place between the system and the surroundings that is, $(\Delta Q = 0)$
- It is achieved by insulating the system or in closed insulated containers (thermos).

5. Cyclic Process

- Here the System undergoes a series of changes but nally comes back to the initial state.
- $\Delta E = 0, \Delta H = 0$

-

In the isothermal process, T=constant

Hence, the option number (3) is correct.

Q. 11 Work done for the reversible expansion of one mole of an ideal gas from volume of 10 litres to 20 litres at 25^0C (in Joule) is:

Option 1:
$2.303 \times 298 \times 0.082 \log 2$

Option 2:
$-298 \times 8.31 \times 2.303 \log 2$

Option 3:
$-2.303 \times 298 \times 0.082 \log 0.5$

Option 4:
$2.303 \times 298 \times 8.31 \log 0.5$

Correct Answer:
$-298 \times 8.31 \times 2.303 \log 2$

Solution:

$$W = -nRT \ln \frac{V_f}{V_i}$$

$$W = -2.303 \times 1 \times 8.314 \times \log\left(\frac{20}{10}\right) \times 298$$

$$W = -298 \times 8.314 \times 2.303 \times \log(2)$$

Therefore, **Option(2) is correct**

Q. 12 Products formed in the following option is (are):

$$2M_2O_2 + 2H_2O \rightarrow$$

[M $\rightarrow$ alkali metal]

Option 1:
MO2

Option 2:
MOH

Option 3:
O2

Option 4:
Only b and c

Correct Answer:
Only b and c

Solution:
As we learned,

The reaction of peroxides -

Reacts with water to give O_2

- wherein

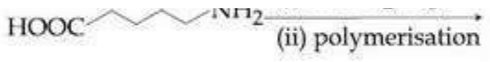
$$2Na_2O_2 + 2H_2O \rightarrow 4NaOH + O_2$$

Metal peroxide M2O2 :

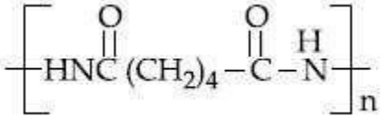
2M2O2 + 2H2O → 4MOH + O2

Therefore, **option(4) is correct.**

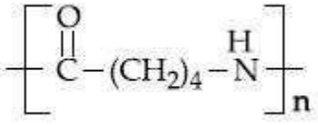
Q. 13 The polymer obtained from the following reactions is :



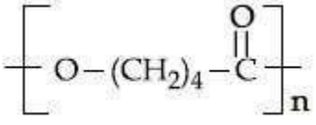
Option 1:



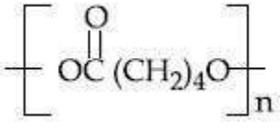
Option 2:



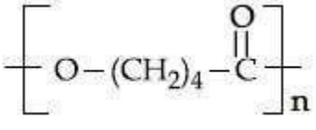
Option 3:



Option 4:



Correct Answer:



Solution:

Reaction with Nitrous Acid Primary Amines -

Primary amines react with nitrous acid to produce diazonium ion.

- wherein

$$R-NH_2+HNO_2\rightarrow R-N^{\oplus}\equiv N$$

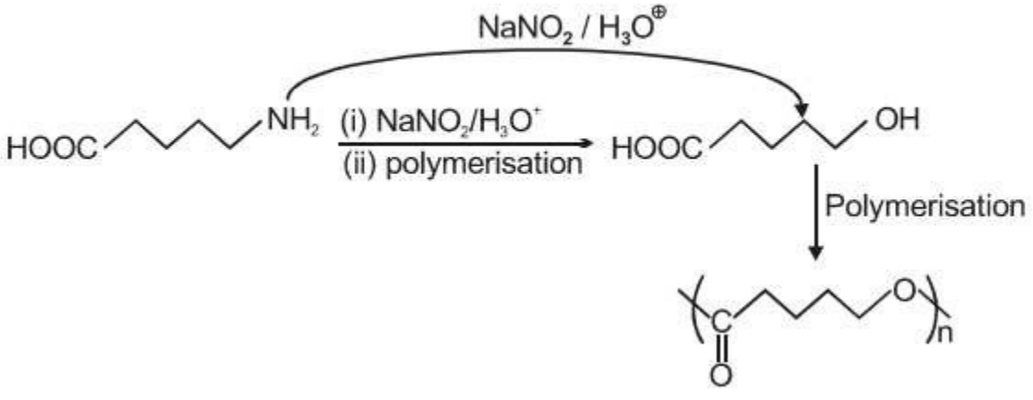
$$ArNH_2+HNO_2\rightarrow Ar-N^{\oplus}\equiv N:$$

as we know that

Fate of aliphatic diazonium ion -

The diazonium ions of aliphatic amines are very unstable and produces carbocation immediately, which can produce di erent products.

-



Hence, the option number (3) is correct.

Q. 14 The temporary hardness of water is due to:

Option 1:
Na2SO4

Option 2:
Ca(HCO3)2

Option 3:
NaCl

Option 4:
CaCl2

Correct Answer:
Ca(HCO3)2

Solution: Hard Water - It contains calcium and Magnesium salt in the form of hydrogen carbonate , chloride

and sulphate - wherein Hard water does not give Lathers with soap. Temporary Hardness - It is

due to the presence of CaCO3, MgHCO3 - wherein

Temporary hardness can be removed by :

1) Boiling

2) Clark's method

$Ca\,(HCO_3)_2$ is responsible for the temporary hardness of the water.

While the permanent hardness is due to sulphates and chlorides.

Therefore, **option (2) is correct.**

Q. 15 Correct statements among a to d regarding silicones are :

(a) They are polymers with hydrophobic character

(b) They are biocompatible

(c) In general, they have high thermal stability and low dielectric strength.

(d) Usually, they are resistant to oxidation and used as greases

Option 1:
(a), (b), (c) and (d)

Option 2:
(a), (b) and (c) only

Option 3:
(a) and (b) only

Option 4:
(a), (b) and (d) only

Correct Answer:
(a), (b) and (d) only

Solution:

Silicones -

Polymeric organo-silicon compounds having (R2SiO)n general formula

R= alkyl or aryl groups

-

Cyclic or ring silicates -

Two tetrahedral units share two oxygen atoms per tetrahedron to form a closed ring containing basic unit $(SiO_3)_n^{2n-}$

- wherein

E.g. Beryl $(Be_3Al_2Si_6O_{18})$

As we know

They hve high thermal stability but has high dielectric strength.

Therefore, **option (4) is correct.**

Q. 16 The number of possible dichloronitrobenzene isomers is:

Option 1:
3

Option 2:
4

Option 3:
6

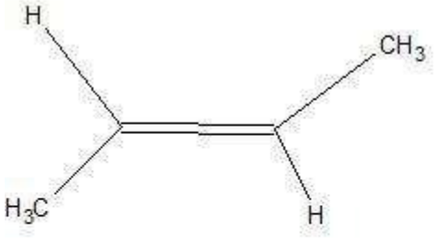
Option 4:
8

Correct Answer:
6

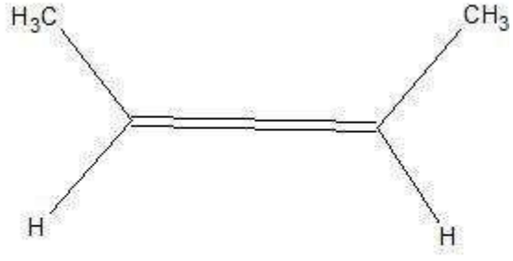
Solution:

geometrical isomers -

Compounds having some molecular formula but a di rent geometric arrangement . This phenomenon appears in case of unsaturated compounds or ring compounds in which rotaion around a carbon bond is restricted
- wherein



trans / E



cis / Z

Positional isomers are constitutional isomers that have the same carbon skeleton and the same functional groups but di er from each other in the location
of the functional groups on or in the carbon chain
Dichloronitrobenzene has 2 Cl and 1 NO2 group, they can change their position 6 times uniquely at 1,2,3,4,5, and 6 positions of benzene. Hence, the option number (3) is correct.

Q. 17 In the equation A + 2B + H2O → C + 2D

where A = HNO2 ; B = H2SO3 ; C = NH2OH

Identify the geometry and hybridisation of (D)

Option 1:
Trigonal planar and sp2

Option 2:
Bent and sp2

Option 3:
Tetrahedral and sp3

Option 4:
Trigonal pyramidal and sp3

Correct Answer:
Tetrahedral and sp3

Solution:
Structure of sulphuric acid -

H_2SO_4 is a covalent molecule with sulphur in a +6 oxidation state

-

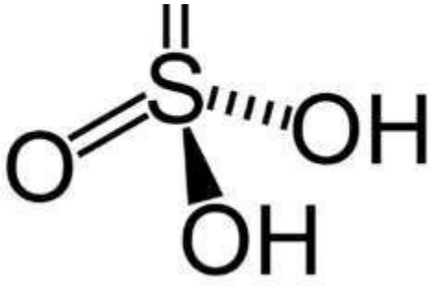
Properties of Sulfuric acid -

H_2SO_4 is a strong dibasic acid

-

The reaction occurs as follows:

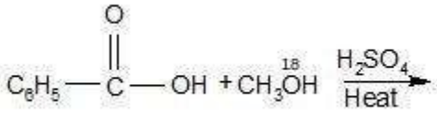
$$HNO_2 + 2H_2SO_3 + H_2O \rightarrow NH_2OH + 2H_2SO_4$$



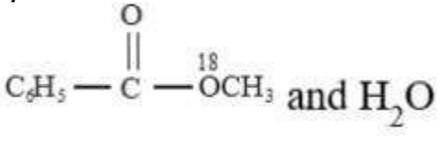
Thus, the geometry is tetrahedral and its hybridisation is *sp*3.

Therefore, **Option(3) is correct**

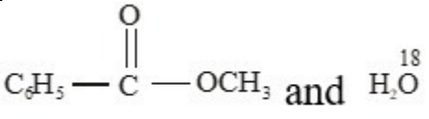
Q. 18 The products formed in the reaction are:



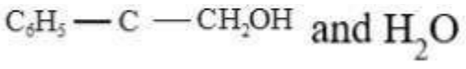
Option 1:



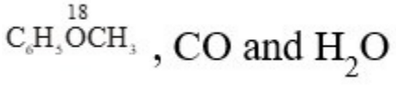
Option 2:



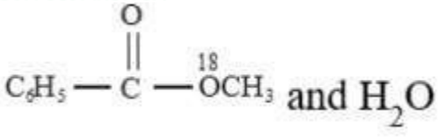
Option 3:



Option 4:



Correct Answer:



Solution:

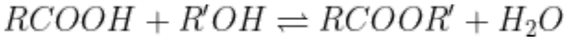
Esteri cation of carboxylic acid -

⇒ Carboxylic acid with alcohols or phenols forms esters in the presence of catalyst H2SO4 / HCl

⇒ It's a kind of nucleophilic acyl substitution.

⇒ Involves cleavage of C - OH bond.

- wherein



Therefore, **Option(1) is correct.**

Q. 19

(1)

The basicity order of I, II and III is

Option 1:
III > I > II

Option 2:
II>I> III

Option 3:
I > II > III

Option 4:
I > III>II

Correct Answer:
III > I > II

Solution:

Basicity of Aromatic Amines -

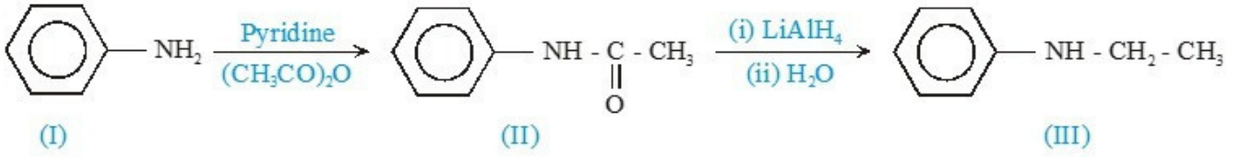
The unshared pair of electrons at the nitrogen atom is in resonance with the benzene ring and hence not fully available for donation as in the case of aniline.

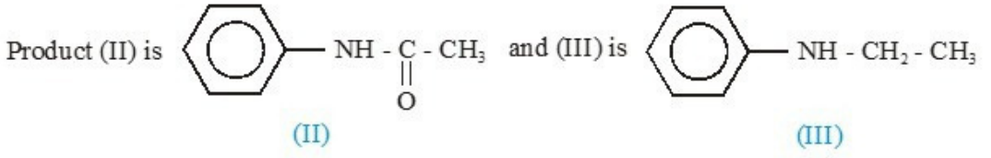
-

Nature of group and basicity -

Electron withdrawing groups (-I and -M e ect) decreases basicity, whereas Electron releasing groups (+I and +M e ect) increases basicity.

-





Therefore, **Option(1) is correct**

Q. 20 The maximum prescribed concentration of copper in drinking water is:

Option 1:
5 ppm

Option 2:
0.05 ppm

Option 3:
0.5 ppm

Option 4:
3 ppm

Correct Answer:
3 ppm

Solution:

Maximum prescribed concentration of some metals in drinking water -

The maximum concentration of some common metals recommended in drinking water are given in table:

Metal	Maximum concentration (ppm or mg dm-3)
Fe	0.2
Mn	0.05
Al	0.2
Cu	3.0
Zn	5.0
Cd	0.005

-

Factual based

The safe limit of copper is 3 ppm

Hence, the option number (4) is correct.

Q. 21 The peptide that gives positive ceric ammonium nitrate and carbylamine tests is:

Option 1:
Ser-Lys

Option 2:
Gln-Asp

Option 3:
Lys-Asp

Option 4:
Asp-Gln

Correct Answer:
Ser-Lys

Solution:

Test for Alcohol -

Alcohol + Ceric Ammonium Nitrate $\rightarrow$ Red Solution

- wherein

Alcohol is Present

carbylamnie Reaction -

Product is isocyanide & this reaction is used for the detection of primary amines.

- wherein

$$RNH_2 + CHCl_3 + 3KOH \rightarrow R - NC + 3KCl + 3H_2O$$

$$an\ isocyanide\ (foul\ smelling)$$

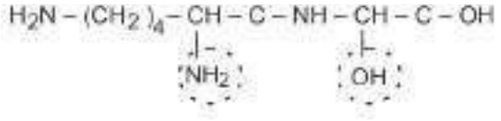
positive ceric ammonium nitrate positive

carbylamine tests

$\rightarrow -OH$ gives

$\rightarrow -NH_2$ gives

(1) Ser-Lys (Lysine + serine)



Both present so it will give positive tests for both tests.

Hence, **the option number (1) is correct.**

Q. 22 The correct statement among I to III regarding group 13 element oxide are ,

I. Boron trioxide is acidic.

II. Oxides of aluminium and gallium are amphoteric.

III. Oxides of indium and thallium are basic .

Option 1:
I and II only

Option 2:
I , II and III

Option 3:
I and III only

Option 4:
II and III only

Correct Answer:
I , II and III

Solution:

Oxides of boron family -

Acidity decreases and basicity increases down the group

General formula: M2O3 - wherein Aluminium oxide is

amphoteric I. II. III.

B_2O_3 is acidic oxide in nature .

Al_2O_3 and Ga_2O_3 are amphoteric oxides.

Tl_2O_3 and In_2O_3 are basic oxides.

All statements are correct.

Therefore, **Option(2) is correct.**

Q. 23 In Chromatography, which of the following statements is INCORRECT for R_f ?

Option 1:
R_f value depends on the type of chromatography.

Option 2:
The value of R_f can not be more than one.

Option 3:
Higher R_f value means higher adsorption.

Option 4:
R_f value is dependent on the mobile phase.

Correct Answer:
Higher R_f value means higher adsorption.

Solution:

Chromatography -

This technique is used to separate a mixture into their components and test the purity of the compounds.

-

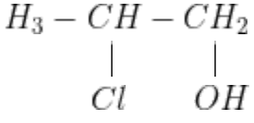
Greater the R_f value means weak adsorption in low polarity compounds.

Hence, the option number (3) is correct.

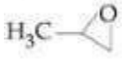
Q. 24 The major product of the following addition reaction is

$$CH_3 - CH = CH_2 \xrightarrow{Cl_2/H_2O}$$

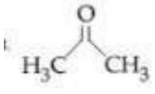
Option 1:



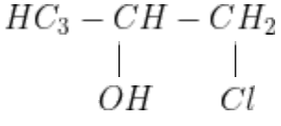
Option 2:



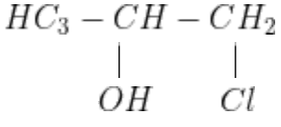
Option 3:



Option 4:



Correct Answer:

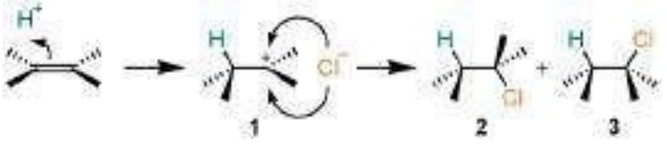


Solution:

Addition of Hydrogen Halide on alkene -

hydrogen halides add up to alkenes to form alkyl halides. The order of reactivity of the hydrogen halides is HI>HBr>HCl

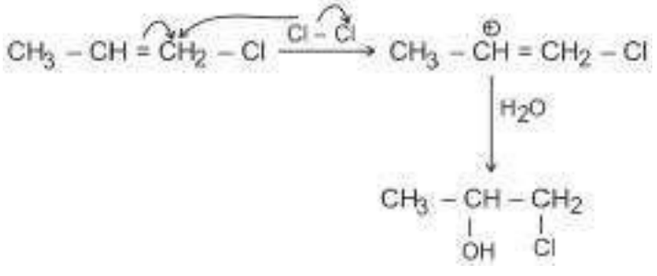
- wherein



$$CH_3 - CH = CH_2 \overset{Cl_2/H_2O}{\rightarrow}$$

$$Cl_2 + H_2O \rightarrow Cl^+ + H_2O$$

Now,



Therefore, **Option(4) is correct**

Q. 25 If the molecule of HCl were totally polar, the expected value of dipole moment is 6.12 D(debye) but the experimental value of dipole moment was $1.03D$. The percentage ionic character is:

Option 1:
17

Option 2:
83

Option 3:
50

Option 4:
Zero

Correct Answer:
17

Solution:
As we have learnt,

Percentage ionic character is given by the following formula

$$\%\ \text{Ionic Character} = \frac{\text{experimental value of dipole moment}}{\text{theoretical value of dipole moment}} \times 100 = \frac{1.03\text{D}}{6.12\text{D}} \times 100 = 16.83\% = 17\%$$

Hence, **option number (1) is correct**

Q. 26 Which of the following is correct for characteristics for any gas:

Option 1:
Gases are highly compressible

Option 2:
Gases have much lower density than the solids and liquids

Option 3:
Gases exert pressure equally in all directions

Option 4:
All of the above

Correct Answer:
All of the above

Solution:
Following are the few physical properties of gaseous state :

(i) The volume and shape of gases is not xed. These assume the volume and shape of the container.

(ii) The thermal energy of gases >> molecular attraction.

(iii) Gases have in nite expansibility and high compressibility.

(iv) Gases exert pressure equally in all directions

(v) Gases have much lower density than the solids and liquids due to negligible intermolecular forces.

vi) Gas mix evenly with other gases or their mixtures are homogeneous in composition.

Therefore, **Option (4) is correct**

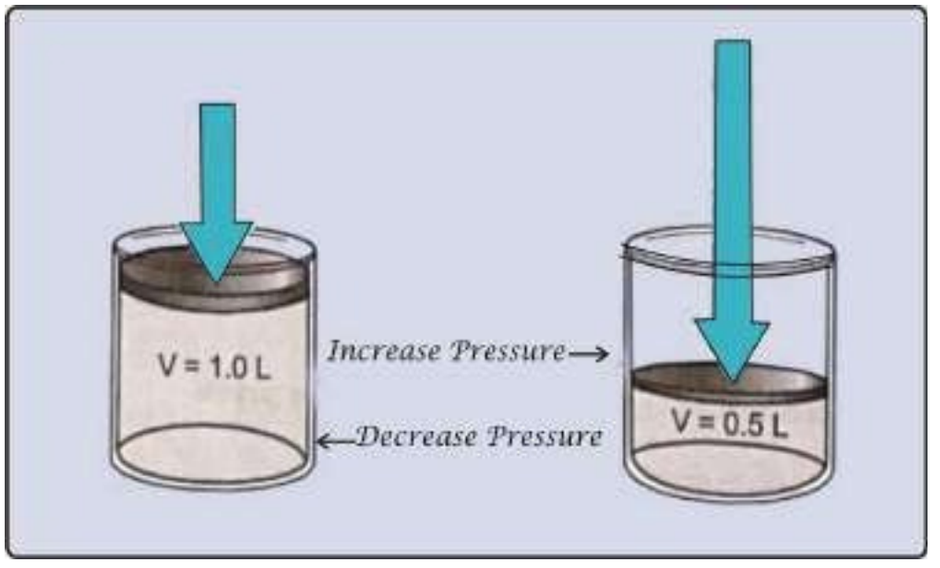
Q. 27 A balloon is lled with hydrogen gas at room temperature. It will burst if pressure exceeds 0.2 bar. If at 1 bar pressure, the gas occupies 2.27L volume, upto what volume (in L) can the balloon be expanded?

Correct Answer:
11.35

Solution:
As we have learnt,

The Gas Laws- Boyle's Law (Pressure - Volume Relationship) -

An Anglo-Irish scientist 'Robert Boyle' in 1662 gave the pressure-volume relationship of a gas. He made some experiments on the basis of which he concluded that "At constant temperature, the pressure of a xed amount of gas varies inversely with the volume of the gas." That means if the pressure is doubled, the volume is halved.



The Boyle's law may be expressed mathematically as

$$P \propto \frac{1}{V}, \text{ (at constant T and n)}$$

$$\text{or } V \propto \frac{1}{P}, \text{ (at constant T and n)}$$

Where,

T = temperature, P = pressure of the gas

n = number of moles of a gas and V = volume of the gas

$$\Rightarrow V = k_1 \frac{1}{P}$$

k1 is the proportionality constant whose value depends upon the following factors.

1. Amount of gas
2. Temperature

On rearranging the above equation we can write

i.e., 'PV' is constant at constant temperature and for a xed amount of the gas. So, Boyle's law can also be stated as "At constant temperature, the product of pressure and volume of xed amount of a gas remains constant."
Now if the initial pressure and volume of a xed amount of gas at constant temperature are P_1 and V_1, and after expansion the new pressure of the gas is P_2 and volume becomes V_2 then according to Boyle's law

$$P_1V_1 = P_2V_2 = \text{constant}$$

$$\text{or} \quad \frac{P_1}{P_2} = \frac{V_2}{V_1}$$

-

According to Boyle's law, we have:

$$P_1V_1 = P_2V_2$$

Now, if P_1 = 1 bar, V_1 = 2.27L
And, if P_2 = 0.2 bar, then:

$$V_2 = \frac{P_1V_1}{P_2}$$

$$= \frac{1 * 2.27}{0.2} = 11.35L$$

Thus, if the balloon bursts at 0.2 bar pressure, the volume of balloon must be less than 11.35L.
Therefore, **Option(1) is correct.**

Q. 28 If pK bfor uoride ion at 25o C is 10.83, the ionisation constant of hydro uoric acid in water at this temperature is:

Option 1:
3.52×10^{-3}

Option 2:
1.74×10^{-5}

Option 3:
8.75×10^{-4}

Option 4:
6.75 x 10-4

Correct Answer:
6.75 x 10-4

Solution:
As we have learnt,

Working of Acidic Bu er -
Acidic bu er solutions are the solutions that are made from a weak acid and one of its salt mainly sodium salt.

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$$CH_3COONa \rightleftharpoons CH_3COO^- + Na^+$$

- **On addition of acid**

  $$H^+ + CH_3COO^-(\text{solution}) \rightarrow CH_3COOH$$

  Although on addition of acid concentration of CH3COOH increases so it wants to go in forward direction but due to common ion e ect CH3COOH cannot dissociate back.
  CH3COO- concentration decreases but we have abundant amount of CH3COO-. So decrease is negligible.

- **On addition of base**

  $$OH^- + H^+(\text{from solution}) \rightarrow H_2O$$

  In this case, [H+] concentration decreases and CH3COOH goes in forward direction to dissociate into H+ so as to restore the concentration of [H]+

-

The dissociation constants of weak acid and its conjugate base are related by an expression.

$$pK_a + pK_b = pK_w$$
$$\text{i.e. } pK_a + 10.83 = 14$$
$$\text{or } pK_a = 14 - 10.83 = 3.17$$
$$\text{or } K_a = \text{ antilog } (-3.17) = 6.76 \times 10^{-4}$$

Therefore,**option(4) is correct**

Q. 29 For the hypothetical reactions, the equilibrium constant (K) values are given:

$\mathrm{A} \rightleftharpoons \mathrm{B}; \mathrm{K}_1 = 2, \quad \mathrm{B} \rightleftharpoons \mathrm{C}; \mathrm{K}_2 = 4, \quad \mathrm{C} \rightleftharpoons \mathrm{D}; \mathrm{K}_3 = 3$

The equilibrium constant (K) for the reaction $\mathrm{A} \rightleftharpoons \mathrm{D}$ is:

Option 1:
12

Option 2:
24

Option 3:
6

Option 4:
9

Correct Answer:
24

Solution:
The required reaction $\mathrm{A} \rightleftharpoons \mathrm{D}$ can be obtained by adding all the given reactions

We know that the Equilibrium constants get multiplied when the equations are added

$\therefore \mathrm{K} = \mathrm{K}_1 \times \mathrm{K}_2 \times \mathrm{K}_3$

$\Rightarrow \mathrm{K} = 2 \times 4 \times 3 = 24$

Therefore,**option(2) is correct**

Q. 30 Value of equilibrium constant depends upon:

Option 1:
Temperature

Option 2:
Method of expressing activity or active mass

Option 3:
Both 1 and 2

Option 4:
Volume

Correct Answer:
Both 1 and 2

Solution:
Equilibrium constants are changed if you change the temperature of the system. Kc or Kp is constant at a constant temperature, but they vary as the temperature changes.

- **The equilibrium constant K is determined by the activities of the components in the equilibrium expression.**
- **The value of Kc and Kp can be di erent in magnitude as well as dimensions.**

Therefore, the option number (3) is correct.

Q. 31 Degree of dissociation for irreversible reaction is:

Option 1:
1

Option 2:
0

Option 3:
2

Option 4:
3

Correct Answer:
1

Solution:
As we have learnt,

Degree of Dissociation -

Degree of dissociation: It is the extent to which an electrolyte gets dissociated in a solvent. It is shown by ?.

$$\alpha = \frac{\text{number of molecules dissociated}}{\text{total number of molecules}}$$

Degree of dissociation(α) depends on the following factors:

- Nature of solute and solvent: For strong electrolytes, ? is more than that for weak electrolytes.
- $\alpha \propto$ dielectric constant of the solvent
  That is, greater the dielectric constant of a solvent more will be ionization of electrolyte in it.
- $\alpha \propto$ Dilution that is ? is maximum at in nite dilution.
- $\alpha \propto$ 1/Concentration
- $\alpha \propto$ Temperature

-

Degree of dissociation for the irreversible reaction is 1 because it is unidirectional in nature and there is 100% dissociation of reactant into the product.

For example:

$$\mathrm{A} \rightarrow \mathrm{B}$$

at time t=0, 100 mole
at time t=t, 0 100 mole

We know,

$$\text{Degree of dissociation} = \frac{\text{Total number of moles of dissociation}}{\text{Total number of moles added}}$$

$$\text{Degree of dissociation} = \frac{100}{100} = 1.$$

Therefore,**option(1) is correct**

Q. 32 The active mass of 64 g of HI in a 2 L ask would be:

Option 1:
2

Option 2:
1

Option 3:
0.25

Option 4:
5

Correct Answer:
0.25

Solution:
As we have learnt,

Observed Density and Molar Mass -

In equilibrium, observed molar mass or average molar mass of the reactant is the total mass of the mixture divided by the total number of moles.

$$\begin{array}{lccc} & A & \rightleftharpoons & nB \\ \text{Initially:} & 1 & & 0 \\ \text{Equil:} & 1-? & & n? \end{array}$$

$$M_{observed} = \frac{\text{Total mass of mix}}{\text{Total number of moles of mix}}$$

$$M_{obs} = \frac{M_{real}}{1-\alpha+n\alpha} = \frac{M_{real}}{1+\alpha(n-1)}$$

In the equilibrium system, the observed molar mass of the reactant is always di erent than the actual mass. Thus, when reaction is reversible, then observed mass vary. In a chemical reaction, some amount of this reactant gets convert into product, thus observed mass is di erent than actual mass.

For example:

In this reaction, original molar mass of N2O4 = 92g/mol. But thee observed molar mass at equilibrium is 80g/mol. The observed molar mass is less than original molar mass as during the reaction some amount of N2O4 is converted into NO2.

Vapour Density

Similarly, observed density of the substance is di erent than the actual density.

Thus, we know:

Vapour density = Molar mass/2

$$\text{Thus, } 2\,\text{x}\,(\text{V.D})_{\text{obs}} = \frac{2\,\text{x}\,(\text{V.D})_{\text{real}}}{1+\alpha(\text{n}-1)}$$

$$\Rightarrow \text{ d} = \frac{\text{D}}{1+\alpha(\text{n}-1)}$$

-

$$\text{Active mass} = \text{Concentration} = \text{mol}\,\text{L}^{-1}$$

$$[\text{HI}] = \frac{64}{128\times 2} = 0.25\text{M}$$

Therefore,**option(3) is correct**

Q.33 The equivalent conductances of Ba2+ and Cl- are 63.5 ohm-1 cm2 eq-1 and 76 ohm-1 cm2 eq-1,respectively, at in nite dilution. The equivalent conductance (in ohm-1 cm2) of BaCl2 at in nite dilution will be:

Option 1:
101

Option 2:
239.5

Option 3:
203

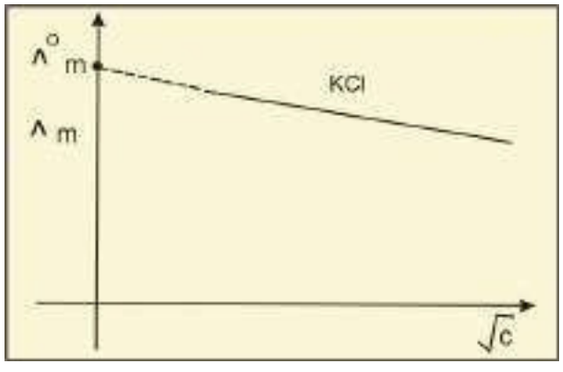
Option 4:
139.5

Correct Answer:
139.5

Solution: As we have learned,

Molar Conductance at In nite Dilution -
When addition of water doesn't bring about any further change in the conductance of a solution, this situation is referred to as In nte Dilution.

- **Strong Electrolytes:** When in nite dilution is approached, the conductance of a solution of strong electrolyte approaches a limiting value and can be obtained by extrapolating the curve between Λm and c1/2 as shown in the gure given below:

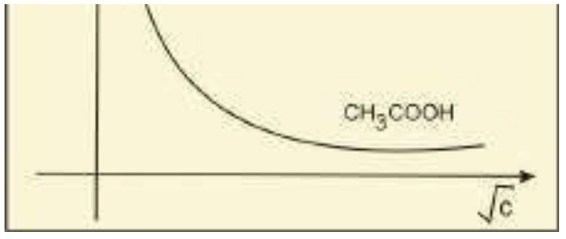


The molar conductivity of strong electrolytes is found to vary with concentration as:

$$\Lambda_m = \lambda_m^0 - b\sqrt{c}$$

where b is a constant depending upon the type of electrolyte, the nature of the solvent and the temperature. This equation is known as Debye Huckel-Onsages equation and is found to hold good at low concentrations.

- **Weak Electrolytes:** When in nite dilution is approached, the conductance of a solution of weak electrolyte increases very rapidly and thus, cannot be obtained through extrapolation. Also, the variation between Λm and c1/2 is not linear at low concentrations.



-

$$\Lambda^{\circ}_{\mathrm{eq}(BaCl_2)} = \lambda^{\circ}_{\mathrm{eq}\left(Ba^{2+}\right)} + \lambda^{\circ}_{\mathrm{eq}(Cl)}$$
$$= 63.5 + 76 = 139.5\ \mathrm{S\ cm^2\ eq^{-1}}$$

therefore,**option(4) is correct**

Q. 34 A certain amount of charge is passed through acidulated water. A total of 504 mL of hydrogen and oxygen were collected at STP. Find the magnitude of charge that is passed during electrolysis in coulombs.

Option 1:
2895 C

Option 2:
5040 C

Option 3:
1680 C

Option 4:
8467.2 C

Correct Answer:
2895 C

Solution:

$$504\,\mathrm{mL} \Rightarrow \frac{1 \times 504}{16.8 \times 10^3}$$
$$= 0.03\,\mathrm{F} = 0.03 \times 96500 = 2895\,\mathrm{C}$$

Therefore,**option(1) is correct**

Q. 35 If k1 and k2 are the rate constants at temperature T1 and T2 then which of the following relation holds good?

Option 1:
$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\left[\frac{T_1 - T_2}{T_1}\right]$$

Option 2:
$$\log \frac{k_2}{k_1} = \frac{E_a}{R}\left[\frac{T_1 - T_2}{T_1 T_2}\right]$$

Option 3:
$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

Option 4:
None of above

Correct Answer:
$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

Solution: As we have learned,

Ratio of Two Rate Constants at Two Di erent Temperatures -

We have the rate constant K1 at temperature T1 and rate constant K2 at temperature T2.

We know that the Arrhenius equation is given as follows:

$$\log_{10}K_1 = \log_{10}A - \frac{E_a}{2.303RT_1} \quad \text{.....(i)}$$

$$\log_{10}K_2 = \log_{10}A - \frac{E_a}{2.303RT_2} \quad \text{.....(ii)}$$

On subtracting equation (i) from (ii), we get:

$$\log_{10}K_2 - \log_{10}K_1 = \frac{E_a}{2.303RT_1} - \frac{E_a}{2.303RT_2}$$

$$\textbf{Thus, } \log\frac{K_2}{K_1} = \frac{Ea}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

-

$$\log\frac{k_2}{k_1} = \frac{E_a}{2.303\,R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$$

where, Ea is activation energy.

Therefore, **option(3) is correct**

Q. 36 Soap molecules form micelles around the oil droplet in such a way that:

Option 1:

The hydrophobic part of the stearate ions lies in the oil droplet

Option 2:

The hydrophobic part of the stearate ions lies out of the oil droplet.

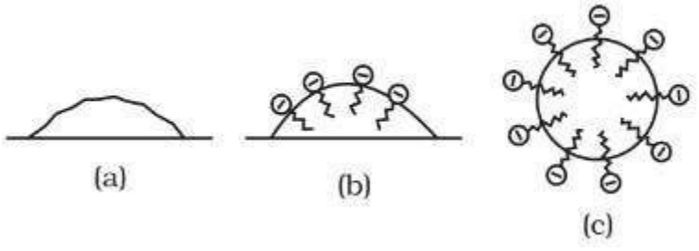
Option 3:
The hydrophilic part of the stearate ions lies in the oil droplet

Option 4:
None of these.

Correct Answer:
The hydrophobic part of the stearate ions lies in the oil droplet

Solution: As we have learnt,

Cleansing Action of Soaps -
Cleaning action of soap is due to the fact that soap molecules form micelle around the oil droplet in such a way that hydrophobic part of the stearate ions is in the oil droplet and hydrophilic part projects out of the grease droplet like the bristles. Since the polar group can interact with water, the stearate ions is now pulled in water and remove from rst surface.



-

The cleansing action of soap is due to the fact that soap molecules form micelle around the oil droplet in such a way that hydrophobic part of the stearate ions is in the oil droplet and hydrophilic part projects inside the grease.
Since polar groups can interact with water, the oil droplet surrounded by stearate ions is now pulled in water and removed from the fabric. Thus soap helps in emulsi cation and washing away of oil and fats.
Therefore, **the option number (1) is correct.**

Q. 37 How many π bonds present in $CH_3CH = CHCN$?

Option 1:
3

Option 2:
4

Option 3:
2

Option 4:
1

Correct Answer:
3

Solution: As we have learnt,

Characteristics Features of π-bonds -
In a π (pi) bond formation, parallel orientation of the two *p* orbitals on adjacent atoms is necessary for a proper sideways overlap. Thus, in H2C=CH2 molecule all the atoms must be in the same plane. The *p* orbitals are mutually parallel and both the *p* orbitals are perpendicular to the plane of the molecule. Rotation of one CH2 fragment with respect to other interferes with maximum overlap of p orbitals and, therefore, such rotation about carbon-carbon double bond (C=C) is restricted. The electron charge cloud of the π bond is located above and below the plane of bonding atoms. This results in the electrons being easily available to the attacking reagents. In general, π bonds provide the most reactive centres in the molecules containing multiple bonds. - One double bond have 1

π and 1σ and triple bond have 1σ and 2π bonds. So CN has 2 π bonds and $CH = CH$ has 1 π bond.

Total π bond = 3

Therefore, **option (1) is correct.**

Q. 38 What is the general formula of aromatic compounds?

Option 1:
CnHn

Option 2:
CnH2n

Option 3:
C2nHn

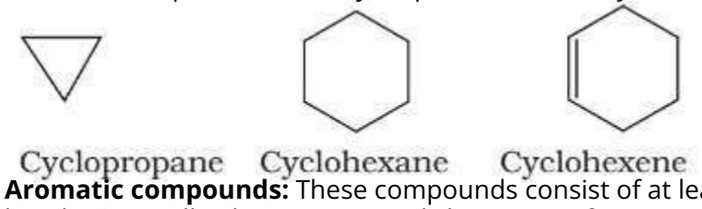
Option 4:
CnH2n+2

Correct Answer:
CnHn

Solution: As we have learnt,

Classi cation of Organic Compounds - 2 -
Cyclic or Closed-chain compounds
These are the compounds in which carbon atoms are linked to each other or to the atoms of other elements in such a manner that the molecule has a closed-chain or cyclic or ring structure. One or more close-chains or rings may be present in the molecule. The compounds with only one ring of atoms in the molecule are known as monocyclic but those with more than one ring of atoms are termed as polycyclic. These are divided into two categories:
(a) Homocyclic compounds: These are the compounds having a ring or rings of carbon atoms only in the molecule. The arbocyclic or hoomocyclic compounds may again be divided into two types, i.e,

- **Alicyclic compounds:** These are the compounds which contain rings of three or more carbon atoms. These resemble with aliphatic compounds than aromatic compounds in many respects. That is why these are named alicyclic, i.e, aliphatic cyclic. Some examples include,



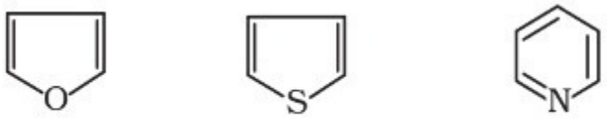
- **Aromatic compounds:** These compounds consist of at least one benzene ring, i.e, a six-membered carbocyclic ring having alternate single and double bonds. Generally, these compounds have some fragrant odour and hence, named as aromatic.

Benzene Aniline Naphthalene

The above compounds are also known as benzenoid aromatics as their molecules consist of benzene ring or rings. However, there are aromatic compounds, which have structural units di erent from benzenoid type and are known as non-benzenoid aromatics.

Tropone

(b) Heterocyclic compounds: These are cyclic compounds having ring or rings built up of more than one kind of atoms. The most common other atoms besides carbon are O, N and S. Some examples include,



Furan Thiophene Pyridine

-

The general formula of aromatic is C_nH_n.

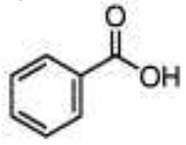
Therefore, **option (1) is correct.**

Q. 39 $C_6H_5MgBr \xrightarrow[(2)H_3O^+]{CO_2} P$

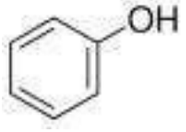
In the above reaction, product P is:

Option 1:

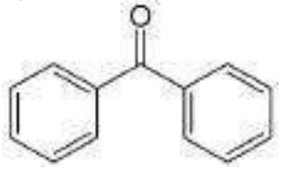
Option 2:



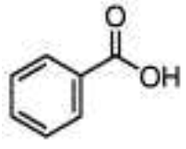
Option 3:



Option 4:



Correct Answer:



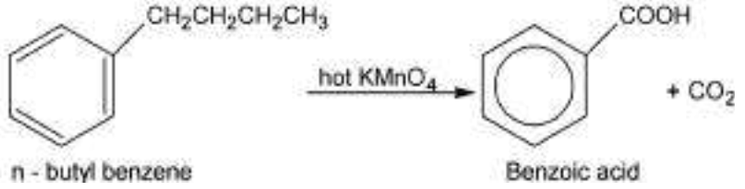
Solution:
As we have learnt,

Oxidation of Aaromatic Compounds -

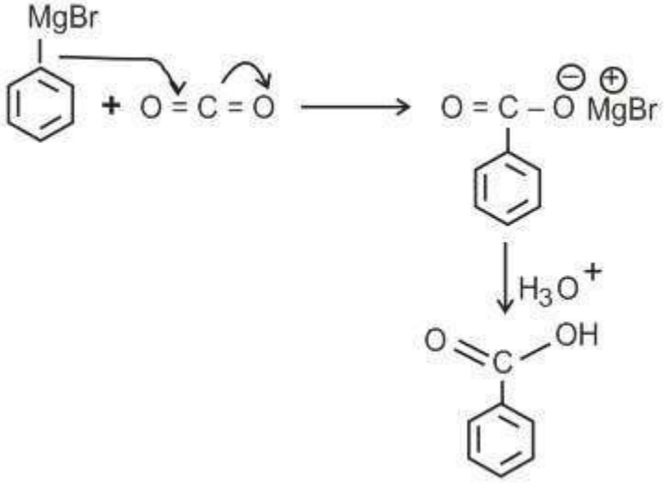
Benzene is unreactive towards even strong oxidising agents such as KMnO4/K2Cr2O7. However, in drastic conditions, it can be oxidised slowly to CO2 and H2O. It can undergo combustion reaction to give luminous and smoky ame.

1. **Controlled oxidation with air:** Benzene on oxidation with air at 773 K in presence of V2O5 as catalyst gives Maleic anhydride.

2. **Oxidation of Alkyl benzene:** Alkyl groups when attached to the benzene ring, they are easily oxidised by an alkaline solution of potassium manganate.



-



Therefore, **option (2) is correct**

Q. 40 Phenol react with dil. HNO_3 at low temperature.What is the major product of this reaction?

Option 1:
$o-Nitrophenol$

Option 2:
$p-Nitrophenol$

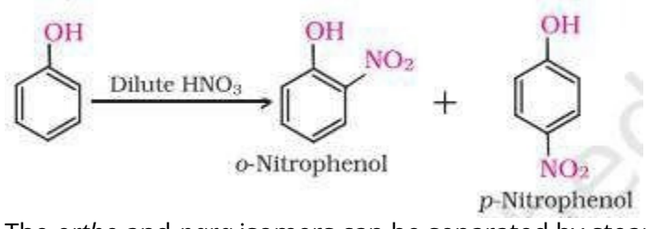
Option 3:

Option 4:
None of these

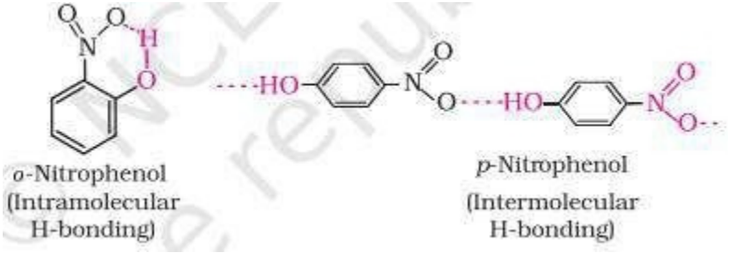
Correct Answer:
$o-Nitrophenol$

Solution:
As we have learnt,

Reaction of Phenols with dil. HNO3 -
With dilute nitric acid at low temperature (298 K), phenol yields a mixture of *ortho* and *para* nitrophenols. The reaction occurs as follows.



The *ortho* and *para* isomers can be separated by steam distillation. *o*-Nitrophenol is steam volatile due to intramolecular hydrogen bonding while *p*-nitrophenol is less volatile due to intermolecular hydrogen bonding which causes the association of molecules.



-

o-Nitrophenol has 40% yield while p- nitrophenol has only 13% yield.

Therefore, **option (1) is correct.**

Maths

Q. 1 If $(27)^{999}$ is divided by 7, then the remainder is :

Correct Answer:
Correct Answer:
6

Solution:
As we have learned

Expression of Binomial Theorem -

$$(x+a)^n = {}^n c_0 x^n a^0 + {}^n c_1 x^{n-1} a^1 + {}^n c_2 x^{n-2} a^2 x - - - - - {}^n c_n x^0 a^n$$

- wherein

for n +ve integral .

$$(27)^{999} = (28-1)^{999} = {}^{999} C_0 (28)^{999} - {}^{999} C_1 (28)^{998} + {}^{999} C_2 (28)^{997} - {}^{999} C_3 (28)^{996} + ...$$

Q. 2 The order and the degree of the di erential equation of all ellipses with centre at the origin, major axis along x-axis and eccentricity $\frac{\sqrt{3}}{2}$ are, respectively :

Option 1:
2, 2

Option 2:
1, 1

Option 3:
2, 1

Option 4:
1, 2

Correct Answer:
1, 1

Solution:
As we learnt in

Order of a Di erential Equation -

The order of a di erential equation is order of highest order occuring in di erential equation

- wherein

order of

$$\frac{d^2y}{dx^2} + 5 = 0$$

is 2. Let the equation of

ellipse is

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad but\ 1 - \frac{b^2}{a^2} = \frac{3}{4}$$

$$\therefore \frac{x^2}{4b^2} + \frac{y^2}{b^2} = 1 \quad \therefore \frac{b^2}{a^2} = \frac{1}{4}$$

$$\therefore x^2 + 4y^2 = 4b^2 \quad \therefore a^2 = 4b^2$$

$$\therefore 2x + 8y.\frac{dy}{dx} = 0$$

$$\therefore x + 4y.\frac{dy}{dx} = 0$$

$$order = 1$$
$$degree = 1$$

Q. 3 The integral

is equal
to : (where C is a constant of integration.)

Option 1:
$$-2\sqrt{\frac{1+\sqrt{x}}{1-\sqrt{x}}}+C$$

Option 2:
$$-2\sqrt{\frac{1-\sqrt{x}}{1+\sqrt{x}}}+C$$

Option 3:
$$-\sqrt{\frac{1-\sqrt{x}}{1+\sqrt{x}}}+C$$

Option 4:
$$2\sqrt{\frac{1+\sqrt{x}}{1-\sqrt{x}}}+C$$

Correct Answer:
$$-2\sqrt{\frac{1-\sqrt{x}}{1+\sqrt{x}}}+C$$

Q. 4 Two sides of a rhombus are along the lines, x−y+1=0 and 7x−y−5=0. If its diagonals intersect at (−1, −2), then which one of the following is a vertex of this rhombus ?

Option 1:
(−3, −9)

Option 2:
(−3, −8)

Option 3:
$\left(\frac{1}{3}, -\frac{8}{3}\right)$

Option 4:
$\left(-\frac{10}{3}, -\frac{7}{3}\right)$

Correct Answer:
$\left(\frac{1}{3}, -\frac{8}{3}\right)$

Solution:
As we learnt in

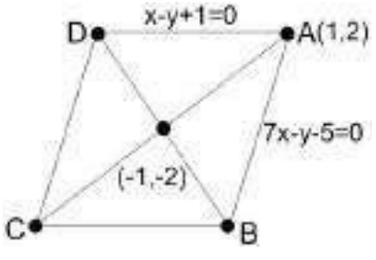
Slope – point from of a straight line -

$$y - y_1 = m(x - x_1)$$

- wherein

$m \rightarrow$ slope

$(x_1, y_1) \rightarrow$ point through which line passes



Point of intersection of AB and AD is

Let C be

$$\frac{x_1+1}{2}=-1$$

and $\frac{y_1+2}{2}=-2$

$x=-3\,;y=-6$

$C\,(-3,-6)$

Slope of $AC=\frac{2+2}{1+1}=2$

Hence, slope of $BD=\frac{-1}{2}$

equation of $BD\Rightarrow\frac{y+2}{x+1}=\frac{-1}{2}$

$2y+4=-x-1$

$BD:x+2y+5=0$

Point $\left(\frac{1}{3},-\frac{8}{3}\right)$ satis es the line BD

Q. 5 The eccentricity of the hyperbola whose length of the latus rectum is equal to 8 and the length of its conjugate axis is equal to half of the distance between its foci, is :

Option 1:
$\frac{4}{3}$

Option 2:
$\frac{4}{\sqrt{3}}$

Option 3:

Option 4:

Option 4:

$\sqrt{3}$

Correct Answer:

Correct Answer:

$\frac{2}{\sqrt{3}}$

Solution:

As we learnt in

Length of latus Rectum -

$$\frac{2b^2}{a}$$

- wherein

For the Hyperbola

$$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$$

given kength of LR=8

Hence $\frac{2b^2}{a}=8----------(1)$

and $2b=\frac{1}{2}(2ae)----------(2)$

from (1) and (2)

$$\frac{2}{a}\times\frac{a^2e^2}{4}=8$$

Also,

Also $b^2 = a^2\left(e^2 - 1\right)$

hence $a^2e^2 - a^2 = 4a$

$\Rightarrow ae^2 - a = 4$

from (3)

16-a=4 $\rightarrow$ a=12

$ae^2 = 16 \Rightarrow e^2 = \frac{16}{12} = \frac{4}{3}$

$e = \frac{2}{\sqrt{3}}$

Q. 6 The variance of rst 50 even natural numbers is :

Option 1:
437

Option 2:
$\frac{437}{4}$

Option 3:
$\frac{833}{4}$

Option 4:
833

Correct Answer:
833

Solution:
As learnt

Variance -

In case of discrete data

$$\sigma^2 = \left(\frac{\sum x_i^2}{n}\right) - \left(\frac{\sum x_i}{n}\right)^2$$

-

$$Variance = \frac{\sum xi^2}{N} - (\bar{x})^2$$

$$T^2 = \frac{2^2 + 4^2 + \cdots \cdot 100^2}{50} - 51^2$$

$$= \frac{4(1^2 + 2^2 + \cdots \cdot 50^2)}{50} - 51^2$$

$$= \frac{4 \times 50 \times 51 \times 101}{50 \times 6} - 51^2$$

$$= 3434 - 2601$$

$$= 833$$

Q. 7 The contrapositive of the statement “I go to school if it does not rain” is :

Option 1:
If it rains, I do not go to school.

Option 2:
If I do not go to school, it rains.

Option 3:
If it rains, I go to school.

Option 4:
If I go to school, it rains.

Correct Answer:
If I do not go to school, it rains.

Solution:

Implications -

Symbol of If p then q is p $\rightarrow$q or p $\rightarrow$q

-

The contrapositive of $p \rightarrow q$ is $\sim q \rightarrow p$

We need to examine the given statement if says If it does not rain , then i go to school

So contrapositive will be

If I do not go to school, it rains

Q. 8 The equation of the circle passing through the foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$, and having centre at (0 , 3) is :

Option 1:
$x^2+y^2-6y+5=0$

Option 2:
$x^2+y^2-6y-7=0$

Option 3:

Option 4:

Option 4:

$x^2+y^2-6y-5=0$

Correct Answer:

Correct Answer:

$x^2+y^2-6y-7=0$

Solution:

As we learnt in

Coordinates of foci -

$\pm ae, o$

- wherein

For the ellipse

$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

Foci of ellipse are $(\pm ae, 0)$

$a^2=16;\ b^2=9;\ e=\sqrt{1-\frac{b^2}{a^2}}=\frac{\sqrt{7}}{4}$

$ae=\sqrt{7}$

Circle is

$x^2+y^2-6y+k=0$

It passes through $\left(\sqrt{7},0\right)$

We get, 7+k=0

$\Rightarrow k=-7$

Q. 9 The area (in square units) bounded by the curves and lying in the rst quadrant is :

Option 1:
$\frac{27}{4}$

Option 2:
9

Option 3:
36

Option 4:
18

Correct Answer:
9

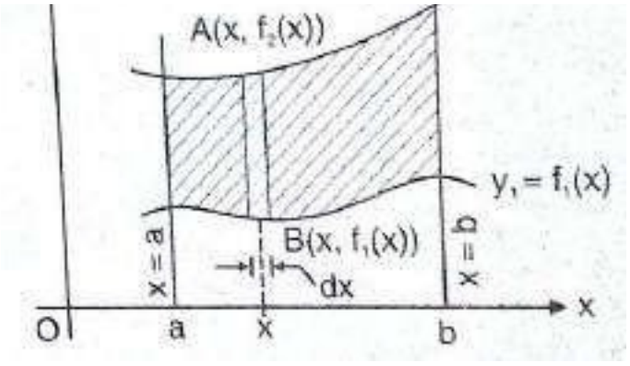
Solution:
As learnt in concept

Area along x axis -

Let $y_1 = f_1(x)\, and\, y_2 = f_2(x)$ be two curve then area bounded between the curves and the lines x = a and x = b is

$$\left|\int_a^b \Delta y\, dx\right| = \left|\int_a^b (y_2 - y_1)\, dx\right|$$

- wherein



Where $\Delta y = f_2(x) - f_1(x)$

$$Area = \int_0^9 \sqrt{x}dx - \int_3^9 \frac{(x-3)}{2}dx$$

$$\left[\frac{x^{\frac{3}{2}}}{\frac{3}{2}}\right]_0^9 - \frac{1}{2}\left[\frac{x^2}{2}\right]_3^9 + \frac{3}{2}(x)_3^9$$

$$18 - \frac{1}{2} \times 36 + \frac{3}{2} \times 6$$

$$= 9$$

Q. 10 If the vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ and $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC ,then the length of the median through A is :

Option 1:
$\sqrt{45}$

Option 2:
$\sqrt{18}$

Option 3:
$\sqrt{72}$

Option 4:

Correct Answer:
Correct Answer:
$\sqrt{33}$

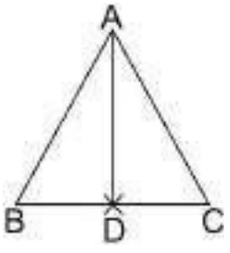
Solution:
As learnt in concept

Mid point formula -

$$\frac{\vec{a}+\vec{b}}{2}$$

- wherein

If $\vec{A}$ and $\vec{B}$, position vector of mid-point of AB



$$\frac{\overrightarrow{AB}+\overrightarrow{AC}}{2}=\overrightarrow{AD}$$

$$\overrightarrow{AD}=4\vec{i}+\vec{j}+4\vec{k}$$

$$\left|\overrightarrow{AD}\right|=\sqrt{4^2+1^2+4^2}=\sqrt{33}$$

Q. 11 if $f(x)=x^n$, then the value of $f(1)-\frac{f'(1)}{1!}+\frac{f''(1)}{2!}-\frac{f'''(1)}{3!}+....+\frac{(-1)^n f^n(1)}{n!}$ is

Option 1:

Option 2:
0

Option 3:
1

Option 4:
2^n

Correct Answer:
0

Solution:
As we learnt in

Di erentiation -

Derivative of a function f(x) is de ned as f'(x) means small increment δx in x corresponding increment in the value of y be δy

- wherein

$$\frac{dy}{dx} = \lim_{\delta x \to o} \frac{dy}{dx}$$

$$= \lim_{\delta x \to o} \frac{f(x+\delta x) - f(x)}{\delta x}$$

$$Since\ f(x) = x^n$$

$$f''(x) = nx^{n-1} \cdots\cdots\cdots and\ so\ on$$

Now,

$$1 - \frac{}{1!} + \frac{\grave{\quad}\quad\acute{}}{2!} - \frac{\grave{\quad}\quad\acute{}\grave{\quad}\quad\acute{}}{3!} + \cdots\cdots \ (i)$$

Now,

$$(1+x)^n = 1 + \frac{nx}{1!} + \frac{n(n-1)x^2}{2!} + \cdots\cdots$$

Put x=-1

$$0 = 1 - \frac{n}{11} + \frac{n(n-1)}{2!} \ \cdots\cdots(ii)$$

From (i) and (ii) it is zero

Q. 12 $\int_{\pi}^{10\pi} |sin\,x|\,dx \ is$

Option 1:
20

Option 2:
8

Option 3:
10

Option 4:
18

Correct Answer:
18

Solution:
As learnt in concept

Properties of De nite Integration -

For periodic function

Let Period (T) then

$$\int_0^{nT} f(n)dx = n\int_0^{T} f(x)dx$$

- wherein

Where $f(x)$ is periodic function with period T and n is any integer.

$$\int_{\pi}^{10\pi} |sin\ x|\ dx = 9\int_0^{\pi} |sin\ x|\ dx$$

=>$9[-cosx]_0^{\pi} = 9[1+1] = 18$

Q. 13 In a series of $2n$ observations, half of them equal a and remaining half equal $-a$. If the standard deviation of the observations is 2, then $|a|$ equals

Option 1:
2

Option 2:
$\sqrt{2}$

Option 3:
$\frac{1}{n}$

Option 4:
$\frac{\sqrt{2}}{n}$

Correct Answer:
2

Solution:
As we learnt in

Standard Deviation -

If x1, x2...xn are n observations then square root of the arithmetic mean of

$$\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$$

–

- wherein

where $\bar{x}$ is mean

Standard deviation = $\sqrt{\frac{\sum (x - \bar{x})^2}{N}}$ $where\, \bar{x} = mean, N = No.\, of\, observation$

Here, $\bar{x} = \frac{(a + a + a..)n\ times - (a + a + a.....n\ times)}{2n} = 0$

N = 2n

Hence standard deviation= $\sqrt{\frac{\sum x^2}{2n}}$

Q. 14 It is given that the events $A\ \ and\ \ B$ are such that $P(A) = \frac{1}{4},\ P(A \mid B) = \frac{1}{2}\ \ and\ \ P(B \mid A) = \frac{2}{3}.$ Then $P(B)$ is:

Option 1:
Option 1:
$\frac{1}{2}$

Option 2:

Option 3:

$\frac{1}{3}$

Option 4:

$\frac{2}{3}$

Correct Answer:

$\frac{1}{3}$

Solution:

As we learnt in

Conditional Probability -

$$P\left(\frac{A}{B}\right)=\frac{P\left(A\cap B\right)}{P\left(B\right)}$$

and

$$P\left(\frac{B}{A}\right)=\frac{P\left(A\cap B\right)}{P\left(A\right)}$$

- wherein

where $P\left(\frac{A}{B}\right)$ probability of A when B already happened.

$$P\left(B|A\right)P\left(A\right)=P\left(A|B\right)P\left(B\right)=P\left(A\cap B\right)$$

$$\Rightarrow\frac{1}{4}\times\frac{2}{3}=\frac{1}{2}\times P\left(B\right)$$

Q. 15 If focus of a parabola is (2, 0) and one extremity of latus return is (2,2), then its equation is

Option 1:
y2= 4(3-x)

Option 2:
y2 = 4x - 4

Option 3:
both (a) and (b)

Option 4:
none of these

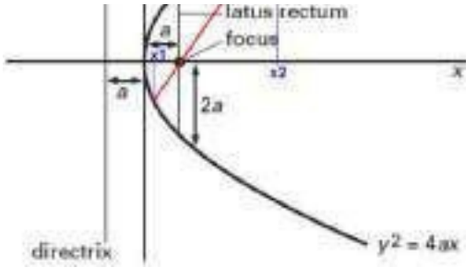
Correct Answer:
both (a) and (b)

Solution:
As we learnt in

Standard equation of parabola -

$$y^2 = 4ax$$

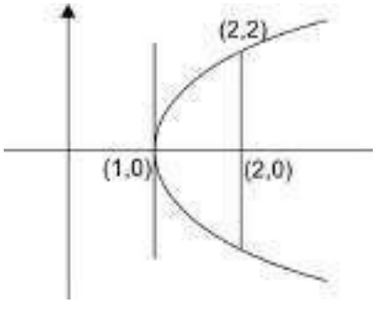
- wherein



4a = 4

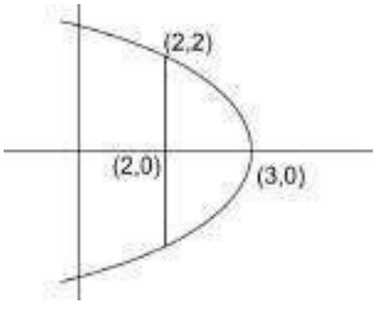
a = 1

$$y^2 = 4(x-1)$$



$$y^2 = -4(x-3)$$

$$\Rightarrow y^2 = 4(3-x)$$



Q. 16 In a triangle ABC, and a+b=4. The area of triangle is maximum when C is

Option 1:
$\frac{\pi}{4}$

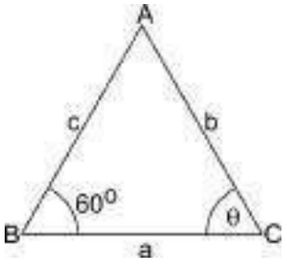
Option 2:
$\frac{\pi}{3}$

Option 3:
$\frac{\pi}{6}$

Option 4:
None of these

Correct Answer:
$\frac{\pi}{3}$

Solution:



Let angle A is 120-θ

where c is θ

Now $\frac{\grave{a}}{\sin(120-\theta)} = \frac{b}{\sin 60^o} = K$

$\therefore a = K\sin(120-\theta) = K(\frac{\sqrt{3}}{2}\cos\theta + \frac{1}{2}\sin\theta)$

$$2$$

$$for\ max\ Area \frac{dA}{d\theta} = 0$$

$$\therefore \theta = 60^o = \frac{\pi}{3}$$

Q. 17 The points (x,3) satisfies the inequality , -5x-2y13, and the smallest possible value of x?

Option 1:
-1.4

Option 2:
1.4

Option 3:
-3.8

Option 4:
3.8

Correct Answer:
-3.8

Solution:

Solution of Linear Programming Problems -

- Corner Point Method - This method of solving a LPP graphically is based on the principle of extreme points theorem.

$$-5x - 2y \leq 13$$

$$\leq 13 + 6$$

$$-5x \leq 19$$

$$x \geqslant \frac{19}{5}$$

$$x \geqslant -3.8$$

$\therefore$ minimum value of x is = -3.8

Q. 18 $2x^3 + mx^2 - 13x + n = 0$ has roots 2 and 3 then m+n equals

Option 1:
10

Option 2:
15

Option 3:
20

Option 4:
25

Correct Answer:
25

Solution:
As we learnt in

Sum of product of pair of roots in cubic equation -

$$\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$$

- wherein

is the cubic equation

Three roots are $2, 3, x \Rightarrow 2(3) + 3(x) + x(2) = \frac{-13}{2} \Rightarrow x = \frac{-5}{2}$

$\therefore roots\ \ are\ \ 2, 3, \frac{-5}{2} \Rightarrow Sum = \frac{-m}{2} = \frac{5}{2} \Rightarrow m = -5$

$and\ \ 2(3)\left(\frac{-5}{2}\right) = product = \frac{-n}{2} \Rightarrow n = 30$

$\therefore m + n = 25$

Q. 19

$$f(x) = \begin{cases} (x-1)^{\frac{1}{2-x}}, x > 1, x \neq 2 \\ k, x = 2 \end{cases}$$

The value of k for which f is continuous at x=2 is :

Option 1:

1

Option 2:

e

Option 3:

Option 4:

Option 4:

e^{-2}

Correct Answer:

Correct Answer:

e^{-1}

Solution:

As we learned,

Rule for continuous -

A function is continuous at x = a if and only if

$L = R = V$

L.H.L R.H.L value at x = a.

- wherein

Where

$L = \lim_{x \to a^-} f(x)$

$R = \lim_{x \to a^+} f(x)$

$V_I = \lim_{x \to a} f(x)$

Let $f(x) = \left\{ \begin{matrix} (x-1)^{\frac{1}{2-x}}, x > 1, x \neq 2 \\ k, x = 2 \end{matrix} \right\}$

for

Limit

$$\lim_{x\to 2}(x-1)^{\frac{1}{2-x}} = \lim_{x\to 2}(1+x-2)^{\frac{1}{2-x}}$$

$$\lim_{x\to 2} = e^{\frac{x-2}{2-x}} = e^{-1}$$

Thus $k = e^{-1}$

Q. 20 Tangents drawn from the point (−8, 0) to the parabola $y^2 = 8x$ touch the parabola at P and Q. If F is the focus of the parabola, then the area of the triangle PFQ (in sq. units) is equal to :

Option 1:
24

Option 2:
32

Option 3:
48

Option 4:
64

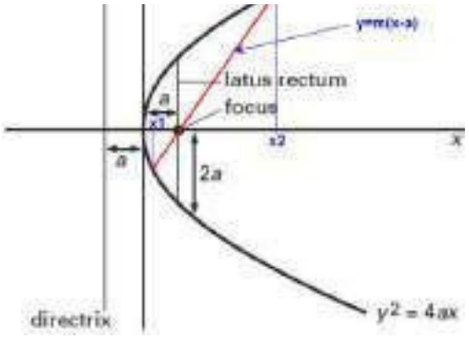
Correct Answer:
48

Solution:
As we learned,

Standard equation of parabola -

$$y^2 = 4ax$$

- wherein



Equation of COC PQ

is T = 0

$$T \equiv 4(x + x_1) - yy_1 = 0$$

Where (x_1, y_1) is $(-8, 0)$

Chord of contact is x = 8

P(8,8) and Q(8,-8)

focus = (2,0)

$$\triangle PQF = \frac{1}{2}(8 - 2) \times (8 + 8) = 48$$ sq units.

Q. 21

Let $f(x) = \begin{vmatrix} x^3 & 1 & 3 \\ x^4 & 2 & 4 \\ x^2 & 3 & 2 \end{vmatrix}$ then $f'(1) =$?

Option 1:
0

Option 2:
1

Option 3:
2

Option 4:
3

Correct Answer:
0

Solution:
As we have learnt,

Di erentiation of a determinant -

$y = \begin{vmatrix} f(x) & g(x) & h(x) \\ p(x) & q(x) & r(x) \\ u(x) & v(x) & w(x)) \end{vmatrix}$ then

$$\frac{dy}{dx} = \begin{vmatrix} f'(x) & g'(x) & h'(x) \\ p(x) & q(x) & r(x) \\ u(x) & v(x) & w(x)) \end{vmatrix} + \begin{vmatrix} f(x) & g(x) & h(x) \\ p'(x) & q'(x) & r'(x) \\ u(x) & v(x) & w(x)) \end{vmatrix} + \begin{vmatrix} f(x) & g(x) & h(x) \\ p(x) & q(x) & r(x) \\ u'(x) & v'(x) & w'(x)) \end{vmatrix}$$

-

Di erciating Columnwise,

$$f'(1) = \begin{vmatrix} 3 & 1 & 3 \\ 4 & 2 & 4 \\ 2 & 3 & 2 \end{vmatrix} + 0 + 0 = 0 + 0 + 0 = 0 \quad (\because C_1 = C_3)$$

Q. 22 What is the range of f(x) = 4[x]?

Option 1:
{....-2,-1,0,1,2,....}

Option 2:
{...-4,-2,0,2,4....}

Option 3:
{...-8,-4,0,4,8....}

Option 4:
{....-12,-6,0,6,12....}

Correct Answer:
{...-8,-4,0,4,8....}

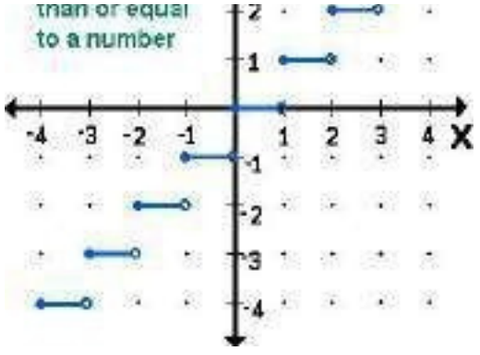
Solution:
As we have learned

Greatest Integer Function -

$[x] =$ Greatest integer less than or equal to x

$(for\, x \in R)$

- wherein



Range = Integers Range of [x] is Z i.e {...-2,-1,0,1,2...} so Range of 4[x] is {...-8,-4,0,4,8}

Q. 23 Degree of di erential equation $\left(\frac{d^3y}{dx^3}\right)^5 - \left(\frac{d^2y}{dx^2}\right)^{10} + 1 = 0$ is

Option 1:
5

Option 2:
10

Option 3:
2

Option 4:
3

Correct Answer:
5

Solution:
As we learnt

Degree of a Di erential Equation -

Degree of Highest order di erential coe cient appearing in it, provided it can be expressed as a polynomial equation in derivatives

- wherein

$$\left(\frac{dy}{dx}\right)^2 + 3\left(\frac{dy}{dx}\right) - 5 = 0$$

Degree = 2

Degree of third order derivative term,when all derivatives are already in form of polynomial equation in derivative is 5. So degree is 5.

Q. 24 Solution of di rential equation $6\frac{dy}{dx} - 2y = xy^4$ is

Option 1:
$2 + (x+1)y^3 = 2cy^3e^x$

Option 2:
$2 - (x+1)y^3 = 2cy^3e^{-x}$

Option 3:

Option 4:

Correct Answer:

Solution:

As we have learned

Bernoulli's Equation -

$$\frac{1}{y^{n-1}} = v$$

$$\frac{1}{y^n}\frac{dy}{dx} = \frac{1}{(1-n)}\frac{dv}{dx}$$

- wherein

$$\frac{1}{y^n}\frac{dy}{dx} + \frac{p}{y^{n-1}} = Q$$

Given equation can be written

as

$$\frac{dy}{dx} - \frac{1}{3}y = \frac{1}{6}xy^4 \Rightarrow \frac{1}{y^4}\frac{dy}{dx} - \frac{1}{3y^3} = \frac{x}{6}$$

Let

$$1/y^4 \frac{dy}{dx} = -1/3 \frac{dt}{dx}$$

$$(-1/3)\frac{dt}{dx} - t/3 = x/6 \Rightarrow \frac{dt}{dx} + t = -x/2$$

IF is $e^{\int 1 dx} = e^x$

$$t \cdot e^x = \int e^x (-\frac{x}{2}) dx$$

$$\frac{1}{y^3} \cdot e^x = -\frac{1}{2}\left(e^x x - e^x\right) + C$$

$$\frac{e^x}{y^3} + \frac{1}{2}(xe^x - e^x) = C$$

Q. 25 If a,b,c are in GP then are in

Option 1:
GP

Option 2:
HP

Option 3:
AP

Option 4:
AGP

Correct Answer:
AP

Solution:
As we learnt

Logarithm and Geometric Progression -

If

$a_1, a_2, a_3, - - - - - -$ is a GP

then $\log a_1, \log a_2, \log a_3, - - - - - -$ is an AP

-

$$\log \frac{1}{a} = \log (a)^{-1} = -\log a$$

Thus is an AP

Q. 26 Number of di erent garlands that can be made using 5 owers out of 7 di erent owers is

Option 1:
156

Option 2:
126

Option 3:
504

Option 4:
252

Correct Answer:
252

Solution:
As we have learned

Rule for Circular Permutation -

Number of circular permutation of n di erent things taken r at a time when clockwise and anticlockwise orders are same is $\frac{^{n}p_{r}}{2r}$.

-

No. of ways = $\frac{^{7}P_{5}}{2\times 5}=252$

or

No. of ways =

Q. 27 The value of

$$\cos\frac{\pi}{2^2}\cdot\cos\frac{\pi}{2^3}\cdot\ldots\cdot\cos\frac{\pi}{2^{10}}\cdot\sin\frac{\pi}{2^{10}}$$ is:

Option 1:
$\frac{1}{256}$

Option 2:
$\frac{1}{2}$

Option 3:
$\frac{1}{1024}$

Option 4:
$\frac{1}{512}$

Correct Answer:
$\frac{1}{512}$

Solution:

Double Angle Formula -

$$
\begin{aligned}
&= 2\cos^2\alpha - 1 \\
&= 1 - 2\sin^2\alpha \\
\tan 2\alpha &= \frac{2\tan\alpha}{1-\tan^2\alpha}
\end{aligned}
$$

- wherein

These are formulae for double angles.

Trigonometric Ratios of Special Angles -

θ	0°	30°	45°	60°	90°
$\sin\theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined
$\cot\theta$	Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0
$\sec\theta$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not defined
$\operatorname{cosec}\theta$	Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1

- wherein

These are the values of trigonometric ratios for standard angles.

$$\cos\frac{\pi}{2^2}\cdot\cos\frac{\pi}{2^3}\cdot\cos\frac{\pi}{2^4}\cdot\ldots\ldots\ldots\cos\frac{\pi}{2^{10}}\cdot\sin\frac{\pi}{2^{10}}$$

$$\cos\left(\frac{\pi}{2^9}\right)\cdot\frac{1}{2}\sin\ \left(\frac{\pi}{2^9}\right)=\frac{1}{2^2}\sin\left(2\cdot\frac{\pi}{2^8}\right)=\frac{1}{2^2}\sin\ \left(\frac{\pi}{2^8}\right)$$

and so on

$$=\frac{\sin(2^9\cdot\frac{\pi}{2^{10}})}{2^9\sin(\frac{\pi}{2^{10}})}\times\sin(\frac{\pi}{2^{10}})$$

$$=\frac{1}{2^9}\sin\frac{\pi}{2}$$

$$=\frac{1}{512}$$

Q. 28 A helicopter ying the curve given by $y-x^{\frac{3}{2}}=7,(x\geq 0)$. A soldier positioned at the point $\left(\frac{1}{2},7\right)$ wants to shoot down the helicopter when its nearest to him. Then the nearest distance is:

Option 1:
$\frac{\sqrt{5}}{6}$

Option 2:
$\frac{1}{6}\sqrt{\frac{7}{3}}$

Option 3:
$\frac{1}{3}\sqrt{\frac{7}{3}}$

Option 4:
$\frac{1}{2}$

Correct Answer:

Solution:

Equation of Normal -

Equation of normal to the curve y = f(x) at the point P(x1, y1) on the curve having a slope MN is

$$(y - y_1) = M_N(x - x_1)$$

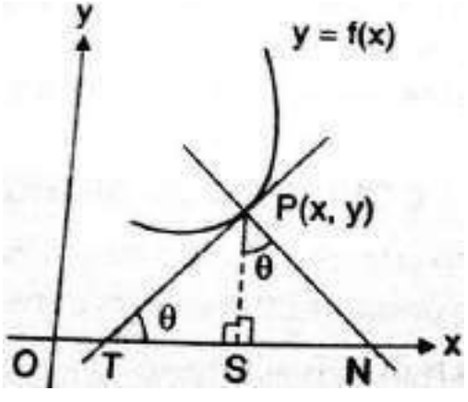
$$= \frac{-1}{\frac{dy}{dx}_{(x_1, y_1)}}(x - x_1)$$

-

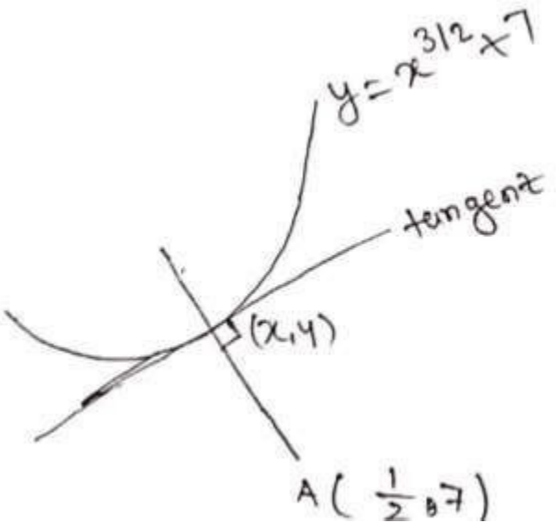
Length of Tangent -

$$L_T = \frac{y}{y'}\sqrt{1 + y'^2}$$

- wherein



Where



Given equation of curve

$$y - x^{\frac{3}{2}} = 7 \ (x \geq 0)$$

from the concept

$$\frac{dy}{dx} = \frac{3}{2}\sqrt{x}$$

condition for perpendicular of two line

$$=> (\frac{3}{2}\sqrt{x})(\frac{7-4}{\frac{1}{2}-x}) = -1$$

$$=> (\frac{3}{2}\sqrt{x})(\frac{-x^{\frac{3}{2}}}{\frac{1}{2}-x}) = -1$$

$$=> \frac{3}{2}x^2 = \frac{1}{2} - x$$

$$=> 3x^2 + 2x - 1 = 0$$

So,

$x = \frac{1}{3}$

$y = 7 + (\frac{1}{3})^{\frac{3}{2}}$

$l_{AB} = \sqrt{(\frac{1}{2} - \frac{1}{3})^2} = \sqrt{\frac{1}{36} + \frac{1}{27}} = \frac{1}{6}\sqrt{\frac{7}{3}}$

Q. 29 The mean of a data set consisting of 20 observations is 40 . If one observation 53 was wrongly recorded as 33 , then the correct mean will be :

Option 1:
41

Option 2:
49

Option 3:
40.5

Option 4:
42.5

Correct Answer:
41

Q. 30

If , then:

Option 1:
k=-3

Option 2:
k=-1

Option 3:
k=1

Option 4:
k=3

Correct Answer:
k=-1

Solution:
As we have learnt in

Elementary row (column) transformation -

Multiplying all elements of a row (column) of a matrix by a non-zero scalar

- wherein

$$R_i \to kR_i \, [C_i \to kC_i]$$

$= (x-y)(y-z)(z-x)(xy+zy+zx)x^k y^k z^k \qquad at\ k=-1$

$= (x-y)(y-z)(z-x)\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)$

Q. 31 The number of the integral solution of $|5x+7|+|2x-14|=21$ is

Correct Answer:
Correct Answer:
2

Solution:

Domain of function -

All posible values of x for f(x) to be de ned is known as domain.

-

$|5x+7|+|2x-14|=21$

Case 1:

$5x+7 \geq 0$ and $2x-14 \geq 0$

i.e. $x \geq 7$

Both Mode open with the positive sign

$(5x+7)+(2x-14)=21$

$7x-7=21$

but
Hence

Case 2:

$5x + 7 \leq 0$ and $2x - 14 \leq 0$

i.e. $x \leq -\frac{7}{5}$

Both Mode open with the positive sign

$-(5x + 7) - (2x - 14) = 21$

$-7x + 7 = 21$

$x = -2$ and $x \leq -\frac{7}{5}$

Hence $x = -2$ is one solution

Case 3:

$5x + 7 \leq 0$ and $2x - 14 \geq 0$

i.e. $x \leq -\frac{7}{5}$ and $x \geq 7$

Not possible

Case 4:

$5x + 7 \geq 0$ and $2x - 14 \leq 0$

i.e. $x \geq -\frac{7}{5}$ and $x \leq 7$

$5x + 7$ open with the positive sign and $2x - 14$ with the negative sign

$(5x + 7) - (2x - 14) = 21$

$3x + 21 = 21$

and

Hence is another solution

Total number of integral solution is 2

Q. 32 The greatest value of $c \in \mathbb{R}$ for which the system of linear equations

$$x - cy - cz = 0$$

$$cx - y + cz = 0$$

$$cx + cy - z = 0$$

has a non-trivial solution, is :

Correct Answer:
Correct Answer:
0.5

Solution:

Cramer's rule for solving system of linear equations -

When $\Delta = 0$ and $\Delta_1 = \Delta_2 = \Delta_3 = 0$,

then the system of equations has in nite solutions.

- wherein

$$a_1x + b_1y + c_1z = d_1$$

$$a_2x + b_2y + c_2z = d_2$$

$$a_3x + b_3y + c_3z = d_3$$

and

$\Delta_1, \Delta_2, \Delta_3$ are obtained by replacing column 1,2,3 of Δ by (d_1, d_2, d_3) column

For non trivial

solution

$$\Delta = 0$$

$$\begin{vmatrix} 1 & -c & -c \\ c & -1 & c \\ c & c & -1 \end{vmatrix} = 1(1-c^2) + c(-\epsilon - c^2) - c(c^2 + c) = 0$$

$$= 1 - c^2 - c^2 - c^3 - c^3 - c^2 = 0$$

$$= -3c^2 - 2c^3 + 1 = 0$$

$$= (c+1)^2(c - \frac{1}{2}) = 0$$

$$c = -1, \frac{1}{2} \quad \frac{1}{2} > -1$$

$$\frac{1}{2} \; is \;\; greatest$$

$$So\, C = \frac{1}{2}$$

Q. 33 The sum of the co-e cients of all even degree terms in x in the expansion of $(x + \sqrt{x^3 - 1})^6 + (x - \sqrt{x^3 - 1})^6, (x > 1)$ is equal to :

Correct Answer:
Correct Answer:
24

Solution:

Properties of Binomial Theorem -

$$(x+a)^n+(x-a)^n=2\left({}^nc_0\,x^n+{}^n\,c_2\,x^{n-2}\,a^2+---\right)$$

- wherein Sum of odd terms or even Binomial

coe cients

$$(x+\sqrt{x^3-1})^6+(x-\sqrt{x^3-1})^6 \quad x>1$$

$$=2\left({}^6C_o\,x^6+{}^6\,C_2\,x^2(x^3-1)+{}^6\,C_4x^A(x^3-1)^2+{}^6\,C_6(x^3-1)^3\right)$$

$$\therefore 2\left({}^6C_o\,x^6+{}^6\,C_2(x^5-x^2)+{}^6\,C_4x^4(x^6-2x^3+1)^2+{}^6\,C_6(x^9-3x^6+3x^3-1)\right)$$

$\therefore$ Sum of the coe cient of even powers

$$2({}^6C_o-{}^6\,C_2+{}^6\,C_4+C_4-3-{}^6\,C_6-{}^6\,C_6)$$

$$=2\,(1-15+15+15-3-1)=24$$

Q. 34 Two newspapers A and B are published in a city. It is known that 25% of the city population reads A and 20% reads B while 8% reads both A and B . Further , 30% of those who read A but not B look into advertisements and 40% of those who read B but not A also look into advertisements, while 50% of those who read both A and B look into advertisements. then the percentage of the population who look into advertisements is :

Correct Answer:
Correct Answer:
13.9

Solution:

COMPLEMENT OF A SET -

Let U be the universal set and A a subset of U. Then the complement of A is the set of all elements of U which are not the elements of A. Symbolically, we write A' to denote the complement of A with respect to U.

- wherein

A' = { ∶ x x ∈ NUu amnbde xr ∉o fA E}l.eOmbveinotuss liyn A' = U – A

Union A & B -

n (A ∪ B) = n (A) + n (B) – n (A ∩ B)

- wherein

Given A and B be any finite sets. then Number of Elements in union A & B is given by this formula.

Let P(A) and P(B) denote respectively the percentage of city population that reads newspapers A and

8. Let us consider total percent be 100 . Then from the given data, we have

$$P(A) = \frac{25}{100} = \frac{1}{4}, \quad P(B) = \frac{20}{100} = \frac{1}{5}$$
$$P(A \cap B) = \frac{8}{100} = \frac{2}{25}$$

Percentage of those who read A but not B

$$\therefore P(A \cap \bar{B}) = P(A) - P(A \cap B) = \frac{25}{100} - \frac{8}{100} = \frac{17}{100} = 17\%$$

And,

Percentage of those who read B but not A

$$P(\bar{A} \cap B) = P(B) - P(A \cap B) = \frac{20}{100} - \frac{8}{100} = \frac{12}{100} = 12\%$$

If P(C) denotes the percentage of those who look into an advertisement , then from the given data we obtain

$$\Rightarrow P(C) = \frac{3}{10} \times \frac{17}{100} + \frac{2}{5} \times \frac{3}{25} + \frac{1}{2} \times \frac{2}{25}$$

$$\Rightarrow P(C) = 13.9\%$$

Q. 35 The line x = y touches a circle at the point (1,1). If the circle also passes through the point (1, - 3) , then its radius is :

Option 1:
3

Option 2:
$2\sqrt{2}$

Option 3:
2

Option 4:
$3\sqrt{2}$

Correct Answer:
$2\sqrt{2}$

Solution:

General form of a circle -

$$x^2 + y^2 + 2gx + 2fy + c = 0$$

- wherein

centre = $(-g, -f)$

radius =

Family of circle touches the line - **Equation of**

the family of circles which touch

$y - y_1 = m(x - x_1)$ at (x_1, y_1) **for any nite m is**
$(x - x_1)^2 + (y - y_1)^2 + \lambda\{(y - y_1) - m(x - x_1)\} = 0$

- From tha family of circle and line circle touch the

line .....(1)

$x - y = 0$ at point (1,1)

$(x-1)^2 + (y-1)^2 + \lambda(x-y) = 0$

It passes through (1 , -3)

$16 + \lambda(4) = 0$

$\lambda = -4$

Put $\lambda = -4$ in (1)

$(x-1)^2 + (y-1)^2 + (-4)(x-y) = 0$

$=> x^2 + y^2 - 6x + 2y + 2 = 0$

$r = \sqrt{g^2 + f^2 - c}$

$r = 2\sqrt{2}$

$\therefore$ correct option is (2)

Q. 36 The minimum distance of from equals

Option 1:

Unbalanced Eqn

Option 2:

Unbalanced Eqn

Option 3:

Unbalanced Eqn

Option 4:

Unbalanced Eqn

Correct Answer:

Unbalanced Eqn

Solution:
As we have learnt in

Equation of Circle:

The equation of the circle whose center is at the point Z_0 and have radius r is given by

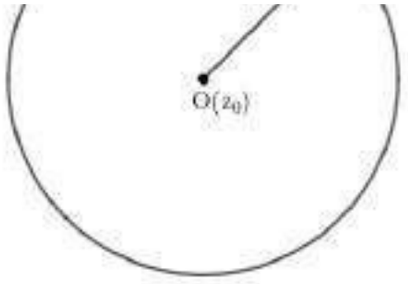
$$|z - z_0| = r$$

If the center is origin then, $z_0 = 0$, hence equation reduces to |z| = r

Interior of the circle is represented by $|z - z_0| < r$

The exterior is represented by $|z - z_0| > r$

Here z can be represented as x + iy and Z_0 is represented by $x_0 + iy_0$



-

|z - 1 - i| = 2 is the equation of a circle with centre (1,1) and radius = 2 units.

$z_1 = 3 + 4i$ is a point (3,4), the minimum distance between them will be “distance between point (3,4) and (1,1) minus radius”, so

$$\text{Minimum distance} = \sqrt{(3-1)^2 + (4-1)^2} - 2$$
$$= \sqrt{4+9} - 2 = \sqrt{13} - 2$$

so the correct option is (d)

Q. 37

Find the skew-hermitian matrix of matrix $\begin{bmatrix} i & 1-i & 2 \\ -1-i & 3i & i \\ -2 & i & 0 \end{bmatrix}$.

Option 1:

$\begin{bmatrix} -i & -1+i & -2 \\ 1+i & -3i & -i \\ 2 & -i & 0 \end{bmatrix}$

Option 2:

$$\begin{bmatrix} -2 & i & 0 \end{bmatrix}$$

Option 3:

$$\begin{bmatrix} i & -1+i & -2 \\ 1+i & 3i & -i \\ 2 & -i & 0 \end{bmatrix}$$

Option 4:

$$\begin{bmatrix} -i & -1+i & 2 \\ 1+i & 3i & -i \\ -2 & -i & 0 \end{bmatrix}$$

Correct Answer:

$$\begin{bmatrix} -i & -1+i & -2 \\ 1+i & -3i & -i \\ 2 & -i & 0 \end{bmatrix}$$

Solution:

Skew-hermitian matrix -

Skew-hermitian matrix

A square matrix i .e.

$\mathrm{A} = [\mathrm{a_{ij}}]_{\mathrm{n\times n}}$ is said to be Skew-Hermitian matrix if $a_{ij} = -\overline{a_{ij}}$ $\forall$ i, j,

$\mathrm{A}^{\theta} = -\mathrm{A}, \quad [\text{where } \mathrm{A}^{\theta} \text{ is conjugate transpose of matrix A}]$

We know that when we take the transpose of a matrix, its diagonal elements remain the same, and while taking conjugate we just change sign from +ve to -ve OR -ve to +ve in imaginary part of all elements, So to satisfy the condition A? = - A, all diagonal element must be purely imaginary. As A? = - A so

$\Rightarrow a_{ii} = 0$

Hence all diagonal element should be purely imaginary

-

rst, we take the transpose and then it's conjugate and equate it to -A.

$$A' = \begin{bmatrix} i & -1-i & -2 \\ 1-i & 3i & i \\ 2 & i & 0 \end{bmatrix}$$

now taking conjugate of the transpose

$$\overline{A'} = \begin{bmatrix} -i & -1+i & -2 \\ 1+i & -3i & -i \\ 2 & -i & 0 \end{bmatrix} = -A$$

hence option (a) is correct

Q. 38 Find the sum of rst 15 terms of series $1 + 3 + 7 + 13 + ...$

Correct Answer:
Correct Answer:
1135

Solution:

If the di erences of successive terms of a series are in AP -

If the di erences of successive terms of a series are in AP If the di erences of successive terms of a series are in A.P., we can nd the nth term of the series by the following steps : Step 1- Denote the nth term by Tn and the sum of the series up to n terms by Sn. Step 2- Rewrite the given series with each term shifted by one place to the right. Step 3- Now, subtract the second expression of Sn from the rst expression to obtain general term Tn -

$$S_n = 1 + 3 + 7 + 13 + ... + T_n \quad ....(i)$$
$$S_n = \quad 1 + 3 + 7 + ... + T_{n-1} + T_n \quad ...(ii)$$

Equation (i)-(ii)

$$0 = 1 + 2 + 4 + 6.... - T_n$$
$$T_n = 1 + 2(\frac{n(n-1)}{2})$$
$$T_n = n^2 - n + 1$$
$$S_n = \sum_{1}^{15} T_n$$
$$S_n = \frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)}{2} + n$$
$$S_n = \frac{1}{3}\left(n^3 + 2n\right)$$
$$S_{15} = 1135$$

Q. 39 In triangle ABC, if a=2, b=1 and $\angle C = 60^\circ$ then nd other two angles ?

Option 1:

$\frac{\pi}{6}, \frac{\pi}{2}$

Option 2:

Option 3:

$\frac{\pi}{12}, \frac{7\pi}{12}$

Option 4:

None of these

Correct Answer:

$\frac{\pi}{6}, \frac{\pi}{2}$

Solution:

Solution of Triangles (Part 1) -

solution of Triangles (Part 1)- Till now we have learned di erent rules and properties of triangles. Now see the application and use of these rules to solve a triangle in di erent situations. In a triangle, there are six variables, three sides (say a, b, c) and three angles (say A, B, C). If any three of these six variables (except all the angles A, B, C) is given, then the triangle is known completely. And the other three variables can be expressed in terms of the given variables and unknown variables can be calculated.

There are di erent cases that arise when a few components of the triangle are given. Case 1 When three sides (a, b and c) of a triangle is given The remaining variables can be found by using the following formulae

where, $2s = a + b + c$

(ii) To find angles, use cosine rule
$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$, similarly angle B can be found
For angle C, use $180^0 - \text{A} - \text{B} = \text{C}$

(iii) Angles can also be calculated
usimg half angle formula
$\tan \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$

-

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$$\frac{1}{2} = \frac{4 + 1 - c^2}{4}$$

$$c = \sqrt{3}$$

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$\frac{\sin A}{2} = \frac{\sin B}{1} = \frac{\frac{\sqrt{3}}{2}}{\sqrt{3}}$$

$$\sin B = \frac{1}{2}$$

$$B = \frac{\pi}{6}$$

$$A = \frac{\pi}{2}$$

Q. 40 Find the number of the solution of x for which

Correct Answer:
Correct Answer:
0

Solution: Important Points to remember while solving trigonometric equations -

Important Points to remember while solving trigonometric equations

1. While solving a trigonometric equation, squaring the equation at any step should be avoided as much as possible. If squaring is necessary, check the solution for extraneous values.
2. Never cancel terms containing unknown terms on the two sides which are in product. It may cause the loss of a genuine solution.
3. The answer should not contain such values of angles which make any of the terms unde ned or in nite.
4. Domain should not change while simplifying the equation. If it changes, necessary corrections must be made.
5. Check that the denominator is not zero at any stage while solving the equations.

-

$$\frac{\tan 3x - \tan 2x}{1 + \tan 3x \tan 2x} = \tan 3x - 2x = \tan x = 1$$

$$\Rightarrow \quad x = n\pi + \frac{\pi}{4}$$

$[\text{using } \tan\theta = \tan\alpha,\ \theta = n\pi + \alpha]$

But for this value of x

$$\tan 2x = \tan\left(2n\pi + \frac{\pi}{2}\right) = \infty$$

which dose not satisfy the given equation

Hence, there is no solution

Q. 41 If ,then at is ?

Option 1:
$\sin y$

Option 2:
$-x \cos y$

Option 3:
e

Option 4:
$\sin y - x \cos y$

Correct Answer:
e

Solution:

Di erentiation of Function and Relation -
Di erentiation of Function and Relation To solve the question of the type where functional relation in two independent variables with some conditions are given and asked to nd the derivative of
the function at some value of x or it is asked to nd the function.
Since, there are two independent variables in the functional relation we can di erentiate the relation w.r.t. any one variable considering another variable constant,
Let's go through some illustration to understand how to deal with such questions. **Illustration 1**

$$\text{Let } \mathrm{f}\left(\frac{\mathrm{x}+\mathrm{y}}{2}\right)=\frac{\mathrm{f}(\mathrm{x})+\mathrm{f}(\mathrm{y})}{2} \text{ for all real . x and y. If } \mathrm{f}'(0) \text{ exists and equal to } -1 \text{ and } \mathrm{f}(0)=1. \text{ Then } \mathrm{f}'(\mathrm{x}) \text{ is}$$

$f\left(\frac{x}{2}\right) = \frac{1}{2}[f(x)+1] \quad \Rightarrow f(x) = 2f_i\left(\frac{x}{2}\right) - 1 \qquad \ldots(ii)$

Now,

$$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$$

$$= \lim_{h\to 0} \frac{f\left(\frac{2x+2h}{2}\right) - f(x)}{h}$$

$$= \lim_{h\to 0} \frac{\frac{f(2x)+f(2h)}{2} - f(x)}{h} \qquad [\text{ using (i)}]$$

$$= \lim_{h\to 0} \frac{f(2x)+f(2h)-2f(x)}{2h}$$

$$= \lim_{h\to 0} \frac{2f(x)-1+f(2h)-2f(x)}{2h} \qquad [\text{ using (ii)}]$$

$$\Rightarrow \lim_{h\to 0} \frac{f(2h)-1}{2h} = f'(0)$$

$$\therefore \quad f'(x) = -1$$

-

$$\sin y + e^{-x\cos y} = e$$

differentiate with respect to x

$$\cos y\frac{dy}{dx} + e^{-x\cos y}\left\{(-x)\left(-\sin y\frac{dy}{dx}\right) + \cos y(-1)\right\} = 0$$

$$\cos y\frac{dy}{dx} + x\sin y e^{-x\cos y}\frac{dy}{dx} - \cos y e^{-x\cos y} = 0$$

$$\frac{dy}{dx} = \frac{\cos y e^{-x\cos y}}{\cos y + x\sin y e^{-x\cos y}}$$

$$\frac{dy}{dx}|_{(1,\pi)} = \frac{\cos\pi e^{-\cos\pi}}{\cos\pi + \sin\pi e^{-\cos\pi}} = \frac{-1\times e}{-1+0} = e$$

Q. 42 The number of 4 letter words (with or without meaning) that can be formed from the eleven letters of the word 'EXAMINATION' is _____,

Option 1:

$8!$

Option 2:

$\frac{8!}{2!2!}$

Option 3:

3600

Option 4:

$24548!$

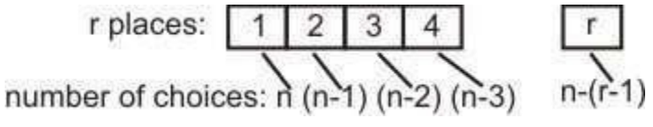
Correct Answer:

$24548!$

Solution:

PERMUTATION AS AN ARRANGEMENT -

Permutation basically means the arrangement of things. And when we talk about arrangement then the order becomes important if the things to be arranged are di erent from each other (when things to be arranged are the same then order don't have any role to play). So in permutations order of arrangement becomes important. Arranging n objects taken r at a time is equivalent to lling r places from n things.



So the number of ways of lling n places with r objects = n(n - 1) (n - 2) ... (n - r + 1)

$(n-1)!$ $n-1$

Where $r \leq n$ and $r \geq 0$

The number of ways arranging n di erent objects taken all at a time = ${}^{n}P_{n} = n!$.

-

APPLICATIONS OF SELECTIONS -I -
Let us take an example of Selecting things from two or more di erent groups:

Out of 5 men and 6 women in how many ways can a committee of 5 members be selected such that at least 2 members are women?

Solution:

At Least 2 members are women implies that there could be 2 women or 3 men or 3 women or 2 men or All 5 are women in the committee. Thus, the required number of ways are
2 women + 3 men =

3 women + 2 men =

4 women + 1 men = ${}^{6}\mathrm{C}_3 \times {}^{5}\mathrm{C}_2$

5 women = ${}^{6}\mathrm{C}_3 \times {}^{5}\mathrm{C}_2$

So, the total number of ways ${}^{6}\mathrm{C}_4 \times {}^{5}\mathrm{C}_1$

- ${}^{6}\mathrm{C}_5$

$$= {}^{6}\mathrm{C}_2 \times {}^{5}\mathrm{C}_3 + {}^{6}\mathrm{C}_3 \times {}^{5}\mathrm{C}_2 + 6\mathrm{C}_4 \times {}^{5}\mathrm{C}_1 + {}^{6}\mathrm{C}_5 = 431$$

EXAMINATION 2N, 2A, 2I, E, X, M, T, O

Case I All are di erent so

Case II 2 same and 2 di erent so $^{3}C_{1} \cdot ^{7}C_{2} \cdot \frac{4!}{2!} = 756$

Case III 2 same and 2 same so $^{3}C_{2} \cdot \frac{4!}{2! \cdot 2!}$ = 18

Total = 2454

Correct Option (4)

Q. 43 The number of real roots of the equation,

$e^{4x} + e^{3x} - 4e^{2x} + e^{x} + 1 = 0$ is :

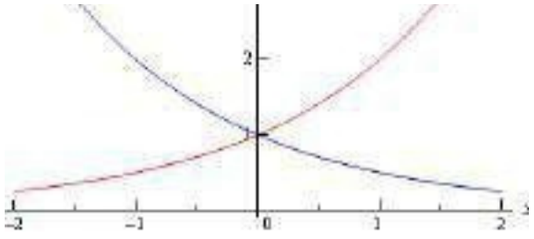
Correct Answer:
Correct Answer:
1

Solution:

Transcendental function -
Transcendental functions: the functions which are not algebraic are called transcendental functions. Exponential, logarithmic, trigonometric and inverse trigonometric functions are transcendental functions.
Exponential Function: function f(x) such that

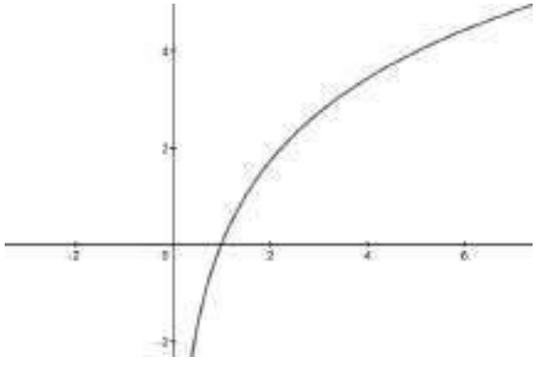
$f(x) = a^{x}$ is known as an exponential function.

$\text{base}: \quad a > 0, a \neq 1$
$\text{domain}: x \in \mathbb{R}$
$\text{range}: f(x) > 0$

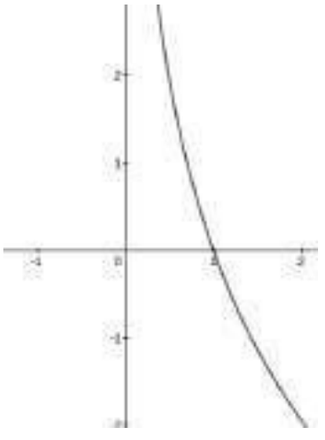


Logarithmic function: function f(x) such that $f(x) = \log_a x$ is called logarithmic function

$\text{base}: \quad a > 0, a \neq 1$
$\text{domain}: x > 0$
$\text{range}: f(x) \in \mathbb{R}$



If a > 1



If a < 1

Properties of Logarithmic Function

4. $\log_a a = 1$
5. $\log_{b^m} a = \frac{1}{m} \log_b a$
6. $\log_b a = \frac{1}{\log_a b}$
7. $\log_b a = \frac{\log_m a}{\log_m b}$
8. $a^{\log_a m} = m$
9. $a^{\log_c b} = b^{\log_c a}$
10. $\log_m a = b \Rightarrow a = m^b$

-

Quadratic Equation -
The root of the quadratic equation is given by the formula:

$$x = \frac{-b \pm \sqrt{D}}{2a}$$

or

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Where D is called the discriminant of the quadratic equation, given by $D = b^2 - 4ac$,

-

Let

Now the equation

$t^4 + t^3 - 4t^2 + t + 1 = 0$
$t^2 + t - 4 + \frac{1}{t} + \frac{1}{t^2} = 0$
$\left(t^2 + \frac{1}{t^2}\right) + \left(t + \frac{1}{t}\right) - 4 = 0$

Let $\mathrm{t} + \dfrac{1}{\mathrm{t}} = \alpha$

$(\alpha^2 - 2) + \alpha - 4 = 0$
$\alpha^2 + \alpha - 6 = 0$
$\alpha^2 + \alpha - 6 = 0$

$\alpha = -3, 2$

Only positive value possible so $\alpha = 2 \Rightarrow \quad \mathrm{e}^x + \mathrm{e}^{-\mathrm{x}} = 2$

x=0 is the only solution.

Q. 44 A random variable X has the following probability distribution:

$X:$	1	2	3	4	5
$P(X):$	K^2	$2K$	K	$2K$	$5K^2$

Then $P(X > 2)$ is equal to:

Option 1:
$\dfrac{7}{12}$

Option 2:
$\dfrac{23}{36}$

Option 3:

Option 4:

$\frac{1}{6}$

Correct Answer:

$\frac{23}{36}$

Solution:

Random Variables and its Probability Distributions -

A random variable is a real valued function whose domain is the sample space of a random experiment. It is a numerical description of the outcome of a statistical experiment.

-

$$\sum P_i = 1 \Rightarrow 6k^2 + 5k = 1$$

$$\Rightarrow 6k^2 + 5k - 1 = 0$$

$$\Rightarrow k = \frac{1}{6},\ k = -1\ (\text{invalid})$$

$$P(x > 2) = k + 2k + 5k^2$$

$$= \frac{1}{6} + \frac{2}{6} + \frac{5}{36} = \frac{6 + 12 + 5}{36} = \frac{23}{36}$$

Correct Option 2

Q. 45 If the distance between the plane, and the plane containing the lines and $\frac{\quad}{2} = \frac{\quad}{6} = \frac{\quad}{\lambda}$ $(\lambda \in \mathbf{R})$ is equal to $\frac{\quad}{\sqrt{633}}$, then k is equal to _____.

Correct Answer:
Correct Answer:
3

Solution:

Distance of a Point From a Plane -
Cartesian Form Let P(x1, y1, z1) be the given point

with position vector

$\vec{\mathbf{a}}$ and ax + by + cz + d = 0 be the Cartesian equation of the given plane. Then

$$\vec{a} = x_1\hat{i} + y_1\hat{j} + z_1\hat{k}$$
$$\vec{n} = a\hat{i} + b\hat{j} + c\hat{k}$$

Hence, from Vector form of the perpendicular from P to the plane is

$$\left|\frac{\left(x_1\hat{i} + y_1\hat{j} + z_1\hat{k}\right) \cdot (a\hat{i} + b\hat{j} + c\hat{k}) + d}{\sqrt{a^2 + b^2 + c^2}}\right| = \left|\frac{ax_1 + by_1 + cz_1 + d}{\sqrt{a^2 + b^2 + c^2}}\right|$$

-

Lines must be intersecting

distance of plane contains given lines from given plane is same as distance between point $(-3, -2, 1)$ from given plane.

Required distance equal to

$$\frac{|-69+20-2+48|}{\sqrt{529+100+4}} = \frac{3}{\sqrt{633}} = \frac{k}{\sqrt{633}} \Rightarrow k = 3$$

Correct Option 4

English

Q. 1 Change the speech.

Alright, yes, "I was wrong and you were right", he said.

Option 1:
He admitted that he was wrong and I have been right.

Option 2:
He admitted that I was wrong and he was right.

Option 3:
He admitted that he had been wrong and I had been right.

Option 4:
He admitted that I was wrong and you were right.

Option 5:
He admitted that he has been wrong and I have been right.

Correct Answer:
He admitted that he had been wrong and I had been right.

Solution:
Appropriate and gramattically right.

Q. 2 Complete the following phrasal verb from the given choices:

You must ___ your sweater; otherwise, you will catch cold.

Option 1:

Put on

Option 2:

Wear

Option 3:

Put out

Option 4:

Put off

Option 5:

Put up

Correct Answer:

Put on

Solution:

Wear is wrong. The word means to carry something. Hence, put on is the best choice.

Q. 3 Read the following passage and answer the question that follows: History cannot be altered and its myriad paths would follow their own destined course. However, it would not be entirely futile to indulge our imagination in picturing the course of history if such and such an event had not taken place. One such occurrence is the British colonization of India. The British colonized India gradually and established their rule over the country for more than a century. If the British colonization had not happened at all, where would we be today?

To begin with, we would not have suffered all that we did under the British in the process of winning freedom from them. Today, India's history bears the scars of British colonialism and exploitation that the memory finds hard to erase. The country was forced to undergo humiliation in terms of its pride besides suffering political, economic and social exploitation. In colonized India, the people were stripped of their rights in every sense. They could not participate in the political and economic development of their own country. They were denied the right to form their own government and run the administration of their country. The country's primary institutions including those related to judiciary, defense and law were run by outsiders who did not care about the welfare of the nation and its people. The people's attempt to win their rights only brought about suffering and death. It was not only loss of wealth and prosperity that the masses had to endure; thousands of people lost their lives in the fight for freedom from the British yoke. The country's nationalist leaders paid a heavy price in their attempt to secure freedom for India. All this would not have happened if the British had not come to reign in India.

Which of the following is synonymous to freedom?

Option 1:
Right to act

Option 2:
Right to protest

Option 3:
Self-rule

Option 4:
Right to discuss

Option 5:
Right to speak

Correct Answer:
Self-rule

Correct Answer:

Solution:
Indians had to fight the British to establish self-rule

Q. 4 Find out the pair of words from the options which exhibits the same relationship as shown by the question pair of words:

Lull: Break

Option 1:
Destitution: Penury

Option 2:
Paucity: A uence

Option 3:
A uent: Penurious

Option 4:
Misogamist: Brawn

Correct Answer:
Destitution: Penury

Solution:
Lull means a break. Similarly, destitution means penury.

Q. 5 Find out the pair of words from the options which exhibits the same relationship as shown by the question pair of words:

Buttress: Thwart

Option 1:
Belligerence: Hostility

Option 2:
Matrix: Network

Option 3:
Urbane: Uncouth

Option 4:
Humility: Modesty

Correct Answer:
Urbane: Uncouth

Solution:
The question pair has antonyms. Thwart and buttress are also antonyms.

Q. 6 Find out the pair of words from the options which exhibits the same relationship as shown by the question pair of words:

Propitiate: Favour

Option 1:
Beating: Improvement

Option 2:
Pampering: Mollify

Option 3:
Vicious: Scraggily

Option 4:
Alienate: Defying

Correct Answer:
Pampering: Mollify

Solution:
Propitiating is done to win a favour. Similarly, by pampering we may mollify someone

Q. 7 Find out the pair of words from the options which exhibits the same relationship as shown by the question pair of words:

Plateau: Altitude

Option 1:
Meticulous: Victory

Option 2:
Fraternity: Disunity

Option 3:
Palpable: Sensible

Option 4:
Astonish: Dexterous

Correct Answer:
Meticulous: Victory

Solution:
By being on plateau (the raised part of land) the altitude is enhanced, similarly, by being meticulous, victory may be achieved.

Q. 8 Rearrange the following paragraph to answer the following question

(A) Therefore, it is an encouraging symbol, but we must watch against our rising pace of populace expansion.

(B) De ciency mitigation is one of the most momentous programmes.

(C) Even though this modi cation is sluggish and steady, it appears to be unswerving.

(D) The degree of success of this programme can be gauged when we examine the share of citizens underneath de ciency line.

Which sentence should come SECOND in the paragraph?

Option 1:
A

Option 2:
B

Option 3:
C

Option 4:
D

Correct Answer:
C

Solution:
The correct arrangement of sentences is: BCAD

B- This is the opening line of the paragraph which establishes the idea of de ciency mitigation

C- C and B form a mandatory pair. Here 'this modi cation refers to de ciency mitigation.

A- This is the concluding sentence of the paragraph.

D-This sentence further elaborates about the triumph of this programme.

Q. 9 Rearrange the following paragraph to answer the following question

(A) Therefore, it is an encouraging symbol, but we must watch against our rising pace of populace expansion.

(B) De ciency mitigation is one of the most momentous programmes.

(C) Even though this modi cation is sluggish and steady, it appears to be unswerving.

(D) The degree of success of this programme can be gauged when we examine the share of citizens underneath de ciency line

Which sentence should come FOURTH in the paragraph?

Option 1:
A

Option 2:
B

Option 3:
C

Option 4:
D

Correct Answer:
D

Solution:
The correct arrangement of sentences is: BCAD

B- This is the opening line of the paragraph which establishes the idea of de ciency mitigation

C- C and B form a mandatory pair. Here 'this modi cation refers to de ciency mitigation.

A- This is the concluding sentence of the paragraph.

D-This sentence further elaborates about the triumph of this programme.

Q. 10 Rearrange the following paragraph to answer the following question

(A) Therefore, it is an encouraging symbol, but we must watch against our rising pace of populace expansion.

(B) De ciency mitigation is one of the most momentous programmes.

(C) Even though this modi cation is sluggish and steady, it appears to be unswerving.

(D) The degree of success of this programme can be gauged when we examine the share of citizens underneath de ciency line

Which sentence should come THIRD in the paragraph?

Option 1:
A

Option 2:
B

Option 3:
C

Option 4:
D

Correct Answer:
A

Solution:
The correct arrangement of sentences is: BCAD

B- This is the opening line of the paragraph which establishes the idea of de ciency mitigation

C- C and B form a mandatory pair. Here ‘this modi cation refers to de ciency mitigation.

A- This is the concluding sentence of the paragraph.

D-This sentence further elaborates about the triumph of this programme.

Q. 11 Rearrange the following paragraph to answer the following question

(A) Therefore, it is an encouraging symbol, but we must watch against our rising pace of populace expansion.

(B) De ciency mitigation is one of the most momentous programmes.

(C) Even though this modi cation is sluggish and steady, it appears to be unswerving.

(D) The degree of success of this programme can be gauged when we examine the share of citizens underneath de ciency line

Which sentence should come FIRST in the paragraph?

Option 1:
A

Option 2:
B

Option 3:
C

Option 4:
D

Correct Answer:
B

Solution:
The correct arrangement of sentences is: BCAD

B- This is the opening line of the paragraph which establishes the idea of de ciency mitigation

C- C and B form a mandatory pair. Here ‘this modi cation refers to de ciency mitigation.

A- This is the concluding sentence of the paragraph.

D-This sentence further elaborates about the triumph of this programme.

Logical Reasoning

Q. 1 Find out which of the gure formed after combining the gures

Option 1:

Option 2:

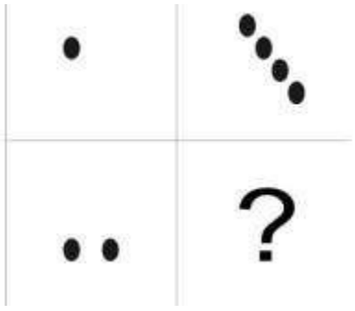
Option 3:

Option 4:

Correct Answer:

Solution:
it is clear from the gure

Q. 2 Find the missing gure in the gure matrix



Option 1:

Option 2:

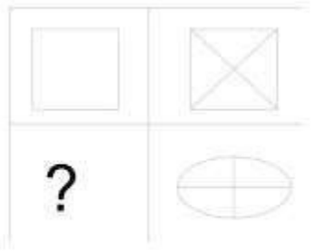
Option 3:

Option 4:

Correct Answer:

Solution:
in the matrix we have four me the dot in upper row so clearly we have 8 circles according to upper row

Q. 3 Find the missing gure in the gure matrix



Option 1:


Option 2:

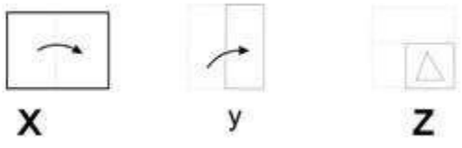

Option 3:

Option 4:

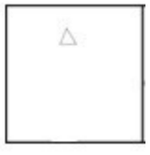
Correct Answer:

Solution:
As shown in the figure first figure is blank mul ple lines in the second figure. So we have second figure ellipse with lines so we should have blank figure .

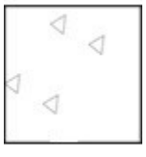
Q. 4 Consider the three gures Marked By X, Y and Z
From amongest the four alternatives gures . Select the one showing the one unfolded position of Z



Option 1:
Option 1:



Option 2:
Option 2:

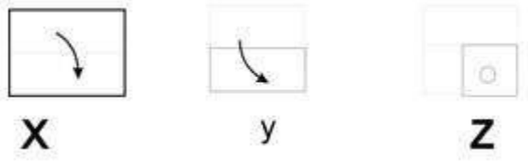


Option 3:
Option 3:

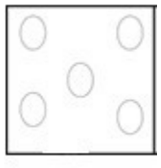
Option 4:

Correct Answer:

Q. 5 Consider the three gures Marked By X, Y and Z
From amongest the four alternatives gures . Select the one showing the one unfolded position of Z



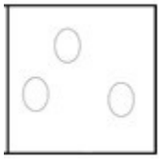
Option 1:



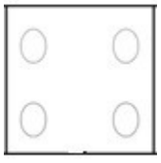
Option 2:

Option 3:

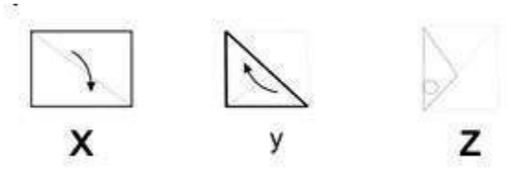
Option 4:



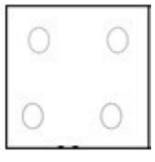
Correct Answer:



Q. 6 Consider the three gures Marked By X, Y and Z
From amongest the four alternatives gures . Select the one showing the one unfolded position of Z

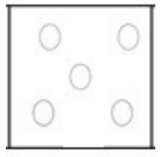


Option 1:

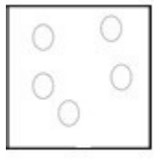


Option 2:

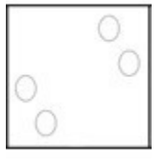
Option 3:



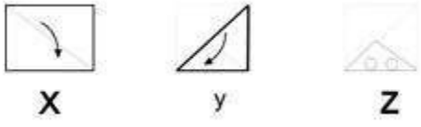
Option 4:



Correct Answer:

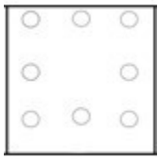


Q. 7 Consider the three gures Marked By X, Y and Z
From amongest the four alternatives gures .
Select the one showing the one unfolded position of Z

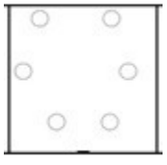


Option 1:

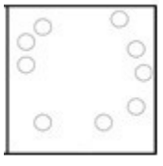
Option 2:



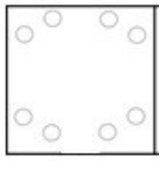
Option 3:



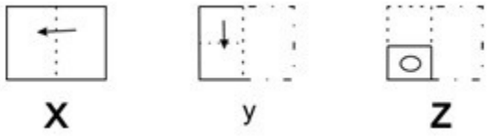
Option 4:



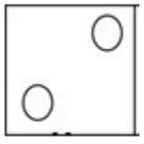
Correct Answer:



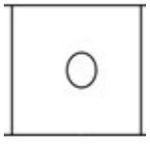
Q. 8 Consider the three gures Marked By X, Y and Z
From amongest the four alternatives gures . Select the one showing the one unfolded position of Z



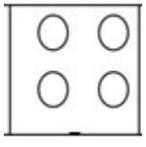
Option 1:



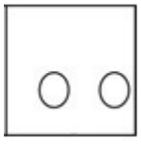
Option 2:



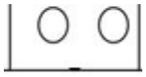
Option 3:



Option 4:



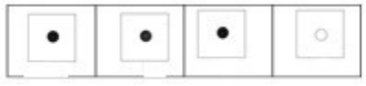
Correct Answer:



Q. 9 Select the arrangement of gures which follows the principle

Principle :- The Even number gure have darken dots

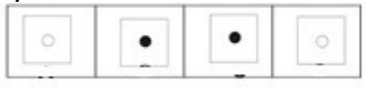
Option 1:



Option 2:

Option 3:

Option 4:



Correct Answer: