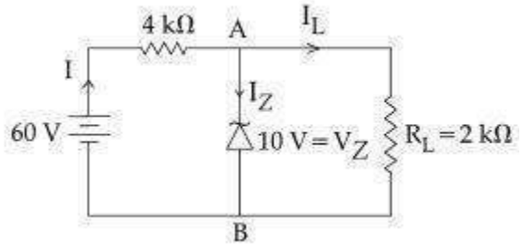
Physics

Q.1 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

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. 2 A car is moving with speed 30 m/s on a circular path of radius 500m. Its speed is increasing at the rate of $2m/s^2$.What is the acceleration of the car?

Option 1:
$2m/s^2$

Option 2:
$2.7m/s^2$

Option 3:
$1.8\ m/s^2$

Option 4:
$9.8\ m/s^2$

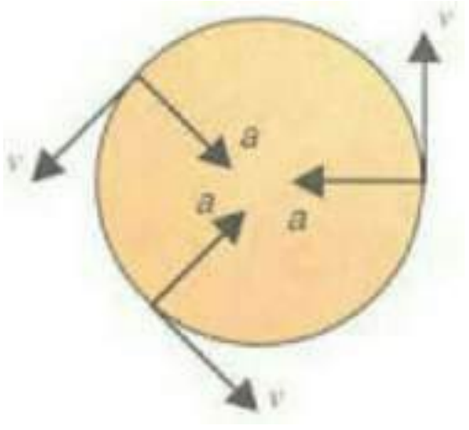
Correct Answer:
$2.7m/s^2$

Solution:
As we have learned-

Centripetal acceleration -

When a body is moving in a uniform circular motion, a force is responsible to change direction of its velocity.This force acts towards the centre of circle and is called centripetal force.Acceleration produced by this force is centripetal acceleration.

$$a_c = \frac{v}{r}$$



When a body is moving in circular motion,a centripetal acceleration acts along the radius and is directed towards the center of the crcular path and a tangential acceleration along the tangent.

Total acceleration in circular motion $= \sqrt{a_c^2 + a_t^2} = \sqrt{(\frac{\vartheta^2}{R})^2 + a_t^2}$

$$= \sqrt{(\frac{30 \times 30}{500})^2 + 2^2} = \sqrt{\frac{181}{25}} = 2.7\ m/s^2.$$

Q. 3 In nity number of the masses, each 1 kg , are placed along the X-axis at $x = \pm 1m, \pm 2m, \pm 4m, \pm 8m, \pm 16m, - - - - - \infty$. The magnitude of the resultant gravitational potential in terms of gravitational constant G at the origin is

Option 1:
2G

Option 2:
4G

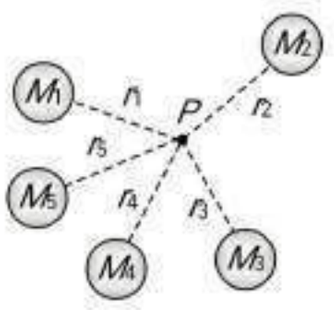
Option 3:
8G

Option 4:
G/2

Correct Answer:
4G

Solution:
As we learn

Superposition of Gravitational potential -



$$V = -G \sum_{i=1}^{i=n} \frac{M_i}{r_i}$$

$m_i \rightarrow$ Sum of mass

$r_i \rightarrow$ distances

- wherein

$$V = V_1 + V_2 + V_3 \cdots$$

$$= -\frac{GM}{r_1} - \frac{GM}{r_2} - \frac{GM}{r_3} \cdots$$

As we know $V = \frac{\quad}{r}$

$$|V| = \left|\frac{-Gm}{r}\right| = \frac{Gm}{r}$$

Total Potential (v) $= \frac{2Gm}{r}$ [because particle along the both sides]

$$V = 2Gm\left[1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + - - - - - - - - - - - - - \infty\right]$$ GP

$$= 2Gm\left[\frac{1}{1-\frac{1}{2}}\right]\left[As\ S_\infty = \frac{a}{1-r}\right]$$

$$V = \frac{2Gm}{\frac{1}{2}} = 4Gm$$

As, m =1 kg

So, V= 4G

Q. 4 Equal amount of an ideal monoatomic gas at 400K is lled in two cylinders A and B. The piston A is free to move while that of B is held xed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 45 K. Then the rise in temperature of gas in B is

Option 1:
100K

Option 2:
75K

Option 3:
55K

Option 4:
45K

Correct Answer:
75K

Solution:
The gas lled in monoatomic piston A is free to move i.e it is isobaric process. Piston B is xed i.e ir is isochoric process. If same amount of heat is given,

$$(\Delta Q)_{isobaric} = (\Delta Q)_{isochoric}$$

$$\mu C_p(\Delta T)_A = \mu C_u(\Delta T)_B$$

$$(\Delta T)_B = \left(\frac{C_P}{C_U}\right)(\Delta T)_A$$

$$= \gamma \times (\Delta T)_A$$

$$= \frac{5}{3} * 45 = 75K$$

Q. 5 If $\vec{P} = 3\hat{i} + 4\hat{j} + 7\hat{k}$ and $\vec{Q} = \hat{i} + 2\hat{j} + \hat{k}$ the value of magnitude of resolution of $\vec{P} - \vec{Q}$ is -

Option 1:
$\sqrt{45}$

Option 2:
$2\sqrt{11}$

Option 3:
$4\sqrt{11}$

Option 4:
$5\sqrt{11}$

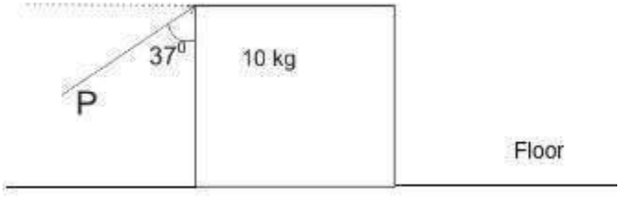
Correct Answer:
$2\sqrt{11}$

Solution:

$= 2i + 2j + 6k$

$\sqrt{(2)^2 + (2)^2 + 6^2} = \sqrt{4 + 4 + 36} = 2\sqrt{11}$

Q. 6 Find the value of pushing force P just to move the block. If the coe ecient of friction between block and the oor is given as $\mu = 0.6$.



Option 1:
55.6 N

Option 2:
60 N

Option 3:
35.5 N

Option 4:
50 N

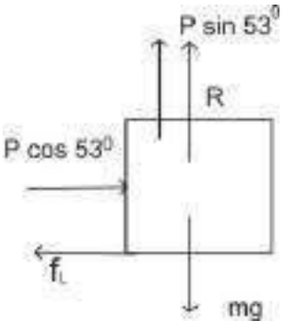
Correct Answer:
55.6 N

Solution:
Use

$F = \mu R$

F = Force

R = Reaction



For just tendancy to move

$$P\cos 53 = F_L$$

$$P\cos 53 = \mu R \qquad [R + P\sin 53^0 = mg]$$

$$P\frac{3}{5} = 0.6 \times \left[10 \times 10 - P\frac{4}{5}\right] \quad [R = mg - P\sin 53^0 = mg]$$

So $P\frac{3}{5} = 60 - \frac{2.4P}{5}$

$$\frac{5.4P}{5} = 60$$

$$P = \frac{60 \times 5}{5.4} = 55.6N$$

Q. 7 Calculate the acceleration of the system as shown in the gure , assume all the surfaces are smooth

Option 1:
g/3

Option 2:
g/4

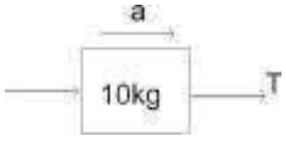
Option 3:
g/2

Option 4:
g

Correct Answer:
g/3

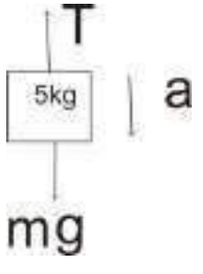
Solution:

FBD of 10 kg



$T = m_1 a - - - (i)$

FBD of 5 kg



$m_2 g - T = m_2 a - - - -(ii)$

By solving both the equation -

$n_1 + n_2 \quad 10 + 5 \quad 5$

Q. 8 There are 5000 turnes of a wire in every metre length of a long solenoid . If 4 ampere current is owing in rthe solenoid the approximate value of magnetic eld along its axis at one end will be

Option 1:
$6.3 \times 10^{-3} weber/m^2$

Option 2:
$25.1 \times 10^{-3} weber/m^2$

Option 3:
$6.3 \times 10^{-5} weber/m^2$

Option 4:
$12.6 \times 10^{-3} weber/m^2$

Correct Answer:
$12.6 \times 10^{-3} weber/m^2$

Solution:
As we have learned

Magnetic eld due to In nite length solenoid -

$$\alpha = 0, \beta = \frac{\pi}{2}$$

$$B_{end} = \frac{1}{2}(\mu_0 ni)$$

$$B_{end} = \frac{1}{2}(B_{in})$$

So,

Near one end

$$B_{end} = 1/2(\mu_u nI)$$

$$= 1/2(4\pi \times 10^{-7} \times 5000 \times 4)$$

$$= 12.6 \times 10^{-3} wb/m^2$$

Q. 9 The line joining the earth's surface joining the points where the eld is horizontal is

Option 1:
Magnetic Meridian

Option 2:
Magnetic Axis

Option 3:
Magnetic Equator

Option 4:
Magnetic Line

Correct Answer:
Magnetic Equator

Solution:
At a place of Equator -

$$B_V = 0$$

$$B \sin \phi = B$$

$$\phi = 0^\circ$$

At magnetic equator, the magnetic eld is in horizontal direction.

Q. 10 A screw gauge gives the following reading when used to measure the diameter of a wire:

Main scale reading is 50 mm

Circular sacle reading is 50mm

1mm of the main scale corresponds to 100 divisions of circular scale. The diameter of the wire is:

Option 1:
100 mm

Option 2:
50.05 mm

Option 3:
50.5 mm

Option 4:
99.5 mm

Correct Answer:
50.5 mm

Solution:
Least count of screw gauge = 0.01mm

Diameter = Division on circular scale x L.C + main scale reading

$$= \frac{50}{100} + 50$$

= 50.5 mm

Q. 11 Choose correct statement rearding Escape speed of body from earth.

Option 1:
It depends on mass of the body.

Option 2:
It depends on direction of projection of body.

Option 3:
It depends on height of location from where body is projected.

Option 4:
All of these.

Correct Answer:
It depends on height of location from where body is projected.

Solution:
Escape velocity (in terms of radius of planet) -

$$V_c = \sqrt{\frac{2GM}{R}}$$

$$V_c = \sqrt{2gR}$$

$V_c \rightarrow$ Escape velocity

$r \rightarrow$Radius of earth

For di erent height 'g' value would be di erent so it depends on height of location from where body is projected.

Q. 12 What is ratio of acceleration due to gravity at $h = \frac{R}{2}\ to\ \ h = \frac{R}{1000}$

Option 1:
0.983

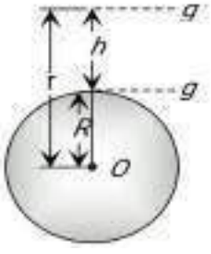
Option 2:
0.446

Option 3:
0.892

Option 4:
1.32

Correct Answer:
0.446

Solution:
Variation in 'g' with height -



$g' \rightarrow$ gravity at height h from surface of earth.

$r \rightarrow$ Radius of earth

$h \rightarrow$ height above surface

$$g' \alpha \frac{1}{r^2}$$

$$r = R + h$$

Value of g when h < <

R - Value of g decreases.

$r \rightarrow$ Radius of earth

$h \rightarrow$ height above surface of earth

at $h = \dfrac{R}{2}$

$$g_1{}' = \frac{GM}{(R+h)^2} = \frac{GM}{\left(R+\frac{R}{2}\right)^2} = \frac{4GM}{9R^2} = \frac{4}{9}g$$

at $h = \dfrac{R}{1000} \qquad (h << R)$

$$g_2{}' = g\left(1 - \frac{2h}{R}\right) = g\left(1 - \frac{2 \times R}{1000 \times R}\right) = \frac{998.g}{1000}$$

$$g' = \left(\frac{499}{500}\right) g$$

$$\frac{g_1{}'}{g_2{}'} = \frac{\left(\frac{4}{9}\right) g}{\left(\frac{498}{500}\right) g} = \frac{4 \times 500}{9 \times 499} = 0.446$$

Q. 13 3 mole of He is mixed with 2 mole of O2 . Then nd the value of $\dfrac{C_p}{C_v}$ for the mixture:

Option 1:

$\dfrac{5}{3}$

Option 2:

Option 3:
$\frac{17}{15}$

Option 4:
$\frac{29}{19}$

Correct Answer:
$\frac{29}{19}$

Solution:

for Monoatomic gas $\gamma = \frac{5}{3}$

for Diatomic gas $\gamma = \frac{7}{5}$

for Triatomic gas $\gamma = \frac{4}{3}$

For O2

$C_{V_2} = \frac{5}{2}RT$

$C_{P_2} = \frac{7}{2}RT$

$n_2 = 2$

For He

$C_{V_1} = \frac{3}{2}RT$

$C_{P_1} = \frac{5}{2}RT$

$n_1 = 3$

Q. 14 Two springs have a spring constant K1 and K2. These are the extended through a distance x1 and x2 respectively. If their elastic energies are equal. Then $\frac{x_1}{x_2}$ is equal to:

Option 1:
$\frac{K_1}{K_2}$

Option 2:
$\frac{K_2}{K_1}$

Option 3:
$\sqrt{\frac{K_1}{K_2}}$

Option 4:
$\sqrt{\frac{K_2}{K_1}}$

Correct Answer:
$\sqrt{\frac{K_2}{K_1}}$

Solution:
As we learn

Potential Energy stored in the spring -

$$U = \frac{1}{2}\,kx^2$$

- wherein

x= elongation or compression of spring from natural position

So $U = \frac{1}{2}Kx^2$ = elastic energy

$$U_1 = \frac{1}{2}K_1x_1^2$$

$$U_2 = \frac{1}{2}K_2x_2^2$$

U1 = U2

$$K_1x_1^2 = K_2x_2^2$$

$$\frac{x_1}{x_2} = \sqrt{\frac{K_2}{K_1}}$$

Q. 15 Which are the factor which cause a process to become irreversible

Option 1:
Friction

Option 2:
Inelastic deformation

Option 3:
Heat transfer due to nite temperature di erence between system and surrounding

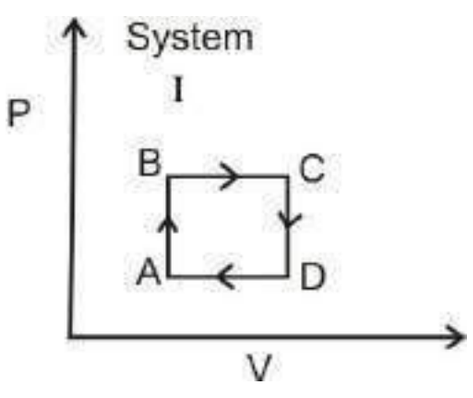
Option 4:
All of these

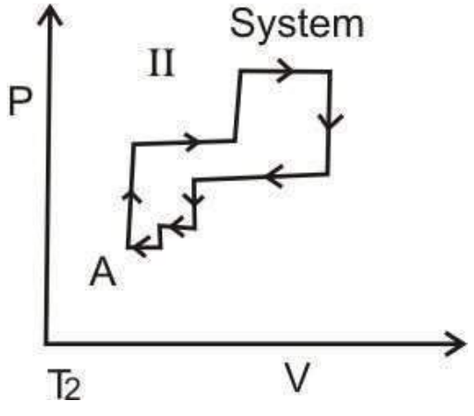
Correct Answer:
All of these

Solution: Condition of reversible process -

1) Complete absence of dissipative force. (Like friction, inelastic deformation etc.) 2) The process should be in nitely slowing. 3) The temperature of system must not di er appreciably from surrounding. (Finite temperature di erence heat transfer will occur which is irreversible) No process is reversible in true sense. e.g. extreme slow contraction of spring.

Q. 16 Two system starting from the same state A return to the same state A after performing a di erent path as shown in graph





Then choose the reaction between $\Delta U_I to \Delta U_{II}$

Where ΔU_I - Change in internal energy of system I

ΔU_{II} - Change in internal energy of system II

Option 1:

Option 2:
$\Delta U_I < \Delta U_{II}$

Option 3:
$\Delta U_I = \Delta U_{II}$

Option 4:
None of these

Correct Answer:
$\Delta U_I = \Delta U_{II}$

Solution:
Non Cyclic Process -

The series of changes involved do not return the system back to its initial state.

So $\Delta U \neq 0$ is this case

But for a cyclic process

$\Delta U = 0$

Q. 17 The ratio of radius of nuclei $_{13}Al^{27}$ and $_{52}Te^{125}$ is:

Option 1:
$\frac{3}{5}$

Option 2:

Option 3:

$\frac{9}{25}$

Option 4:

$\frac{25}{9}$

Correct Answer:

$\frac{3}{5}$

Solution:

$R \alpha A^{\frac{1}{3}}$

$\Rightarrow \frac{R_{Al}}{R_{Te}} = \left[\frac{A_{Al}}{A_{Te}}\right]^{\frac{1}{3}} = \left[\frac{27}{125}\right]^{\frac{1}{3}} = \frac{3}{5}$

Q. 18 The Q value for the given reaction is equal to -

$_1H^2 +_1 H^2 \rightarrow_2 He^4 + Q$

Binding energy per nuclear for detron ($_1H^2$)=1.1 Mev

Binding energy per nuclear for Helium $(_2He^4) = 7Mev$

Option 1:

10.5 Mev

Option 2:

13.4 Mev

Option 3:
23.6 Mev

Option 4:
9.7 Mev

Correct Answer:
23.6 Mev

Solution:
Q value -

$$X + Y \rightarrow Z + Q$$

$$Q = (M_x + M_y - M_z)C^2$$

M_x and M_y are mass of reactant

M_z is mass of product

So,

Q value -

$$= \Sigma BE_{Prod} - \Sigma BE_{React}$$

$$= (4 \times 7) - 2(2 \times 1.1) = 23.6Mev$$

Q. 19 Bragg's law for X-rays is -

Option 1:
$d \sin \Theta = 2n\lambda$

Option 2:
$2d \sin \theta = n\lambda$

Option 3:

Option 4:

$d \sin \Theta = n\lambda$

Correct Answer:

$2d \sin \theta = n\lambda$

Solution:

Bragg's law -

$$2d \sin \theta = n\lambda$$

(condition of constructive maxima)

d=distance between parallel lines

λ = wavelength

θ= angle between light & plane

Q. 20 The equivalerd of the Boolean expression

(A+B) B + (B+C) C + (A+C) A

Option 1:

$AB + AC + BC$

Option 2:

$\bar{A}B + \bar{A}C + BC$

Option 3:

abc

Option 4:

Correct Answer:
$A + B + C$

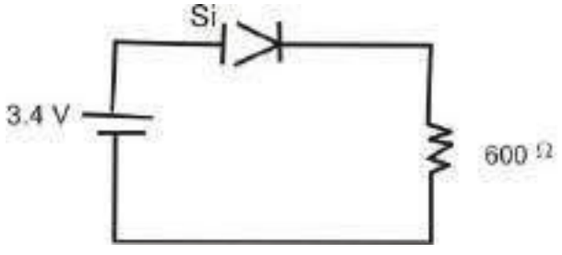
Solution:

$AB + B + BC + C + AC + A$

$B(A + 1) + C(B + 1) + A(C + 1)$

$A + B + C$

Q.21 Find the current through the circuit for Si diode`



Given that -

Knee voltage for Ge is 0.3 V

Knee voltage for Si is 0.7 V

Option 1:
4.5 A

Option 2:
5.6 A

Option 3:
4.5 mA

Option 4:
5.6 mA

Correct Answer:
4.5 mA

Solution:
Knee voltage of P-N junction -

It is de ned as that forward voltage at which the current through the junction starts rising rapidly with increase in voltage .

Knee voltage for Ge is 0.3 V

Knee voltage for Si is 0.7 V

$$I = \frac{3.4 - 0.7}{600} = \frac{2.7}{600} = 4.5\, mA$$

Q. 22 Centre of the mass of a hollow cone of height "h" from the top of the cone is at a distance

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

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

Option 3:

Option 4:

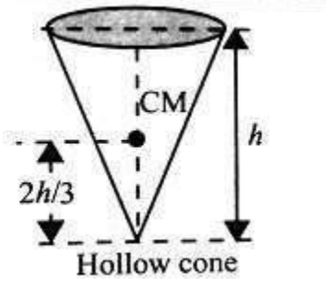
$\frac{3h}{2}$

Correct Answer:

$\frac{2h}{3}$

Solution:

Centre of mass lies at a distance of $\frac{2h}{3}$ from apex of cone.



Q. 23 A ring is rolling an inclined plane of inclination 45° The minimum value of the coe cient of friction between plane and body for pure rolling is

Option 1:

$\frac{1}{4}$

Option 2:

$\frac{1}{3}$

Option 3:

Option 4:

$\frac{3}{4}$

Correct Answer:

$\frac{1}{2}$

Solution:
As we learned

Condition for pure rolling on inclined plane -

$$\mu_s \geq \frac{\tan\Theta}{1+\frac{R^2}{K^2}}$$

- wherein

μ_s = limiting co cient of friction

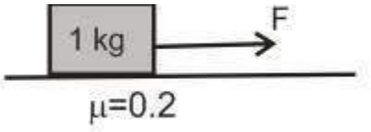
for pure rolling

$$\mu_s \geqslant \frac{tan\theta}{1+\frac{R^2}{K^2}}$$

for ring $\frac{R^2}{K^2}=1$

$$\mu \geqslant \frac{tan45}{1+1}=\frac{1}{2}$$

Q. 24 A time variable force is applied on block. Then nd work done by friction force for time interval t=0 to t=2 sec.



Option 1:

$-\frac{10}{3}J$

Option 2:

$+\frac{20}{3}J$

Option 3:

$-10J$

Option 4:

$+\frac{40}{3}J$

Correct Answer:

$-\frac{10}{3}J$

Solution:

As we learned

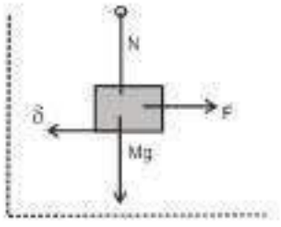
Work done by the frictional force is negative -

When the force is large enough to overcome the friction

-

as

at $t = 0 \quad F = 4N$



and $F_{friction} = \mu mg = 0.2 \times 10 = 2N$

So $(F > f)$

block will start moving.

as time increase force value decreases.

so at, F = 0 at t = 2sec.

But Block will stop moving

When $F = f_{max} = 2N$

So

$4 - 2t = 2$

$t = 1sec$

So at t = 1sec block will stop and it will be at rest upto t = 2sec.

So work done by friction force from t = 1 sec to t = 2 sec is zero.

Now for block

$$F = m.a = (1) \times \frac{\mathrm{d}v}{\mathrm{d}t} = 4 - 2t$$

$$V = 4t - \frac{2t^2}{2} + C_1$$

at t = 0 V = 0

Similarly

$$S = \frac{4t^2}{2} - \frac{t^3}{3} + C_2$$

at t = 0 S = 0

so $S = 2t^2 - \frac{t^3}{3}$

Now, $at\ t = 1$

$$S = (2 \times 1) - \frac{1}{3} = \frac{5}{3}m.$$

So for t = 0 to t = 2 sec -- S = 0

So

$$W_f = (-f \times S)_{0\,to\,1sec} + (-f \times S)_{1sec\,to\,2sec}$$

$$= (-2) \times \frac{5}{3} + (-2) \times 0$$

$$W_f = -\frac{10}{3}J$$

Q. 25 Choose the corect relation b/w V_{rms}, V_{avg}, V_{mp}

Option 1:
$V_{rms} > V_{avg} > V_{mp}$

Option 2:
$V_{rms} > V_{mp} > V_{avg}$

Option 3:

Option 4:
$V_{avg} > V_{rms} > V_{mp}$

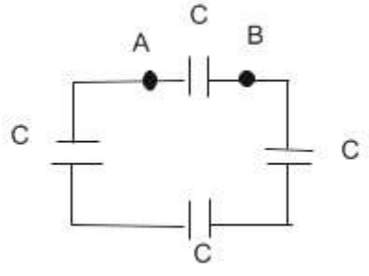
Correct Answer:
$V_{rms} > V_{avg} > V_{mp}$

Solution:
As we have learned

Relation between RMS speed, average speed and most probable speed -

$$V_{rms} > V_{avg} > V_{mp}$$

Q. 26 The equivalent capacitance between point A and B of given diagram is:



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

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

Option 3:

Option 4:

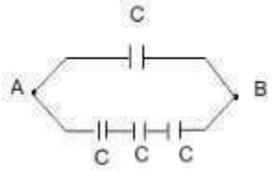
$\frac{C}{2}$

Correct Answer:

$\frac{4C}{3}$

Solution:

By rearranging



$$C_{eq} = C + \frac{C}{3} = \frac{4C}{3}$$

Q. 27 The magnitude of charge of electric dipole is 3.2 x 10^{-19} C and distance between them 2A0. Then the dipole moment is (in C- m):

Option 1:

9 x10-5

Option 2:

12x 10-14

Option 3:

6.4 x 10^{-29}

Option 4:
1.6 x 10-9

Correct Answer:
6.4 x 10-29

Solution:
Dipole moment M = q x l

$= 3.2 \times 10^{-19} \times 2 \times 10^{-10}$

$= 6.4 \times 10^{-29}$ C -m

Q. 28 what should be the height of transmitting antenna if TV telecast is to cover a radius 128 Km

Option 1:
1280 m.

Option 2:
1560 m.

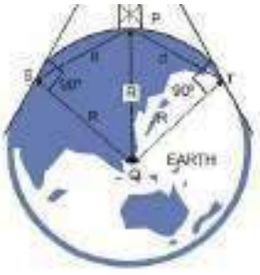
Option 3:
640 m.

Option 4:
320 m.

Correct Answer:
1280 m.

Solution:
Range of transmitting antenna -

$$d_T = \sqrt{2h_T R}$$



$h_T =$ height of antenna

$R =$ Radius of earth

$$d = \sqrt{2hR} = h = \frac{d^2}{2R} = h = \frac{(128 \times 10^3)^3}{2 \times 6400 \times 10^3} = \frac{128 \times 128 \times 10^6}{7 \times 64 \times 10^5}$$

d =1280 meter

Q. 29 Using ohm's law experiment we can nd the value of

Option 1:
static resistance

Option 2:
dynamic resistance

Option 3:
both (a) and (b)

Option 4:
None of the above

Correct Answer:
static resistance

Solution:
To determine resistance of given wire by plotting graph between V versus I -

So we can draw the graph by using Ohm's law and the slope of that graph gives the value of static resistance. -

$$I \alpha V$$

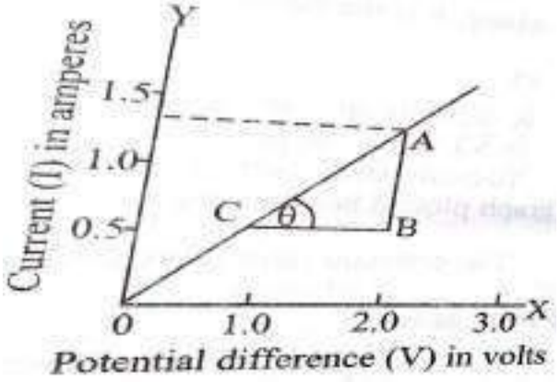
V= IR

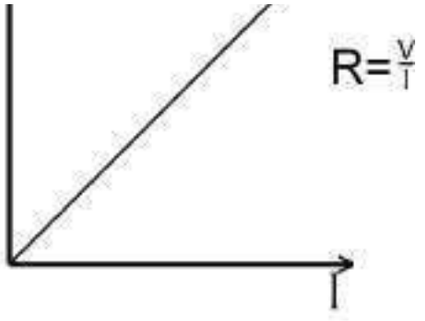
$$\frac{V}{I} = R$$

R= Resistance

I = Current V=

Voltage





Q. 30 If $E = 50\sin(100t)\ volt$ and $I = 100\sin(100t) mA$ are the instantaneous values of voltage and current then the apparent power of the circuit is-

Option 1:
2.5 watt

Option 2:
5 watt

Option 3:
3 watt

Option 4:
2 watt

Correct Answer:
2.5 watt

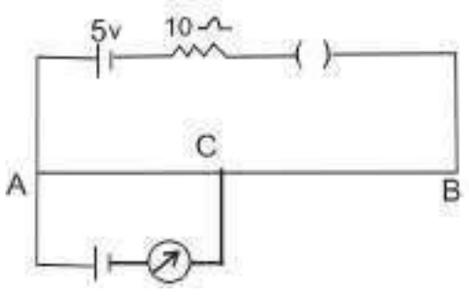
Solution:

$$P_{app} = V_{rms} I_{rms}$$

$$= \frac{V_o}{\sqrt{2}} \frac{I_o}{\sqrt{2}} = \frac{V_o I_o}{2}$$

— 2.5 watt

Q. 31 In the given gure, the potentiometer wire has a resistance of 2Ω and length 4m. The balancing length AC for emf 0.5V is



$0.5\ V$

Option 1:
2.2m

Option 2:
2m

Option 3:
4.4m

Option 4:
3.2m

Correct Answer:
2.2m

Solution:

$$E = \left(\frac{e}{R + R_n + r}\right)\frac{Rl}{L}$$

$22 = 10l$

l = 2.2 m

Q. 32 Which of the following is true about pure resistive circuit-

Option 1:
Phase di erence between voltage and current $\phi = \frac{\pi}{2}$

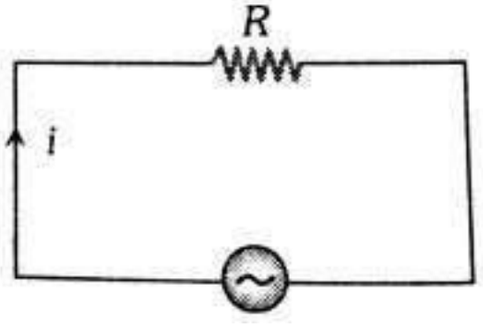
Option 2:
Time di erence is $\frac{T}{4}$

Option 3:
Power factor $\cos\phi = 1$

Option 4:
None of the above

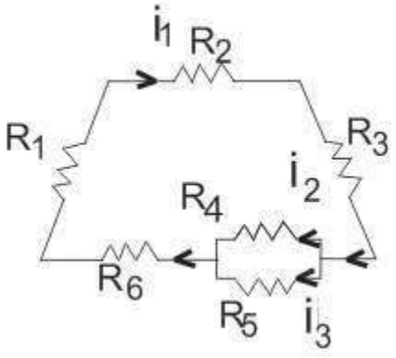
Correct Answer:
Power factor $\cos\phi = 1$

Solution:



Power factor

Q. 33



Option 1:

$$i_1\left(R_1+R_2+R_3+R_6\right)+i_2R_4=0$$

Option 2:

$$i_1\left(R_1+R_2+R_3+R_6\right)+i_3R_5=0$$

Option 3:

Both (1) andd (2)

Option 4:

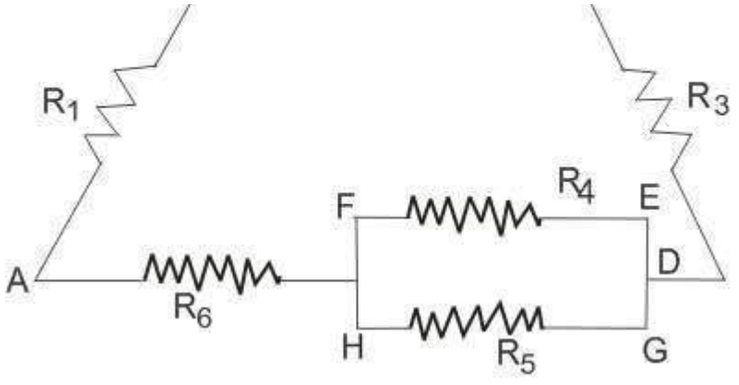
None of the above

Correct Answer:

Both (1) andd (2)

Solution:

This law is also known as kircho 's Voltage law (KVL)



For loop A B C D E F A

$$i_1 (R_1 + R_2 + R_3 + R_6) + i_2 R_4 = 0$$

For loop A B C D G H A

$$i_1 (R_1 + R_2 + R_3 + R_6) + i_3 R_5 = 0$$

Q. 34 The length of an astronomical telescope of focal lenth of objective lens 'fo' and focal length of eye lens 'fe' for normal vision (relaxed eye) is

Option 1:
$fo - fe$

Option 2:
$fo + fe$

Option 3:

Option 4:

$\frac{fe}{fo}$

Correct Answer:

$fo + fe$

Solution:

$$L\infty = f_o + f_e$$

f_o = focal length of objective

f_e = focal length of eyepiece

Q. 35 Two waves represented by

$y_1 = 3sin(\omega t)$ and $y_2 = 4sin(\omega t)$

interfere at a point, then the amplitude of the resultant wave is

Option 1:

7

Option 2:

6

Option 3:
8

Option 4:
9

Correct Answer:
7

Solution:
Resultant amplitude of two wave -

$$A = \sqrt{{A_1}^2 + {A_2}^2 + 2A_1A_2\cos\theta}$$

- wherein

$A_1 =$ amplitude of wave 1

$A_2 =$ amplitude of wave 2

$\phi =$ phase di erence

Unbalanced Eqn

here $\phi = 0$

$$A = \sqrt{9 + 16 + 2 \times 3 \times 4 \times 1}$$

$$A = \sqrt{49} = 7$$

Q. 36 Light take 9sec. to cover a distance 'd' if the whole medium is lled with water $\mu = \frac{4}{3}$ then the time taken to cover the same distance is

Option 1:
12 sec

Option 2:
10 sec

Option 3:
8 sec

Option 4:
14 sec

Correct Answer:
12 sec

Solution:

$$\mu = \frac{C_a}{C_m} = \frac{t_m}{t_q} \Rightarrow t_m = t_q \mu$$

$$= 9 \times \frac{4}{3} = 12sec$$

Q. 37 If we want to reduce De - Brogile wavelength of electron from 10-9 m to 0.25 x 10-9 m then we have to increrase its velocity by:

Option 1:
twice of intial velocity

Option 2:
equal to intial velocity

Option 3:
thrice the itial velocity

Option 4:
four times the intial velocity

Correct Answer:
four times the intial velocity

Solution:

$$\lambda_1 = \frac{h}{mv_1} = 10^{-9}$$

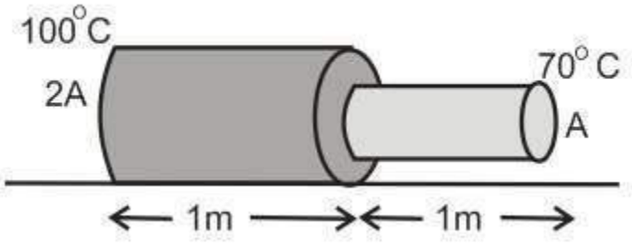
$$\lambda_2 = \frac{h}{mv_2} = 0.25 \times 10^{-9} = \frac{1}{4} \times 10^{-9}$$

$$\frac{\lambda_1}{\lambda_2} = 4 = \frac{v_2}{v_1}$$

$$v_2 = 4v_1$$

Hence option (4) is correct

Q. 38 Two rods of same length are arranged as shown. The ends are maintained at temperature 100^0C and 70^0c. The temperature at the junction point (where the area of cross-section changes suddenly) is -



Option 1:

95^0c

Option 2:

90^0c

Option 3:

Option 4:

80^0c

Correct Answer:

90^0c

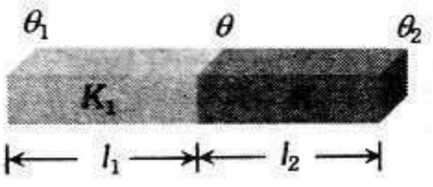
Solution:

As we learn

Temperature of Interface (Junction Temperature) -

$$\theta = \frac{\frac{K_1}{l_1}\theta_1 + \frac{K_2}{l_2}\theta_2}{\frac{K_1}{l_1} + \frac{K_2}{l_2}}$$

- wherein



Let θ be temperature of junction point and in series rate of heat ow is same.

$K(2A)(100-\Theta) = KA(\Theta - 70)$ (As length is same for both)

$(200 - 2\theta) = \Theta - 70$

$\Rightarrow 3\theta = 270$

$\Theta = 90^0C$

Q. 39 The thermo emf of a thermocouple varies with temperature as If the cold junction is kept at , the neutral temperature is

Option 1:
$0^{\circ}C$

Option 2:
$600^{\circ}C$

Option 3:
$150^{\circ}C$

Option 4:
No neutral temperature is possible

Correct Answer:
No neutral temperature is possible

Solution:
At neuttral temperature

$$\frac{dE}{d\theta} = 0$$

$$\Rightarrow A + 2B\theta_n = 0$$

$$\Rightarrow 2B\theta_n = -A$$

$$\theta_n = \frac{-A}{2B} = \frac{-1}{2}600 = -300^{\circ}C$$

Since $\theta_n = -300^{\circ}C,$

So, No neutral temperature is possible because Neutral temperature can never be negative hence no θ is possible.

Q. 40 A 4 m long rod of radius 1cm which is xed from one end is given a twist of 0.4 radians . The shear strain developed in a rod is -

Option 1:
0.002

Option 2:
0.004

Option 3:
0.008

Option 4:
0.001

Correct Answer:
0.001

Solution:
As we learn

Shearing strain -

$$\phi = \frac{x}{L}$$

- wherein

$\phi = Shearing\ Strain$

$x = deformed\ position$

$L = length$

So, shearing strain can also be written in terms of $x = r\theta$

by equating both

$$r\Theta = L\phi$$

$\psi = 0.001$

Q. 41 Within the elastic limit the ratio of stress and strain is de ned as -

Option 1:
Modulus of elasticity

Option 2:
Rigidity

Option 3:
Plastic coe cient

Option 4:
None of these

Correct Answer:
Modulus of elasticity

Solution:
The ratio of stress and strain up to elastic limit is known as Modulus of elasticity or Young's modulus. It is denoted by E.

$$E = \frac{Stress}{Strain}$$

Q. 42 The condition where the uid properties at a point in a system is time dependent is called -

Option 1:
Steady ow

Option 2:
Unsteady ow

Option 3:
Laminar ow

Option 4:
Turbulent ow

Correct Answer:
Unsteady ow

Solution:
As we learn

Unsteady ow -

$$\frac{dv}{dt} \neq 0 \ \frac{dp}{dt} \neq 0 \ \frac{d\rho}{dt} \neq 0$$

They varies with time.

Unsteady ow is dependent ow..

Q. 43 Which rays are used in radio and TV communication -

Option 1:
Radio and microwave

Option 2:
Ultravoilet

Option 3:
Infrared

Option 4:
X-Rays

Correct Answer:
Radio and microwave

Solution:
Application of Radio and Microwaves -

These are used in radio and TV communication.

Q. 44 The peak value of electric eld of light coming from sun is 8×10^2 N/M then the average total density of the electromagnetic wave is $P\epsilon_o \times 10^4$ then the value of P is

Option 1:
16

Option 2:
8

Option 3:
32

Option 4:
64

Correct Answer:
32

Solution:
Energy density =

$$\frac{1}{2}\epsilon_o E^2 = \frac{1}{2}\epsilon_o(8 \times 10^2)^2 = \frac{1}{2}\epsilon_0 \times 64 \times 10^4$$

$$= 32 \times \epsilon_o \times 10^4$$

So, P = 32

Q. 45 Find the speed of sound in hydrogen gas at 300K.

$M = 2 \times 10^{-3}\, kg/mol)$

Option 1:
$1.321\ m/s$

Option 2:
$1321\ m/s$

Option 3:
$660\ m/s$

Option 4:
$6.6\ m/s$

Correct Answer:
$1321\ m/s$

Solution:

$$v = \sqrt{\frac{\gamma p}{\rho}} = \sqrt{\frac{\gamma RT}{m}}$$

$$= \sqrt{\frac{1.4 \times 8.31 \times 300}{2 \times 10^{-3}}}$$

$$= 1321\ m/s$$

Q. 46 A pressure wave is represented by . The frequency of the wave is

Option 1:
$200\,\pi\,Hz$

Option 2:
$2Hz$

Option 3:
$100Hz$

Option 4:
$100\pi Hz$

Correct Answer:
$100Hz$

Solution:
$\omega = 2\pi f = 200\pi$

$= f = 100Hz$

Q. 47 A 100 V carrier wave is made to vary between 160 V and 40 V by a modulating signal . What is the modulation index ?

Option 1:
0.4

Option 2:
0.5

Option 3:
0.6

Option 4:
0.3

Correct Answer:
0.6

Solution:

$$m_a = \frac{E_m}{E_c}$$

$$A_c = 100V$$

$$A_c + A_m = 160V = A_{max} \quad (1)$$

$$A_c - A_m = 40 = A_{min} \quad (2)$$

From (1) & (2)

$$A_c = 100V \text{ & } A_m = 60m$$

So,

$$\mu = \frac{A_m}{A_c} = 0.6$$

Q. 48 Let $y = l^2 - \frac{l^3}{Z}$ where $l = 2.0 \pm 0.1, Z = 1.0 \pm 0.1$ then the value of 'y' is given by :

Option 1:
$+2 \pm 0.8$

Option 2:

Option 3:
-4 ± 0.8

Option 4:
None of these

Correct Answer:
-4 ± 1.6

Solution:

$$y = l^2 - \frac{l^3}{Z}$$

$$dy = 2ldl - \left(\frac{Z3l^2dl - l^3dZ}{Z^2}\right) = \left(2l - \frac{3l^2}{Z}\right)dl + \frac{l^3}{Z^2}dZdy = \left(2 \times 2 - \frac{3 \times 2^2}{1}\right)(\pm 0.1) + \frac{8}{1}(\pm 0.1)$$

$$dy = |-8(\pm 0.1)| + 8(\pm 0.1)| = \pm 1.6$$

$$y = l^2 - \frac{l^3}{Z^2} = 2^2 - \frac{2^3}{1} = 4 - 8 = -4$$

$$\therefore y = -4 \pm 1.6$$

Q. 49 Dimensional formula ML^2T^{-2} is equal to dimensional formula of

Option 1:
Surface tension

Option 2:
Kinetic Energy

Option 3:
Both (1) and (2)

Option 4:
None of these

Correct Answer:
Kinetic Energy

Solution:
As we know that the dimension of Work as well as that of energy is same i.e., ML^2T^{-2}

Also, we know that the dimension of Surface tension $M^1L^0T^{-2}$

And we know kinetic energy is given by:

$$K.E = \frac{1}{2}MV^2,$$

so it's Dimensional formula-ML^2T^{-2}

So, correct option- (2)

Q. 50 The unit of absolute permittivity is

Option 1:
Farad - Metre

Option 2:
$\frac{Farad}{Metre}$

Option 3:
$\frac{Farad}{(Metre)^2}$

Option 4:
Farad

Correct Answer:

Solution:
The standard SI unit for permittivity or absolute permitivity is farad per meter (F/m or F·m−1).

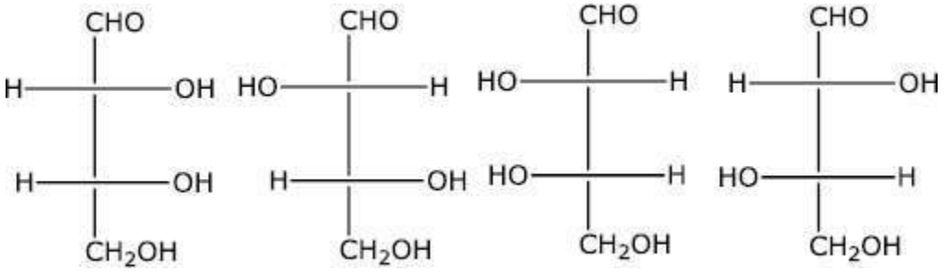
So the answer is -

$$\frac{Farad}{Metre}$$

So the option (2) is correct.

Chemistry

Q. 1 The **correct** corresponding order of names of four aldoses with con guration given below



respectively, is:

Option 1:
L-Erythrose, L-Threose, L-Erythrose, D-Threose

Option 2:
D-Threose, D-Erythrose, L-Threose, L-Erythrose

Option 3:
L-Erythrose, L-Threose, D-Erythrose, D-Threose

Option 3:

Option 4:
$[Co(H_2O)_6]^{3+}$

Correct Answer:
$[Fe(H_2O)_6]^{3+}$

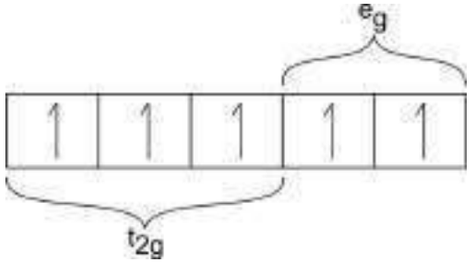
Solution:
As we learnt in

CFSE in the octahedral complex -

$$CFSE = \left[-\frac{2}{5}\left(No.of\ electron\ in\ t_2g\right) + \frac{3}{5}\left(No.of\ és\ in\ eg\right)\right] \triangle o$$

-

for Fe^{3+} we have



$$CFSE = [(-0.4 \times 3) + (0.6 \times 2)] = 0$$

Hence, the option number (2) is correct.

Q. 4 The geometry and magnetic behaviour of the complex [Ni(CO)4] are:

Option 1:
square planar geometry and paramagnetic

Option 2:
tetrahedral geometry and diamagnetic

Option 3:
square planar geometry and diamagnetic

Option 4:
tetrahedral geometry and paramagnetic

Correct Answer:
tetrahedral geometry and diamagnetic

Solution: As we learnt in

Hybridisation - sp3d2 - square bipyramidal

or octahedral d2sp3 - octahedral sp3 -

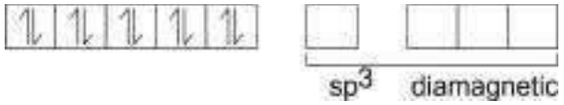
tetradedral dsp2 - square planar sp3d2 -

outer complex d2sp3 - inner complex sp3 -

$[Ni(Cl)_4]^{2-}$

dsp2 - $[Pt(CN)_4]^{2-}$

$Ni \Rightarrow 3d^8 4s^2$



Hence, the option number (2) is correct.

Q. 5 When XO_2 is fused with an alkali metal hydroxide in presence of an oxidizing agent such as KNO_3; a dark green product is formed which disproportionates in acidic solution to a ord a dark purple solution. X is :

Option 1:
Ti

Option 2:
V

Option 3:
Cr

Option 4:
Mn

Correct Answer:
Mn

Solution:
As we learnt in

Colour of d-block element complexes -

Generally, d1- d9 electronic con gurated metal complex show colour according to the

$$MnO_2 + KOH \rightarrow \underset{dark\ green}{K_2MnO_4} \xrightarrow[solution]{Acidic} \underset{dark\ purple}{KMnO_4}$$

Hence, the

option number (4) is correct.

Q. 6 Which of the following liquid pairs shows a positive deviation from Raoult's law:

Option 1:
Water-nitric acid

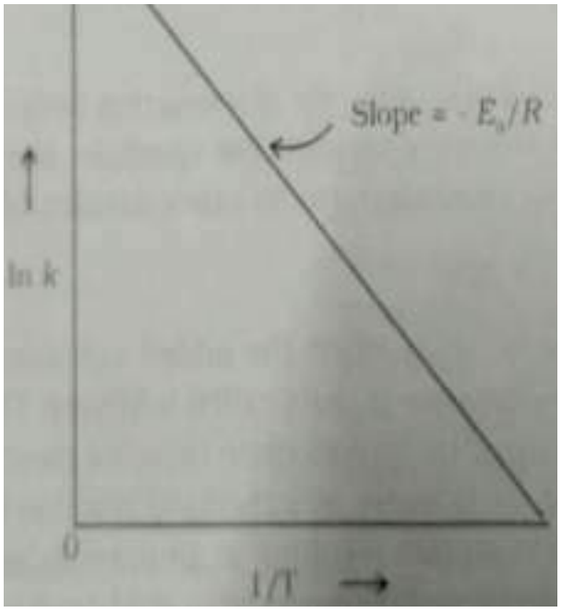
Option 2:
Benzene-methanol

Option 3:
Water-hydrochloric acid

Option 4:
Acetone-chloroform

Correct Answer:
Benzene-methanol

Solution:
As we learned



$$t_{1/2} = \frac{0.693}{k} \; and \; k = Ae^{-E_a/RT}$$

$$t_{1/2} = \frac{0.693}{Ae^{-E_a/RT}} \Rightarrow \frac{0.693}{A}$$

$$t_{1/2} = ce^{+E_a/RT}$$

$$\ln t_{1/2} = \ln c + \frac{E_a}{RT}$$

$$\ln t_{1/2} \, \alpha \, \frac{1}{T}$$

Hence, the option number (1) is correct.

Q. 8 Which of the following work as antifreeze agent for water in cold countries?

Option 1:
Ethyl alcohol

Option 2:
ethylene glycol

Option 3:
Benzene

Option 4:
Glucose

Correct Answer:
ethylene glycol

Solution:
As we learnt,

Antifreeze -

In cold countries, coolant water is mixed with Glycol making it as an freeze and does not freeze at low temperature.

- wherein

Application of depression on freezing point.

Ethylene glycol is used as antifreeze agent in cold countries

Hence, the option number (2) is correct.

Q. 9 d^{2sp^3} hybridisation leads to:

Option 3:
Lactose

Option 4:
Amylase

Correct Answer:
Dehydrogenase

Solution:
As we have learned

Oxidoreductase -

Enzymes responsible for the biological oxidation and reduction reaction

- wherein

Eg. Oxidase, Dihydrogenase

Dehydrogenase belongs to the group of oxidoreductases that catalyse the oxidation and reduction reactions. These enzymes fall into six categories: oxygenases, reductases, peroxidases, oxidases, hydroxylases, and dehydrogenases.
Therefore, **Option(2) is correct.**

Q. 12 Ethanol is manufactured by the fermentation of:

Option 1:
Molases

Option 2:
Starch

Option 3:
Both a & b

Option 4:
Glucose

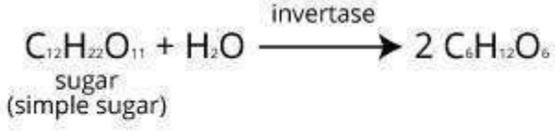
Correct Answer:
Glucose

Solution:
As we learned

Ethanol -

Commercially obtained by fermentation, used in paints.

- wherein



$$C_6H_{12}O_6 \overset{Zymase}{\rightarrow} 2C_2H_5OH + 2CO_2 + energy$$

Hence, **the option number (4) is correct**

Q. 13 The drugs which may interfere with the e ciency of oral contraceptives and increase the failure rates are the following except?

Option 1:
Barbiturates

Option 2:
Rifampicin

Option 3:
Ampicilin

Option 4:
Sulphonamides

Correct Answer:
Sulphonamides

Solution:
As we have learnt,

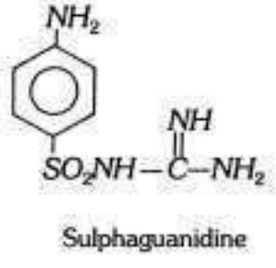
Sulpha drugs -

Synthetic chemotherapeutic drug which contain - SO_2NH_2 group used for bacterial infection in human

- wherein

Sulphapyridine

Sulphadiazine



Sulphaguanidine

Sulphonamides do not interfere with the e ciency of oral contraceptives.

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

Q. 14 When borax is heated strongly it gives:

Option 1:
B_2O_3

Option 2:
$Na_2B_4O_7$

Option 3:
$NaBO_2$

Option 4:
$NaBO_2 + B_2O_3$

Correct Answer:
$NaBO_2 + B_2O_3$

Solution:
As we learnt

Borax/ Tetraborate Decahydrate -

$Na_2\left[B_4O_5\left(OH\right)_4\right]\cdot 8H_2O$

or

$Na_2B_4O_7\cdot 10H_2O$ (Naturally occur as tincal)

$$Na_2B_4O_7.10H_2O \xrightarrow[\Delta]{-10H_2O} Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

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

Q. 15 In the following reaction

The formed hydrocarbon has the hybridisation:

Option 1:
sp^2

Option 2:
sp^3

Option 3:
Both 1 & 2

Option 4:
SP

Correct Answer:
SP

Solution: As we learnt

Preparation of Alkanes - 1 -
Dihydrogen gas adds to alkenes and alkynes in the presence of nely divided catalysts like platinum, palladium or nickel to form alkanes. This process is called hydrogenation. These metals adsorb dihydrogen gas on their surfaces and activate the hydrogen – hydrogen bond. Platinum and palladium catalyse the reaction at room temperature but relatively higher temperature and pressure are required with nickel catalysts.

$$\underset{\text{Ethene}}{CH_2 = CH_2} + H_2 \xrightarrow{Pt/Pd/Ni} \underset{\text{Ethane}}{CH_3 - CH_3}$$

$$\underset{\text{Propyne}}{CH_3 - C \equiv C - H} + 2H_2 \xrightarrow{Pt/Pd/Ni} \underset{\text{Propane}}{CH_3 - CH_2 - CH_3}$$

-

Preparation of alkyne from calcium carbide -

Ethyne is prepared by treating calcium carbide with water.

- wherein

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

Here both carbon atoms are sp hybridised.

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

Q. 16 Hybridisation of XeF6 is:

Option 1:
Sp3d

Option 2:
Sp3d2

Option 3:
Sp3d3

Option 4:
dsp2

Correct Answer:
Sp3d3

Solution:
XeF6 :

Hybridisation

$= \frac{1}{2}(8+6) = 7$

$\therefore$ Hybridisation = Sp3d3

Hence, the option number (3) is correct.

Q. 17 For an exothermic reaction (negative ΔH) as temprature increases the equilibrium constant :

Option 1:
also increases

Option 2:
remains same

Option 3:
decreases

Option 4:
rst increases then decreases

Correct Answer:
decreases

Solution:
As we have learnt,

Le Chatelier's principle -

E ect of change in temperature
On increasing the temperature, equilibrium shifts to that direction which proceeds with the absorption of heat.

- $A + B + \Delta \rightleftharpoons C + D$
  This is an endothermic reaction. Thus, on increasing the temperature, equilibrium shifts in the forward direction.

This is an exothermic reaction. Thus on increasing the temperature, equilibrium shifts in backward direction.

For example:

$$H_2 + I_2 \rightleftharpoons 2HI + 3000\,calories$$

In this reaction, the product formed is HI and the release of 3000 calories of energy. Thus if temperature is increased then equilibrium will shift backward and form the reactants.

E ect of Adding Inert Gas on Equilibrium

- When np is equal to nr there is no e ect of adding an inert gas either at constant volume or pressure.
- When np ≠nr there is no e ect of adding an inert gas at constant volume.
- When np ≠nr at constant pressure on adding inert gas equilibrium will shift towards more volume side. e.g., dissociation of ammonia will be more at constant pressure by adding inert gas like argon (Ar).

-

Equilibrium constant and sign of Enthalpy Change -

The equilibrium constant for an exothermic reaction (negative $\triangle H$) decreases as the temperature increases.

As the T is increased for an exothermic reaction more of the reactants are formed as the concentration of the reactants increases the value of equilibrium constant decreases
Therefore, the option number (3) is correct.

Q. 18 In the estimation of Sulphur by Carius Method, 0.468g of organic compound gave 668mg $BaSO_4$. Calculate %S.

Option 1:
19.6

Option 2:
21.7

Option 3:
17.9

Option 4:
16.9

Correct Answer:
19.6

Solution:
As we learnt

Test for Sulphur -

$$percentage\ of\ S = \frac{32 \times m_1 \times 100}{233 \times m}$$

$$m_1 - mass\ of\ BaSO_4$$

m - the mass of Organic compounds

- wherein

Total mass of organic compound = 0.468 g [Given]
Mass of barium sulphate formed = 0.668 g [Given]
1 mol of $BaSO_4$ = 233 g of $BaSO_4$ = 32 g of sulphur
Thus, 0.668 g of $BaSO_4$ contains $\frac{32 \times 0.668}{233}$ g of sulphur = 0.0917 g of sulphur
Therefore, percentage of sulphur $= \frac{0.0197}{0.468} \times 100 = 19.59\ \%$
Hence, the percentage of sulphur in the given compound is 19.59 %.

Hence, the option number (1) is correct.

Q. 19 DDT is an:

Option 1:
Insecticide

Option 2:
fungicide

Option 3:
herbicide

Option 4:
None of these

Correct Answer:
Insecticide

Solution:
As we learnt

Insecticides -

used to control insects thus curbing diseases and protecting crops.

For example: (DDT) Dichloro diphenyl-trichloro ethane, aldrin, dieldrin.

Hence, the option number (1) is correct.

Q. 20 The correct match between item I and item -II is

	Item-I (drug)	Item-II (test)
A	chloroxylenol	P carbylamine test
B	Norethindrone	Q sodium hydrogen carbonate test
C	Sulphapyridine	R ferric choride test
D	Penicillamine	S Baeyer's test

Option 1:
A→R; B→P;C→S;D→Q

Option 2:
A→Q; B→S;C→P;D→R

Option 3:
A→R; B→S;C→P;D→Q

Option 4:
A→Q; B→P;C→S;D→R

Correct Answer:
A→R; B→S;C→P;D→Q

Solution:

Lassaigne's test for Unsaturation(Baeyer's test) -

Compound + 1% alkaline
KMNO4 Solution ----------> Pink Color Disappear

- wherein Alkene

or Alkyne Present Test

of Ferric -

$$Fe(OH)_3 + 3H^+ \rightarrow Fe^{3+} + 3H_2O$$

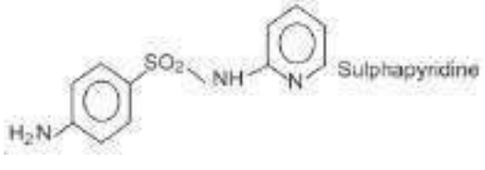
$Fe^{3+} + 6SCN^- \rightarrow [Fe(SCN)_6]^{3-}(deep\ red)$ with K4[Fe(CN)6] .Fe^{3+} gives Prussian blue color

- wherein

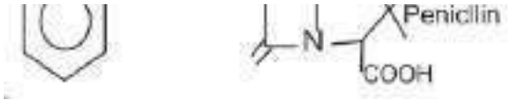
$$Fe^{3+} + K_4[Fe(CN)_6] \rightarrow KFe[Fe(CN)_6] as\ Fe_4[Fe(CN)_6]_3$$

Test for Carbonyl Compound - Carbonyl + 2,4-Dinitrophenylhydrazinet----------> Yellow Orange PPT - wherein

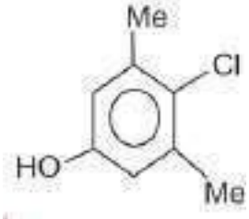
Carbonyl Group Present as we know 1. carbylamine test



2. sodium hydrogen carbonate test

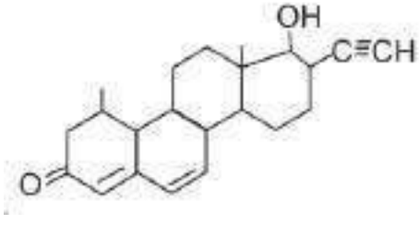


3. Feric chloride test



Chloroxylenol

4.Bayer's test



Norethindrone

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

Q. 21 The process with negative entropy change is:

Option 1:
Sublimation of dry ice

Option 2:
Dissolution of Iodine(s) in water

Option 3:
Synthesis of ammonia from N2 and H2

Option 4:
Dissociation of CaSO4 (s) to CaO(s) and SO3(g)

Correct Answer:
Synthesis of ammonia from N2 and H2

Solution:
As we learnt,

Entropy varies as : Gas > Liquid > Solid

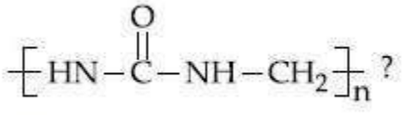
Also,

Entropy change is directly related to the Δn_g

If Δn_g is negative then ΔS is also negative.

The decrease in moles of gas in the Haber ammonia synthesis drives the entropy change negative, making the reaction spontaneous only at low temperatures. Thus higher *T*, which speeds up the reaction, also reduces its extent.
Therefore, **the option number (3) is correct**.

Q. 22 Which of the following compound is a constituent of the polymer



Option 1:
$N-Methyl\ \ urea$

Option 2:

Option 3:
Methylamine

Option 4:
Ammonia

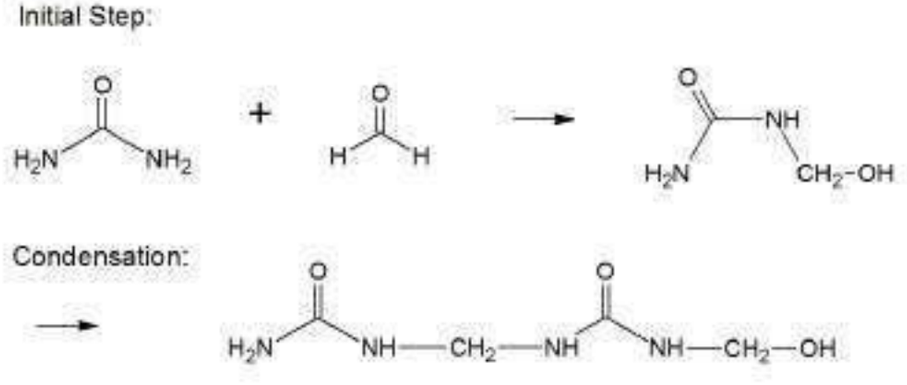
Correct Answer:
Formaldehyde

Solution:

urea-formaldehyde resin -

Urea-formaldehyde (UF), also known as urea-methanal, so named for its common synthesis pathway and overall structure, is a non-transparent thermosetting resin or polymer. It is produced from urea and formaldehyde. These resins are used in adhesives nishes,particle-board, medium-density breboard (MDF), and moulded objects.

- wherein



This is a urea-formaldehyde polymer and its monomers are urea and formaldehyde.

Hence, the option number (2) is correct.

Q. 23 The correct match between Item - and Item - is :

	Item - I		Item-II
(a)	Highest density polythene	(I)	Peroxide catalyst
(b)	Polyacrylonitrile	(II)	Condensation at high temperature & pressure
(c)	Novolac	(III)	Ziegler-Natta Catalyst
(d)	Nylon 6	(IV)	Acid or base catalyst

Option 1:
$(a) \rightarrow (IV), (b) \rightarrow (II), (c) \rightarrow (I), (d) \rightarrow (III)$

Option 2:
$(a) \rightarrow (II), (b) \rightarrow (IV), (c) \rightarrow (I), (d) \rightarrow (III)$

Option 3:
$(a) \rightarrow (III), (b) \rightarrow (I), (c) \rightarrow (II), (d) \rightarrow (IV)$

Option 4:
$(a) \rightarrow (III), (b) \rightarrow (I), (c) \rightarrow (IV), (d) \rightarrow (II)$

Correct Answer:

Solution:
High density Polythene (HDP) -

- Polymerization of ethene in a hydrocarbon solvent under low pressure in presence of triethylaluminium and titanium tetrachloride (Ziegier. natta catalyst)

- Chain growth, Homopolymer

- wherein

- Chemically inert and tougher than LDP.

- Used in manufacturing buckets, Dustbins,etc.

Polyacrylonitrile -

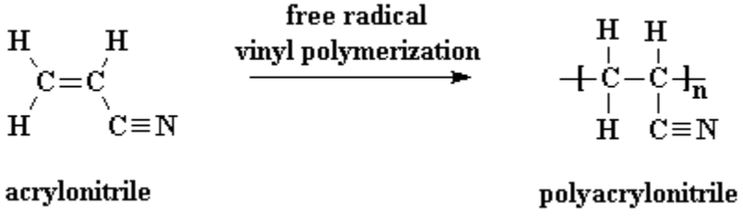
- Addition polymerization of acrylonitrile

$(CH_2 = CHCN)$

- wherein

- Hompolymer

- Used in making commercial bres orlon or acrilon



acrylonitrile **polyacrylonitrile**

Nylon 6 -

- Obtained by heating caprolactam with water.

- Homopolymer

- wherein

- High tensile strength

- Used in manufacture of tyre, cords, fabrics and ropes.

--

(a) High-density polyethene

(H.D.P) $\rightarrow$ (III)Ziegler-Natta catalyst

H.D.P is obtained by using Zigler-Natta Catalyst

(b) Polyacrylonitrile $\rightarrow$ (I)Peroxide catalyst

Polyacrylonitrile is obtained by using the peroxide catalyst

(c) Novolac $\rightarrow$(IV) Acid or base catalyst

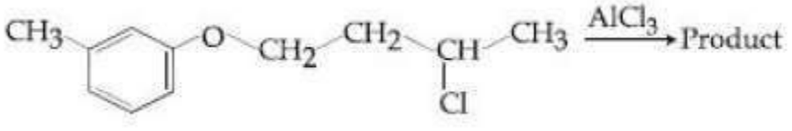
It is obtained by acid /base Catalyst polymerisation of formaldehyde & phenol.

(d) Nylon 6 $\rightarrow$ Condensation at a high temp. & pressure.

At high T &P, it is a condensation polymer of caprolactam.

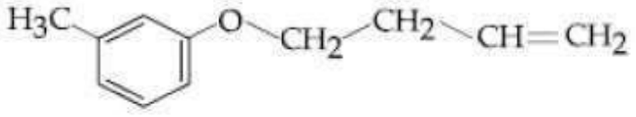
Hence, **the option number (4) is correct.**

Q. 24 The major product obtained in the given reaction is :

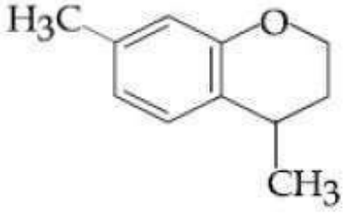


Option 1:

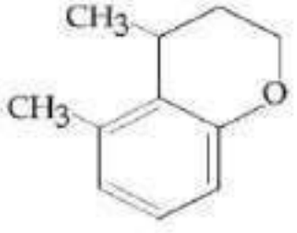
Option 2:



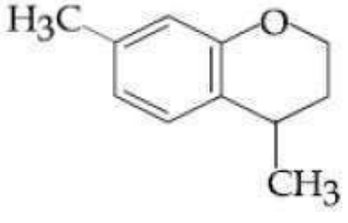
Option 3:



Option 4:



Correct Answer:

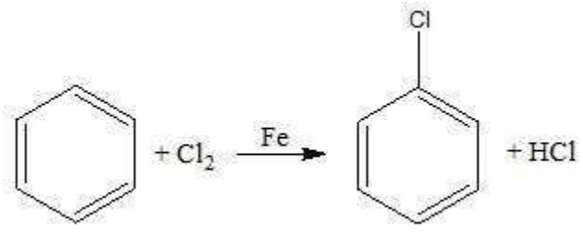


Solution:

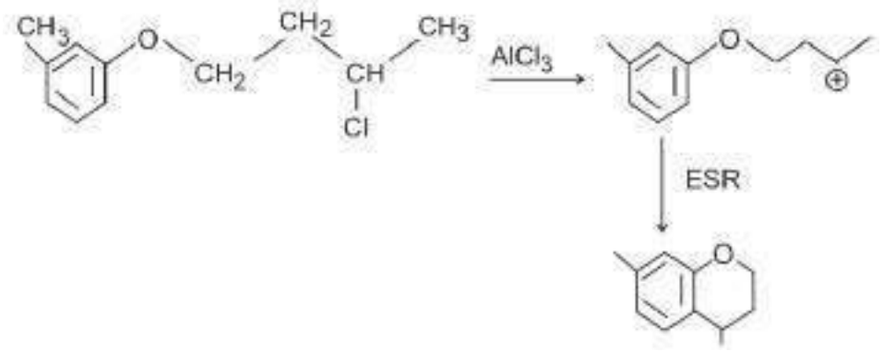
Preparation of alkyl/ aryl halide by the electrophilic substitution reaction -

Benzene undergo electrophilic substitution reaction when treated with Cl2 in presence of lewis acid (FeX3 / AlX3).

- wherein



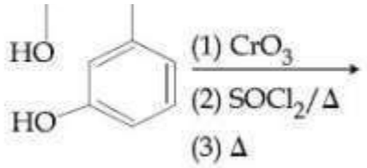
This is Intramolecular fridel craft acylation which provides a useful synthetic approach to cyclic ketones. The cyclization is well-suited to the preparation of six- and particularly ve-membered rings



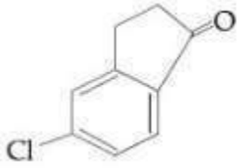
Therefore, the option number (3) is

correct.

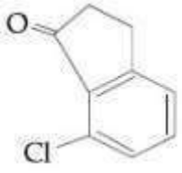
Q. 25 The major product of the following reaction is :



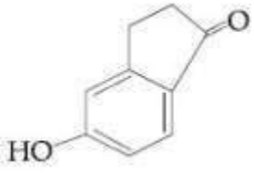
Option 1:



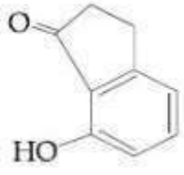
Option 2:



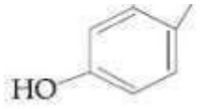
Option 3:



Option 4:



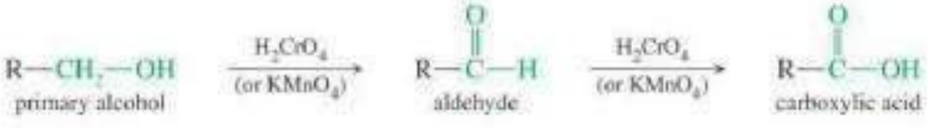
Correct Answer:

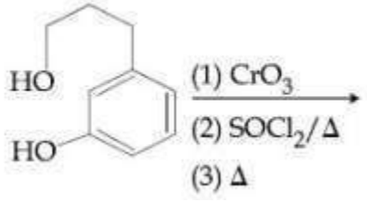


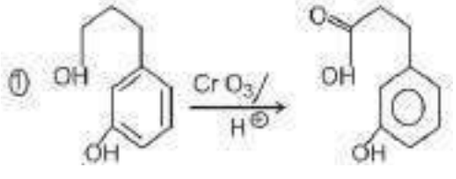
Solution:
Oxidation of primary alcohol or an aldehyde -

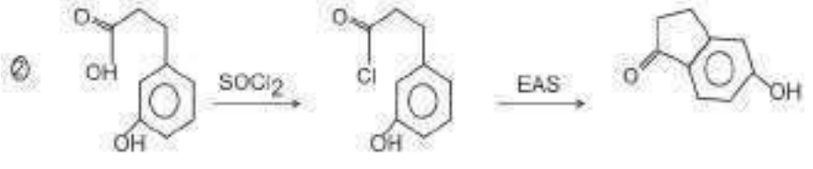
Primary alcohol oxidizes in the presence of oxidising agent to give aldehyde which further oxidises to give the carboxylic acid.

- wherein









∴ Option (3) is correct

Q. 26 The method used to remove the temporary hardness of water is:

Option 1:
Calgen's Method

Option 2:
Clark's Method

Option 3:
Ion-exchange method

Option 4:
Synthetic Resins method

Correct Answer:
Clark's Method

Solution:

Clark's Method -

In this method temporary hardness is removed by adding Slaked Lime Ca(OH)2

-

Option 2 Clark's method

This method is used for removing the temporary hardness of the water.

These precipitates can be removed by Filtration.

Hence, the option number (2) is correct.

Q. 27 Among the following, the narrow spectrum antibiotic is:

Option 1:
penicillin G

Option 2:
ampicillin

Option 3:
amoxycillin

Option 4:
chloramphenicol

Correct Answer:
penicillin G

Solution:

Narrow spectrum antibiotics -

Those e ective against gram positive or gram negative bacteria

- wherein

Eg: Penicillin G

Penicillin G is a narrow spectrum antibiotic. It is used for the speci c infection when the causative organism is known and will not kill as many of the normal microorganisms as a broad spectrum antibiotic in the body.

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

Q. 28 The de-Broglie wavelength of a tennis ball of mass 60g moving with a velocity of 10 metres per second is approximately:
$\left(Planck's\ constant, h = 6.63 \times 10^{-34} Js\right)$

Option 1:
$10^{-33} metre$

Option 2:
$10^{-31} metre$

Option 3:
$10^{-16} metre$

Option 4:
$10^{-25} metre$

Correct Answer:
$10^{-33} metre$

Solution:

De-broglie wavelength and Association of de-broglie principle with bohr's model -

De-broglie wavelength

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

where m is the mass of the particle

v its velocity

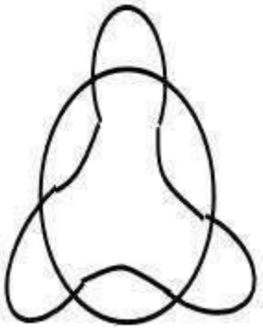
p its momentum

Bohr model and de-broglie principle :

Bohr model,

2π

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



Combining the two

$$2\pi r = n\lambda$$

-

As we have learnt,

de-Broglie wavelength is given by:

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

Thus, we have:

$$= \frac{6.6 \times 10^{-34}}{60 \times 10^{-3} \times 10}$$

$$= 10^{-33}\mathrm{m}$$

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

Q. 29 Identify the group which is not a Dobereiner triad:

Option 1:
Li, Na, K

Option 2:
Be, Mg, Cr

Option 3:
Ca, Sr, Ba

Option 4:
Cl, Br, I

Correct Answer:
Be, Mg, Cr

Solution:

Introduction of Periodic Table -

2. **DOBEREINER TRIAD RULE**

J.W. Dorbereiner pointed out that within a group of three elements having similar chemical and physical properties, the atomic weight of the middle element is the mean of the other two. Some examples of such triads are given below. He also pointed out the triad - iron, cobalt and nickel in which the atomic weights of the elements are almost the same.

Some representative triads of Dobereiner

Triads Elements	Li	Na	K	Ca	Sr	Ba	S	Se	Te	Cl	Br	I
Atomic Weight	7	23	39	40	88	137	32	80	128	35.5	80	127
Mean Value		23			88.5			80			81.25	

Other examples. (K, Rb, Cs), (P, As, Sb) (H, F, Cl) (Sc, Y, La).

Though it was the rst successful attempt to rationalize the problem, it could not be generalised or extended.

Drawback or Limitation: All the known elements could not be arranged as triads.

3. **NEWLAND'S LAW of OCTAVES**

John Alexander Reina newland in England made the rst attempt to correlate the chemical properties of the elements with their atomic weight. According to him -

1. If the elements are arranged in order to their increasing atomic weights, every eighth element had similar properties to rst one like the rst and eighth note in music. For example

Sa Re GaMaPaDhaNiSa
LiBeB C NO FNa
NaMgAl Si P S Cl K

2. Inert gases were not discovered till then.

3. All the elements could not be classi ed on this basis.

-

We know that according to Dobereiner's law of triads the atomic mass of the middle element of a triad is the arithmetic mean of the atomic masses of the other two elements.
The group which does not follow Dobereiner’s law of triad is Be, Mg, Cr.

It is because Cr is not of the same group as Be and Mg are. Be and Mg belong to group second whereas Cr belongs to group sixth.

Moreover, the arithmetic mean of the atomic masses of the other two elements is not equal to the atomic mass of the middle element.

Atomic mass of Be = 8, Mg = 24, Cr = 51.9

Arithmetic mean = 51.9+82=29.9. This arithmetic mean is not equal to atomic mass of central element.

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

Q. 30 The molecular orbital has _____ nodal planes.

Option 1:
2

Option 2:
1

Option 3:
4

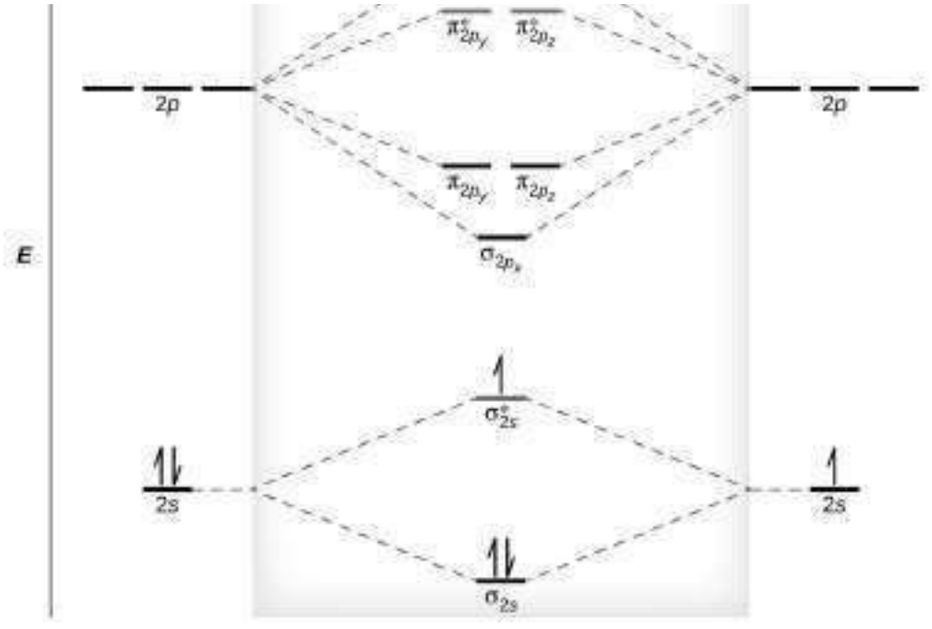
Option 4:
3

Correct Answer:
2

Solution:

Energy Level Diagram for Molecules -
Molecular Orbital Energy Diagrams The relative energy levels of atomic and molecular orbitals are typically shown in a molecular orbital diagram. As given in

the gure below, for a diatomic
molecule, the atomic orbitals of one atom are shown on the left, and those of the other atom is shown on the right. Each horizontal line represents one orbital that can hold two electrons. The molecular orbitals formed by the combination of the atomic orbitals are shown in the center. Dashed lines show which of the atomic orbitals combine to form the molecular orbitals. For each pair of atomic orbitals that combine, one lower-energy (bonding) molecular orbital and one higher-energy (antibonding) orbital result. Thus we can see that combining the six 2p atomic orbitals results in three bonding orbitals (one σ and two π) and three antibonding orbitals (one σ* and two π*).



molecular orbital diagram

The molecular orbitals are lled in the same manner as atomic orbitals, using the Aufbau principle and Hund's rule.

-

As we have learnt,

Representation of π^*molecular orbital:

There are two nodal planes in it.
Hence, option number (1) is correct .

Q. 31 Calculate the u_{rms} (in m/sec) of O_2 if its density at 1 atm pressure and $0^{\circ}C$ is 1.429g/l.

Option 1:
462.21

Option 2:
46.12

Option 3:
56.31

Option 4:
44.23

Correct Answer:
462.21

Solution:
Root Mean Square Speed urms

It is the square root of the mean of the square of the velocities of di erent molecules.

$$u_{rms} = \frac{\sqrt{u_1^2+u_2^2+.....}}{n}$$
$$= \frac{\sqrt{n_1u_1^2+n_2u_2^2+n_3u_3^2}}{n_1+n_2+n_3}$$
$$u_{rms} = \sqrt{3RT/M}$$
$$u_{rms} = \sqrt{3PV/M} = \sqrt{3P/d}$$

-

We know that rms velocity is given as:

$$u_{rms} = \frac{3P}{d}$$

Now, $P = 1atm = 101.3 \times 10^3 Pa$

And d = 1.42g/litre = 1.42kg/m^3

$$u_{rms} = \sqrt{\frac{3 \times 101.32 \times 10^3}{1.429}} = 462.21 m/sec$$

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

Q. 32 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. 33 The potential (in V) of a hydrogen electrode $(\mathrm{P_{H_2}} = 1\ \mathrm{atm})$ in a solution with pH = 5 at 25oC is :

Option 1:
0.295

Option 2:
-0.295

Option 3:
-0.59

Option 4:
0.59

Correct Answer:
-0.295

Solution:

$$E = 0 - 0.059 \log\left(\frac{1}{[H^+]}\right)$$

$$\mathrm{E} = -0.059 \times \mathrm{pH}$$
$$\mathrm{E} = -0.059 \times 5 = -0.295\ \mathrm{V}$$

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

Q. 34 Why do galvanic cells need a salt bridge?

Option 1:
to move electrons from the electrolyte

Option 2:
to maintain charge balance

Option 3:
for both (1) and (2)

Option 4:
To form precipitate.

Correct Answer:
to maintain charge balance

Solution:
The purpose of a salt bridge is not to move electrons from the electrolyte, rather to maintain charge balance because the electrons are moving from one half cell to the other.
Without the salt bridge the solution in the anode compartment would become positively charged and the solution in the cathode compartment would become negatively charged, because of the charge imbalance, the electrode reaction would quickly come to halt, therefore it helps to maintain the ow of electrons from the oxidation half cell to a reduction half cell.

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

Q. 35 The rate of a reaction triples when temperature changes from 20oC to 50oC. Calculate the energy of activation for the reaction? (R = 8.314 J K-1mol-1).

Option 1:
$288.1\ \text{kJ mol}^{-1}$

Option 2:
$28.81\ \text{kJ mol}^{-1}$

Option 3:
$28.81\ \text{J mol}^{-1}$

Option 4:
$81.28\ \text{kJ mol}^{-1}$

Correct Answer:

Solution: As we have learned,

Complex Reaction - Mechanism of Reaction -
On the basis of mechanism, we have two types of reactions:

- Simple or elementary reaction
- Complex or multi-step reaction

Simple or Elementary reaction

- The reactions, which occur in single step, are called simple or elementary reactions. For example:

$$\mathrm{NO(g)} + \mathrm{O_3(g)} \rightarrow \mathrm{NO_2(g)} + \mathrm{O_2(g)}$$

- An elementary reaction is an individual molecular event that involves breaking or making of chemical bonds. The overall reaction describes the stoichiometry of the overall process but provides no information how the reaction occurs.

Complex Reaction

- A complex reaction takes place in a sequence of a number of elementary steps.
- Molecularity of complex reaction is not de ned. Molecularity of each step can be de ned but not for overall.
- Overall rate of reaction is given by slowest step of the complex reaction.
  For example, combination of NO2 and CO occurs in a sequence of elementary steps.

$$\mathrm{NO_2(g)} + \mathrm{NO_2(g)} \rightarrow \mathrm{NO_3(g)} + \mathrm{NO(g)} \qquad \text{(elementary step I)}$$

$$\mathrm{NO_3(g)} + \mathrm{CO(g)} \rightarrow \mathrm{NO_2(g)} + \mathrm{CO_2(g)} \qquad \text{(elementary step II)}$$

Important Facts:

- The numbeer of reactant molecules taking part in an elementary step or in an elementary reaction is expressed as molecularity of that step of molecularity of that reaction respectively.
- For elementary reactions usually order of reaction and molecularity are same. Thus, it can be said that if order of a reaction for a change is fractional it cannot be an elementary reaction.

-

The Arrhenius equation

is:

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

$$\text{Given: } \frac{k_2}{k_1} = 3; R = 8.314 \text{JK}^{-1}\text{mol}^{-1};$$

$$T_1 = 20 + 273 = 293\text{K}; T_2 = 50 + 273 = 323\text{K}$$

Substituting the given values in the Arrhenius equation,

$$\log 3 = \frac{E_a}{8.314 \times 2.303}\left[\frac{323 - 293}{323 \times 293}\right]$$

$$E_a = \frac{2.303 \times 8.314 \times 323 \times 293 \times 0.477}{30}$$

$$= 28811.8 \text{Jmol}^{-1}$$

$$= 28.8118 \text{kJmol}^{-1}$$

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

Q. 36 In a metallurgical process the ux used for removing acidic impurities is:

Option 1:
Sodium carbonate

Option 2:
Limestone

Option 3:
Sodium chloride

Option 4:
Silica

Correct Answer:
Limestone

Solution:
As we have learnt,

Process in Metallurgy -
There are various stages of metals before it comes into pure form. Hence we need to perform certain steps to extract a particular metal. We will discuss the di erent processes which are required for extracting these metals.

1. **Crushing and grinding:** The rst process in metallurgy is the crushing of ores into a ne powder. This process is known as pulverization.
2. **The concentration of ores:** The process of removing impurities from ore is known as a concentration of minerals or ore dressing. The concentration of ores can be done by the following methods
   - Hydraulic Washing
   - Magnetic Separation
   - Froth Floatation Method
   - Leaching
3. **Roasting:** In metallurgy, the process of heating a concentrated ore in the presence of oxygen is known as roasting. This process is applied in the case of sul de ores.
4. **Calcination:** For ores containing carbonate or hydrated oxides, heating is done in the absence of air to melt the ores, and this process is known as calcination.

5. **Re ning:** The impurities contained in the metal product of the roasting/reduction process are removed.

-

Basic ux like limestone(CaCO3) is used to remove acidic impurities such as SiO2. The process occurs as follows:

$$\mathrm{CaCO_3} \rightarrow \mathrm{CaO} + \mathrm{CO_2}$$

$$\underset{\text{Basic ux}}{\mathrm{CaO}} \rightarrow \underset{\text{Acidic gangue}}{\mathrm{SiO_2}} + \underset{\text{Slag}}{\mathrm{CaSiO_3}}$$

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

Q. 37 How many hydrogen-bonded water molecules are associated with CuSO4.5H2O?

Option 1:
Five

Option 2:
One

Option 3:
Four

Option 4:
Two

Correct Answer:
One

Solution:
As we have learnt,

Chemical Properties of Water -
These are the various chemical properties of water:

- Water is neutral in nature. pH of the pure water is 7. It is a weak electrolyte and ionises into H+ and OH- ions.
  $H_2O \rightleftharpoons H^+ + OH^-$
- It reacts with active metals and evolves hydrogen The reaction is exothermic in the case of alali and alkaline earth metals.
  $2Na + 2H_2O \rightarrow 2NaOH + H_2$
- **Reaction with non-metals:** Water reacts with non-metals like uorine and chlorine as follows:
  $2F_2 + 2H_2O \rightarrow 2H_2F_2 + O_2$
- **Action on non-metallic oxides:** Acidic oxides combine with water to form acids viz:
  $CO_2 + H_2O \rightleftharpoons H_2CO_3$
  $SO_2 + H_2O \rightarrow H_2SO_3$
- **Action on metallic oxides:** Basic oxides combine with water to form alkalies.
  $Na_2O + H_2O \rightarrow 2NaOH$
- **Action on hydrides carbides, nitrides, phosphides:** Water decomposes these compounds with the ration of hydrogen acetylene, ammonia, phosphine respectively.

Hydrolysis: Many salts undergo hydrolysis with water.

Decomposition: Water containing either alkali or acid when electrolysed gets decomposed into H2 and O2.

$$2H_2O \rightarrow 2H_2 + O_2$$

- **Water of crystallisation:** It combines with many salts during crystallisation to form hydrates. For example, CuSO4.5H2O, FeSO4.7H2O, etc.
- **Water as a catalyst:** Water acts as a catalyst in many reactions. Perfectly dry gases generally do not react but the presence of moisture brings the chemical change. Ammonia and hydrochloric acid gas combine only in presence of moisture.

-

In CuSO4.5H2O, Cu is cordinated with 4 water molecules. Now fth water molecule is hydrogen bonded and is deeply embedded in the crystal. It is not cordinated. Only 4 water molecules are coordinated and fth is only hydrogen bonded.
Therefore, **Option(2) is correct**

Q. 38 The dipole moments of **CCl4, CHCl3** and **CH4** are in the order:

Option 1:
$CH_4 = CCl_4 < CHCl_3$

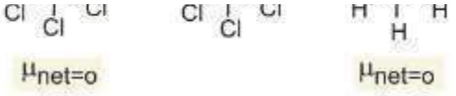
Option 2:
$CHCl_3 < CH_4 = CCl_4$

Option 3:
$CH_4 < CCl_4 < CHCl_3$

Option 4:
$CCl_4 < CH_4 < CHCl_3$

Correct Answer:
$CH_4 = CCl_4 < CHCl_3$

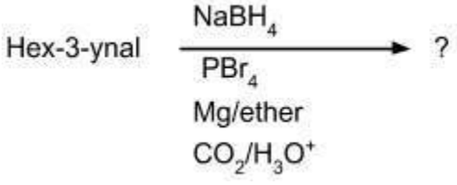
Solution:
Let us rst look at the structures of the given compounds



Clearly $\mu \neq 0$ of $CHCl_3$

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

Q. 39 What is the product of following reaction:?



Option 1:

Option 2:

Option 3:

Option 4:

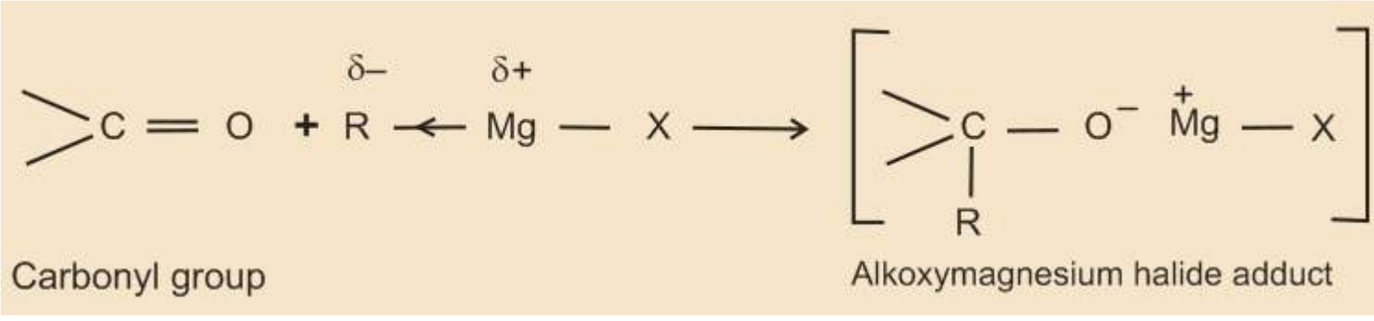
Correct Answer:

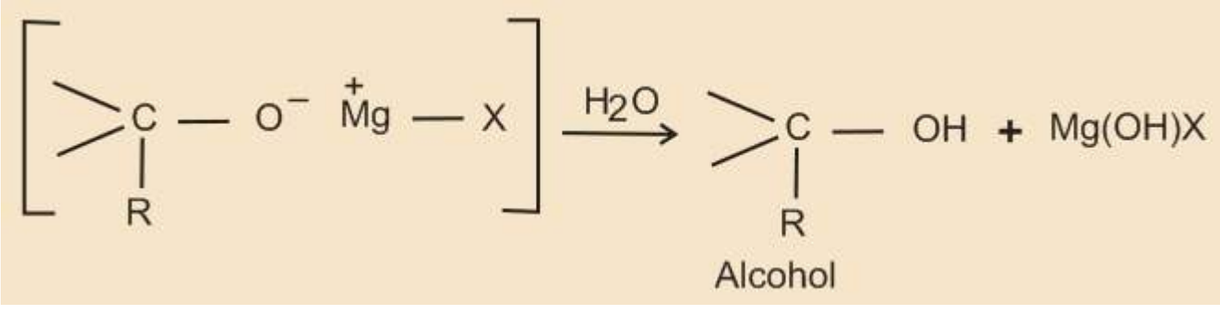
Solution:
As we have learnt,

Grignard Reagent - 1 -

All three types of monohydric alcohols can be prepared by the use of Grignard reagents. Grignard reagents form addition compounds by nucleophile attack with aldehydes and ketones which on hydrolysis with dilute acid yields alcohol.

Mechanism





For example:

-

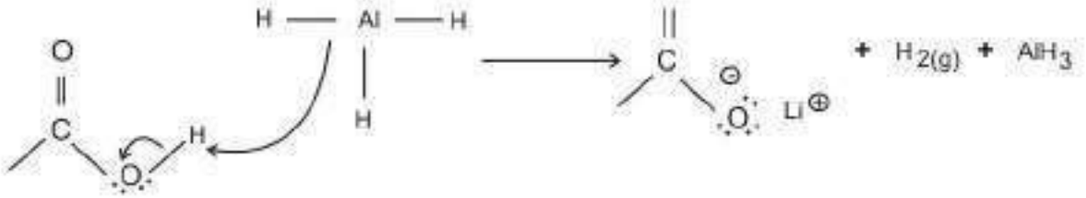
Reduction by LiAlH4 and NaBH4 -

NaBH4 can only reduce keto groups. But LiAlH4 can reduce even anhydrides and esters. LiAlH4 is a very good reducing agent because (Al) atom present in ir is more covalent than (B) atom in NaBH 4. Therefore, Al has more tendency to gain the electrons, thus, it will try to keep the electrons to itself and hence H will go in a particular manner. Thus, LiAlH4 is better reducing agent than NaBH4.

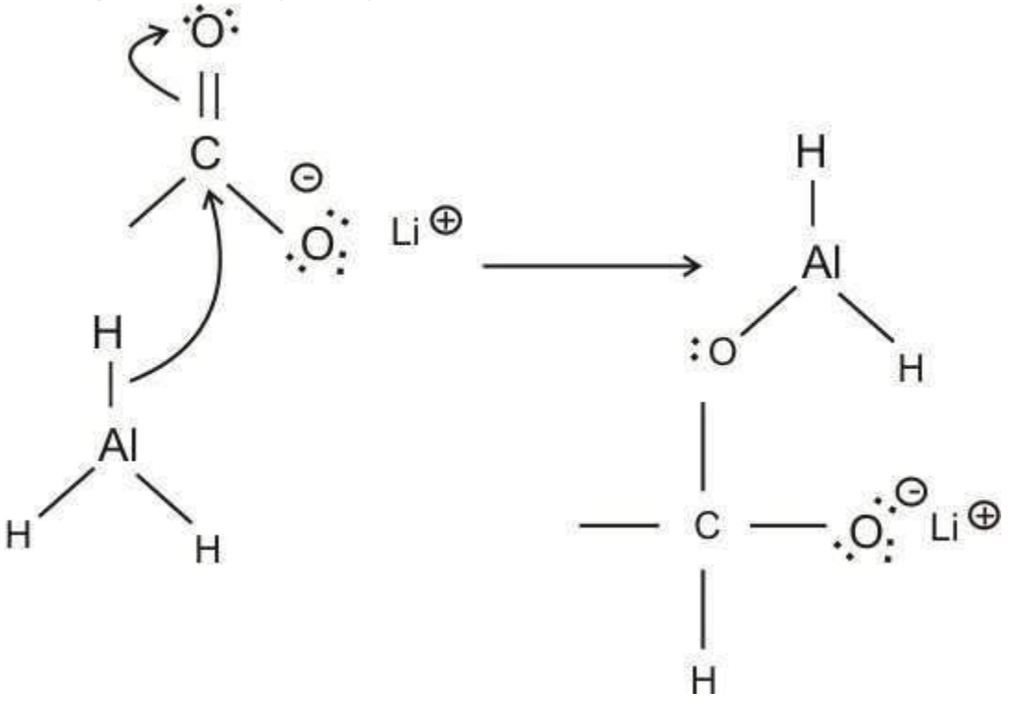
Mechanism

The mechanism for LiAlH4 occurs in the following steps:

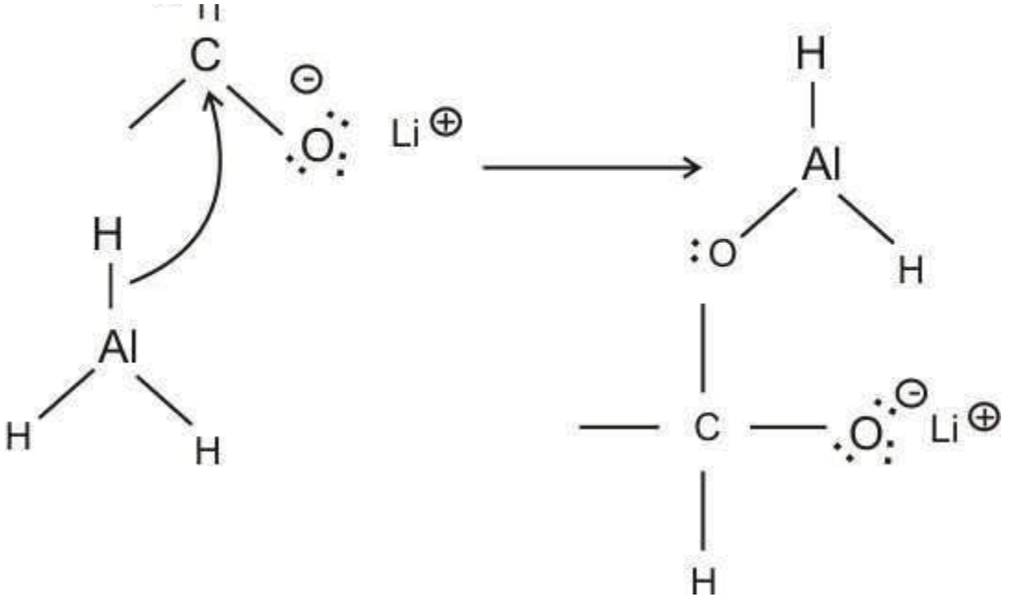
1. **Deprotonation**



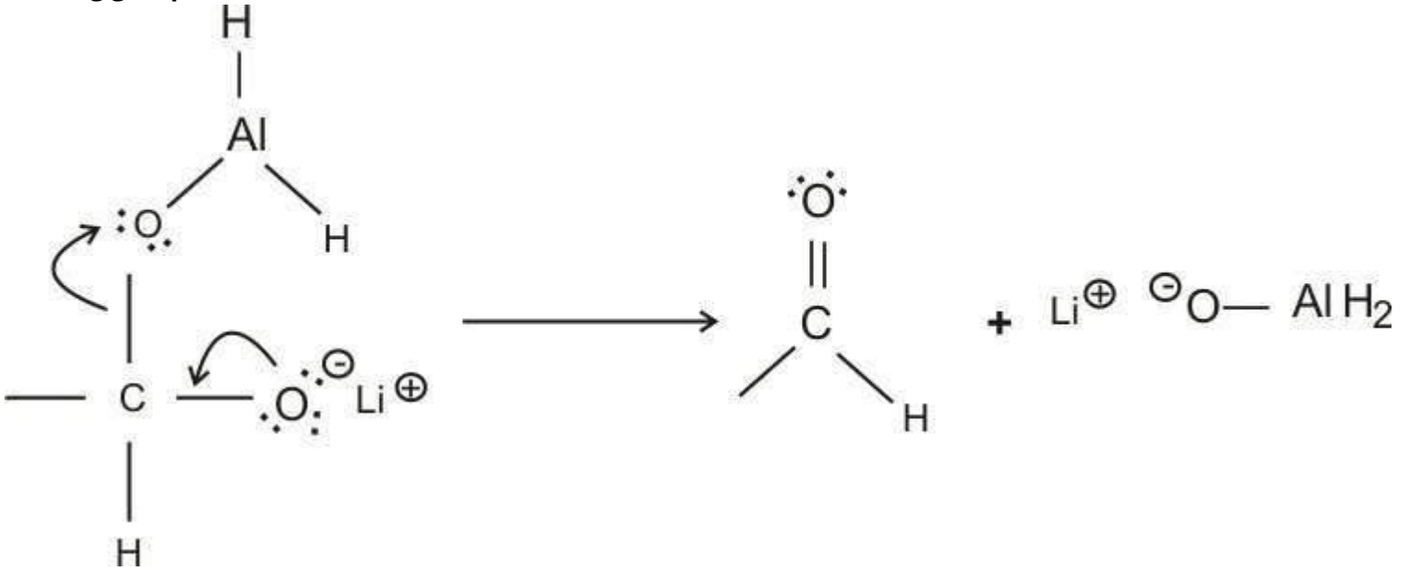
2. **Nucleophilic attack by the hydride ion**



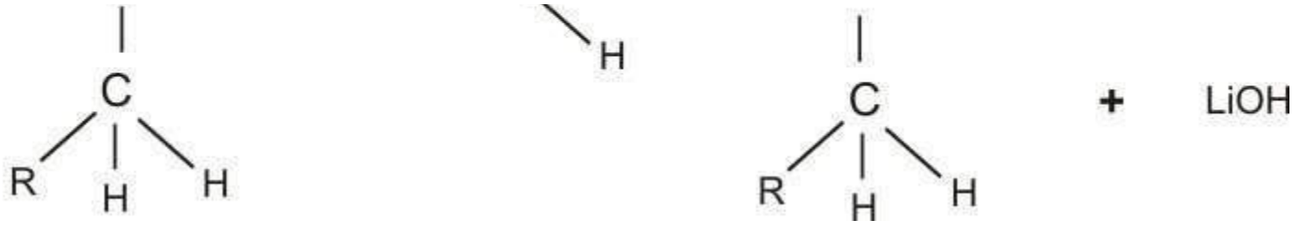
3. **Nucleophilic attack by the hydride ion**



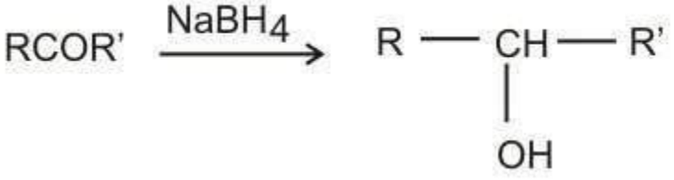
4. **Leaving group removal**

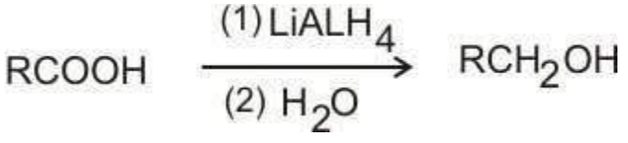


5. **Alkoxide is protonated**



Some examples include:





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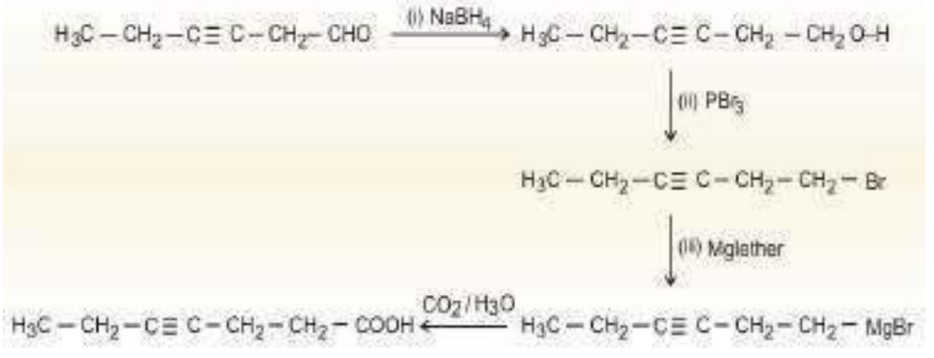
The reactions occur as follows:



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

Q. 40 The number of orbitals associated with quantum numbers is**:**

Option 1:
25

Option 2:
11

Option 3:
15

Option 4:
50

Correct Answer:
25

Solution:
As we have learnt,

Quantum Numbers -
Quantum numbers:

They are the set of four numbers which explain the state of electron i.e., location, energy, type of orbital, orientation of orbital, etc. in an atom. Various quantum numbers are as follows:

1. Principal quantum number(n)
2. Azimuthal quantum number(l)
3. Magnetic quantum number(m)
4. Spin quantum number(s)

Principal quantum number(n):

It represents the principal shell of an atom. It can have integral values except zero like 1,2,3,.... Also denoted as K,L,M,.....etc.

Maximum number of electrons in a principal shell can be 2n2 where n is principal quantum number.

This quantum number gives information about :

- Distance of electron from nucleus i.e., size of electron cloud.
- Energy of electron in any shell

$$E_n = -\frac{1312 \times Z^2}{n^2} \ \text{kJ/mol}$$

Where, Z is atomic number and n is principal quantum number.

Azimuthal quantum number(l):

Azimuthal quantum number represents the subshell or subenergy shell in an atom.

l has values from 0 to (n-1).

For eg: for n=2 ; l= 0, 1

Subshell notation for 0, 1 is s and p.

No. of electrons [2(2l+1)]: for s subshell = 2; for p subshell = 6.

Magnetic quantum number(m):

It represents the number of orbitals present in a subshell.

m has values ranging from -l to +l including zero.

For eg: for ‘s’ subshell :

1. Value of l is 0
2. m has value=0

For ‘p’ subshell :

1. Value of l is 1

2. m has value= -1, 0, +1

Spin quantum number(s):

Electron in an orbital can spin either clockwise or anticlockwise.

Thus, an electron can have only two possible values of this quantum number, either $+\frac{1}{2}$ or $-\frac{1}{2}$ respectively.

-

We have:

n = 5, ms = +1/2

Thus, the values of l are from 0 to (n-1)

l = 0 to 4

Thus, values of l are 5s, 5p, 5d, 5f and 5g

Now, the total number of orbitals $= n^2 = 5^2 = 25$

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

Q. 41 Two solutions A and B each of 100L was made by dissolving 4g of NaOH and 9.8g of H2SO4 in water, respectively. The pH of the resultant solution obtained from mixing 40L of solution A and 10L of solution B is_____:

Option 1:
pH = 10.6

Option 2:
pH = 12.7

Option 3:
pH = 9.8

Option 4:
pH = 11

Correct Answer:
pH = 10.6

Solution: As we have learnt,

pH of solution/mixture -

- **Mixture of Strong Acids:**

$$\mathbf{10^{-2}M\ HCl(1L) + 10^{-2}M\ HNO_3(2L)}$$

The chemical equation for HCl is as follows :
$\mathrm{HCl} \rightarrow \mathrm{H^+} + \mathrm{Cl^-}$
Thus, moles of $\mathrm{H^+} = 10^{-2}\,\mathrm{M}$

Similarly, for $\mathrm{HNO_3}$, we have :
$\mathrm{HNO_3^-} \rightarrow \mathrm{H^+} + \mathrm{NO_3^-}$
Thus, moles of $\mathrm{H^+} = 2 \times 10^{-2}\,\mathrm{M}$ (since volume is 2L)

Thus, total moles of $\mathrm{H^+} = 3 \times 10^{-2}$ and total volume $= 3\mathrm{L}$

$$\text{Thus, } [\mathrm{H^+}] = \frac{3 \times 10^{-2}}{3} = 10^{-2}\,\mathrm{M}$$

$$\mathbf{pH = -\log_{10}(10^{-2}) = 2}$$

NOTE: Shortcut only for monobasic acids and monoacidic bases:

$$[\mathrm{H^+}] = \frac{\mathrm{M_1V_1 + M_2V_2}}{\mathrm{V_1 + V_2}} \quad \text{(for acids)}$$

$$[\mathrm{OH^-}] = \frac{\mathrm{M_1V_1 + M_2V_2}}{\mathrm{V_1 + V_2}} \quad \text{(for bases)}$$

Mixture of Strong Bases:

Using the shortcut formula for bases as given above, we get:

$$[OH^-] = \frac{M_1V_1 + M_2V_2}{V_1 + V_2} = \frac{10^{-3} \times 2 + 10^{-2} \times 1}{3}$$

$$\Rightarrow \frac{10^{-3}(2+10)}{3} = \frac{12 \times 10^{-3}}{3} = 4 \times 10^{-3}$$

$$\text{pOH} = -\log 4 + 3 = -0.60 + 3 = 2.40$$

$$\text{Thus, pH} = 14 - \text{pOH} = 14 - 2.40 = 11.60$$

- **Mixture of Strong Acid and Strong Base:**

$$\mathbf{10^{-2}M\,HCl(2L) + 10^{-3}M\,NaOH(1L)}$$

Clearly, moles of (H+) = 2 x 10-2 moles and moles of (OH-) = 1 x 10-3 moles.
Since moles of (H+) is greater than moles of (OH-), therefore the solution medium will be acidic.
Now, remaining moles of H+ = 2 x 10-2 - 10-3 = 19 x 10-3

$$\text{Thus, } [H^+] = \frac{19 \text{ x } 10^{-3}}{3} = 6.3 \text{ x } 10^{-3}$$

$$\text{Thus, pH of mixture} = -\log_{10}(6.3 \text{ x } 10^{-3})$$

$$\text{pH} = 3 - \log_{10}6.3 = 3 - 0.79 = 2.2$$

Thus, pH of the mixture = 2.2

-

For given solutions, we have:

Moles of NaOH 4/40 = 0.1 moles

Moles of H2SO4 = 9.8/98 = 0.1 moles

Molarity of NaOH = 0.1/100L

And molarity of H2SO4 = 0.1/100

Now, 40L of NaOH solution and 10L of H2SO4 solution are added, thus we get:

Total volume = 50L

Milliequivalents of NaOH = 40x(0.1/100)x1 = 0.04

Milliequivalents of H2SO4 = 10x(0.2/100)x2 = 0.02

Thus, Meq of NaOH left = 0.04 - 0.02 = 0.02

[OH-] = 4x10-4

pOH = -log[4x10-4]

pOH = -log4 - log10-4

pOH = -0.60 + 4 = 3.4

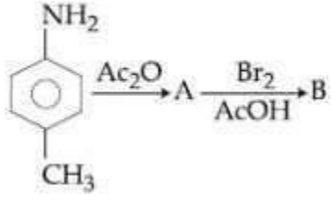
Further, we know:

pH = 14 - 3.4

pH = 10.6

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

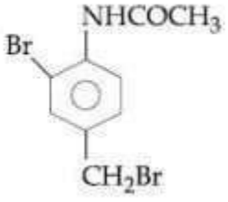
Q. 42 In the following reaction sequence,



the major product B is:

Option 1:

Option 2:



Option 3:

Option 4:

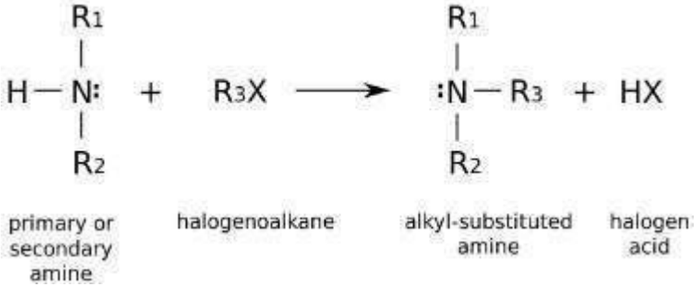
Correct Answer:

Solution: As we have learnt,

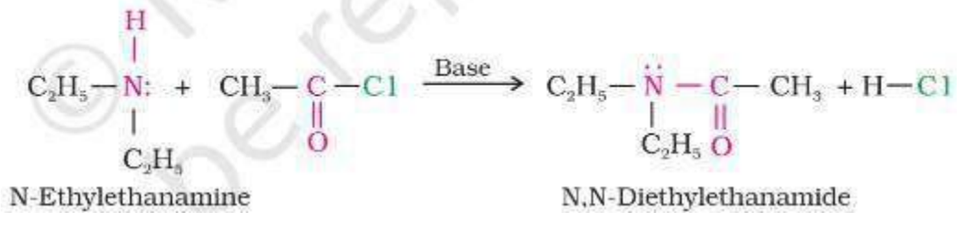
Alkylation and Acylation of Amines -

Alkylation

Amines undergo alkylation with RX and undergo complete methylation and this is called exhaustive methylation, but with Me2SO4 amines undergo monomethylation. 1o and 2o amines are also methylated by heating HCHO and excess of HCOOH at 100oC. This reaction is known as Eschweiler-Clarke methylation. The reaction occurs as follows:



Acylation 1o and 2o aliphatic and aromatic amines react with acid chlorides (RCOCl), anhydrides and esters by SN2 reaction is called acylation reaction. The reaction is carried out in the presence of a base stronger than amine, such as pyridine, which removes HCl so formed and shifts the equilibrium to the product side. The reaction occurs as follows:



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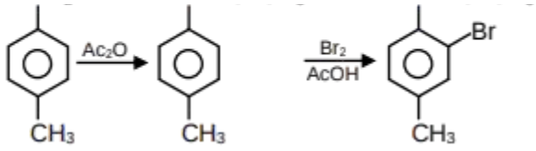
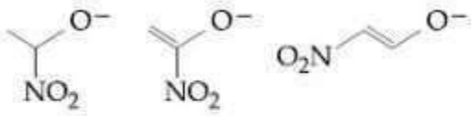


Therefore, **Option(1) is correct.**

Q. 43 The correct order of statbility for the following alkoxides is:



(A) (B) (C)

Option 1:
C > A > B

Option 2:
C > B > A

Option 3:
B > A > C

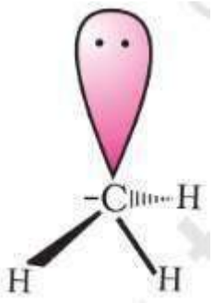
Option 4:
B > C > A

Correct Answer:
C > B > A

Solution:
As we have learnt,

Carbanions -

The carbon species carrying a negative charge on carbon atom is called carbanion. Carbon in carbanion is generally *sp*3 hybridised and its structure is distorted tetrahedron as shown in the gure given below. Carbanions are also unstable and reactive species.

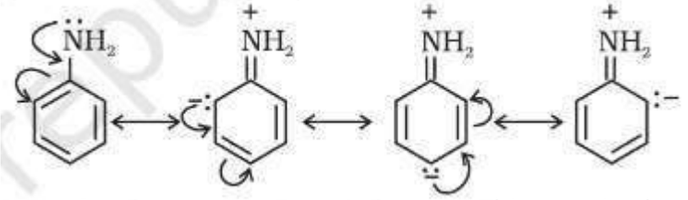


-

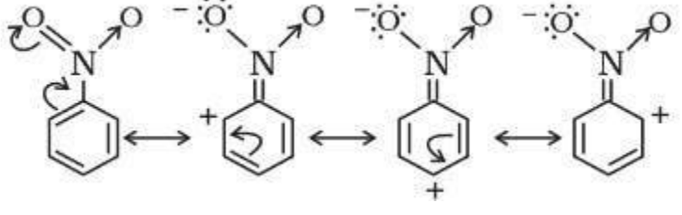
Mesomeric or Resonance E ect -

The resonance e ect is de ned as 'the polarity produced in the molecule by the interaction of two π-bonds or between a π-bond and lone pair of electrons present on an adjacent atom'. The e ect is transmitted through the chain. There are two types of resonance or mesomeric e ect designated as R or M e ect.

- **Positive Resonance E ect (+R e ect):** In this e ect, the transfer of electrons is away from an atom or substituent group attached to the conjugated system. This electron displacement makes certain positions in the molecule of high electron densities. This e ect in aniline is shown as:



- **Negative Resonance E ect (- R e ect):** This e ect is observed when the transfer of electrons is towards the atom or substituent group attached to the conjugated system. For example, in nitrobenzene, this electron displacement can be depicted as:



The atoms or substituent groups, which represent +R or –R electron displacement e ects are as follows :

- **+R e ect:** – halogen, –OH, –OR, –OCOR, –NH2, –NHR, –NR2, –NHCOR,

– R e ect: – COOH, –CHO, >C=O, – CN, –NO2

The presence of alternate single and double bonds in an open-chain or cyclic system is termed as a conjugated system. These systems often show abnormal behaviour. The examples are 1,3- butadiene, aniline and nitrobenzene etc. In such systems, the π-electrons are delocalised and the system develops polarity.
-

When a negative charge is delocalised with an electron-withdrawing group like (NO2) then stability increases.

(A) The negative charge is localised

(B) The negative charge is delocalised with the carbon of the alkene

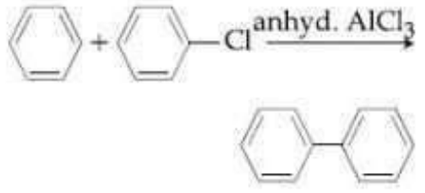
(C) Negative charge is delocalised with NO2 group

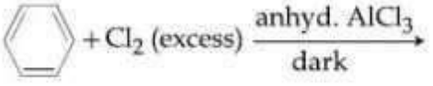
Therefore, **Option(2) is correct.**

Q. 44 Consider the following reactions:

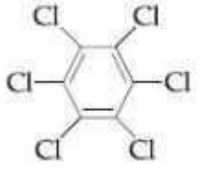
(a)

(b)

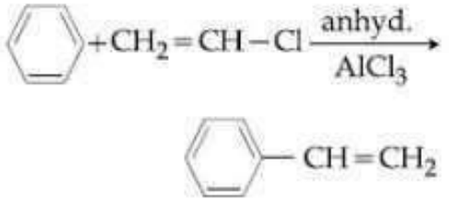


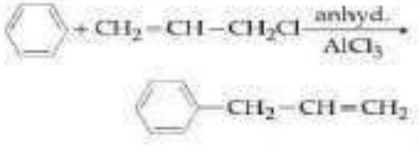


(c)

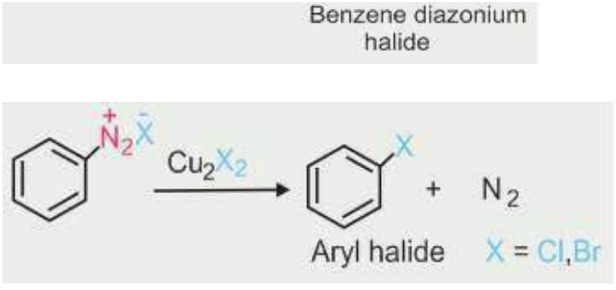


(d)





Which of these reactions are possible?



-

1. Vinyl halides (C) do not give Fridel Craft's reaction because of unstable carbocation formation.

2. Aryl halides (A) do not give Fridel Craft's reaction with Benzene because of formation of unstable phenyl carbocation.

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

Q. 45 The molarity of HNO3 in a sample which has density 1.4 g/mL and mass percentage of 63% is ____ (Molecular weight of HNO3 = 63)

Option 1:
14

Option 2:
15

Option 3:
12

Correct Answer:

Solution: As we have learnt,

Imperfections in Solids -

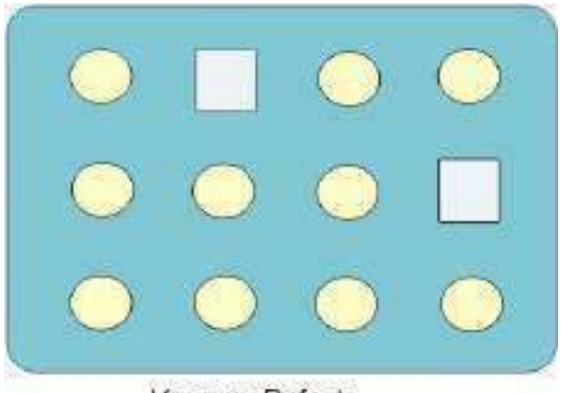
Point Defects, Line Defects

Although crystalline solids have short-range as well as long-range order in the arrangement of their constituent particles, yet crystals are not perfect. Usually a solid consists of an aggregate of a large number Of small crystals. These small crystals have defects in them. This happens when the crystallisation process occurs at a fast or moderate rate. Single crystals are formed when the process of crystallisation occurs at an extremely slow rate. Even these crystals are not free of defects. The defects are basically irregularities in the arrangement of constituent particles. Broadly speaking, the defects are of two types, namely, point defects and line defects. Point defects are irregularities or deviations from ideal arrangement around a point or an atom in a crystalline substance, whereas the line defects are irregularities or deviations from ideal arrangement in entire rows of lattice points. These irregularities are called crystal defects. We shall con ne our discussion to point defects only.

Types of Point Defects

- **Stoichiometric Defects**
  Those compounds in which the number of positive and negative ions are exactly in the ratio indicated by their chemical formula are called stoichiometric compounds example, NaCl. These solids show following types of defects:

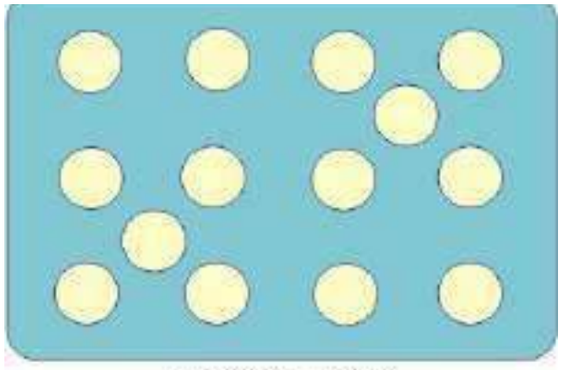
  1. **Vacancy Defect:** When some of the lattice sites are vacant. the crystal is said to have a vacancy defect.



Vacancy Defects

This results in a decrease in the density of the substance. This defect can also develop when a substance is heated.

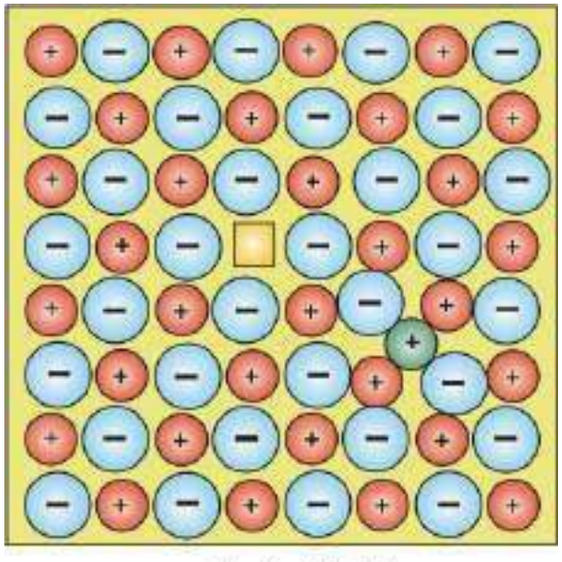
2. **Interstitial Defect:** When some constituent particles (atoms or molecules) occupy an interstitial site, the crystal is said to have an interstitial defect.



Interstitial Defects

This defect increases the density of the substance. Vacancy and interstitial defects as explained above can be shown by non-ionic solids. Ionic solids must always maintain electrical neutrality. Rather than simple vacancy or interstitial defects, they show these defects as Frenkel and Schottky defects.

3. **Frenkel Defect:** This defect is shown by ionic solids. The smaller ion (usually cation) is dislocated from its normal site to an interstitial site.



Frenkel defects

It creates a vacancy defect at its Original site and an interstitial defect at its new location. Frenkel defect is also called dislocation defect. It does not change the density of the solid. Frenkel defect is shown by ionic substance in which there is a large di erence in the size of ions, for example ZnS, AgCl, AgBr and Agl due to small size of Zn2+ and Ag+ ions.

Maths

Q. 1 If $x_1 + x_2$ is less than or equal to 500y and y is (0-1), If y is 0, then $x_1 and x_2$ will be

Option 1:
equal to 0

Option 2:
less than 0

Option 3:
> 0

Option 4:
=500

Correct Answer:
equal to 0

Solution:

Solution of Linear Programming Problems -
- As we learnt in Corner Point Method - This method of solving a LPP graphically is based on

the principle of extreme points theorem. -

$at \quad y = -1 \quad x_1 + x_2 \leq -500$

$Since \; x_1 \quad \& \quad x_2 \geqslant 0$

So only $x_1 = 0 \quad \& \quad x_2 = 0$ satis es.

Q. 2 The points (x,3) satis es the inequality , -5x-2y13, nd 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.

-

$$\int (f(x) + x\, f'(x))\, dx = x\, f(x) + C$$

$$\int e^x (x+1) dx = xe^x + C$$

Q. 4 The area bounded by $x^2 \leq y \;\; and \;\; y \leq x + 2 \;\; is \;\; k/9, then \;\; k = ?$

Option 1:
81/2

Option 2:
81/9

Option 3:
81

Option 4:
none of these

Correct Answer:
81/2

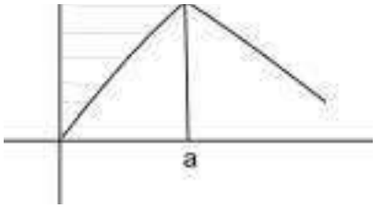
Solution:
As we have learned

Area between two curves -

If we have two functions intersection each other.First nd the point of intersection. Then integrate to nd area

$$\int_o^a [f(x) - 9(x)]\, dx$$

- wherein



The line y = x+2

cut

$x^2 = y \ at \ x = -1 \text{ and } x = 2$

$area = 15/2 - \int_{-1}^{2} x^2 dx = \frac{9}{2}$

$k/9 = 9/2$

$k = 81/2$

Q. 5 If f (x) = $\int \sin(a^x) ln(1/a) a^x dx = g(x) + C,$ Then $g(0) = ?$

Option 1:
$\cos A$

Option 2:
$\cos 1/a$

Option 3:
$\cos 1$

Option 4:
none of this

Correct Answer:
$\cos 1$

Solution:
As we have learned

Type of integration by substitution -

Integral of the functions containing functions of trigonometric functions

$\because \int sinf(x)\backslash leftf'(x)\backslash rightdx$

$\therefore \int sintdt = -cost + c$

ex: $\therefore \int sin\,(ax+b)\,dx = \dfrac{-cos(ax+b)}{a} + c$

- wherein

Let $f(x) = t$

$\therefore f'(x)dx = dt$

$$- \int \sin(a^x)a^x \ln(a)dx$$

$$put \;\; a^x = t \Rightarrow ln(a)a^x dx = dt$$

$$= -\sin(t)dt = \cos(t) + C$$

$$= \cos(a^x) + C$$

$$g(x) = \cos(a^x)$$

$$g(0) = \cos(a^0) = \cos(1)$$

Q. 6 In how many ways can 5 women and 3 men be seated in a row so that no two men are together

Option 1:
6 ! 5!

Option 2:
$6! \times^6 P_3$

Option 3:
$6!^5P_3$

Option 4:
$5! \times^6 P_3$

Correct Answer:
$5! \times^6 P_3$

Solution:
As we have learned

Number of Permutations without repetition -

Arrange n objects taken r at a time equivalent to lling r places from n things.

number of choices: n (n-1) (n-2) (n-3) n-(r-1)

- wherein

Where $r \leq n \ \ and \ \ r \geq 0$

Let us rst seat the 5 women

It can be done in 5 ! ways for such arrangement, 3 men can be seated only at X position

XWXWXWXWXWX

so, 3 men can be seated in $5! \times^{6} P_3$

Q. 7 In expansion of $(x+1+x^2)^3 \ \ coeff \ \ of \ \ x^3$

Option 1:
3

Option 2:
6

Option 3:
7

Option 4:
none of these

Correct Answer:
7

Solution:
As we have learned

Coe cient of x^{R} -

We write general term

and $a = f(x)$

$T_{r+1} =^{n} c_r \cdot x^{n-r} (f(x))^r$

We arrange all of x together and make $x^{(n,r)}$

compare : $x^{(n,c,r)} = x^R$

nd r

- wherein

Take a in terms of x.

r can't be negative or fraction.

$(x + 1 + x^2)^3 \Rightarrow (x + (1 + x^2))^3$

$^3C_r x^r (1 + x^2)^{3-r} \Rightarrow^3 C_1 x (1 + x^2)^3 +^3 C_3 x^3$

$=^3 C_1 *^2 C_1 +^3 C_3 = 1 + 6 = 7$

Q. 8 If $^{15}C_0 +^{15} C_2 +^{15} C_4 + ... +^{15} C_{14} = A;^{15} C_1 +^{15} C_3 +^{15} C_4 ... +^{15} C_{15} = B$ *Then* $\frac{A^2 + B^2}{AB} =?$

Option 1:
1

Option 2:
2

Option 3:
mulitple of 15

Option 4:
none of these

Correct Answer:
2

Solution:
As we have learned

Properties of Binomial Theorem -

Sum of the binomial coe cients of the odd term is equal to sum of the binomial coe cients of even term and each is equal to 2^{n-1}.

- wherein

$$c_0 + c_2 + c_4 - - - -$$

$$= c_1 + c_3 + c_5 - - - -$$

$$= 2^{n-1}$$

A= B = 2^{14} ; Thus

$$\frac{(2^{14})^2 + (2^{14})^2}{2^{14} \times 2^{14}} = 2$$

Q. 9 If in $(1+x)^{17}$ ratio of $T_4 : T_5 : T_6 = a : b : c \;\; then \frac{a(b+c)}{b^2 - ca} = ?$

Option 1:
4

Option 2:
5

Option 3:
6

Option 4:
217

Correct Answer:
4

Solution:
As we have learned

Result of Binomial Theorem -

If the three consecutive terms in the expansion of $(1+x)^n$ are in the ratio $a:b:c$ then the value of r is given by

$$r=\frac{a\left(b+c\right)}{b^2-ac}$$

- wherein

Take $r^{th},(r+1)^{th},(r+2)^{th}$ term

$$T_r:T_{r+1}:T_{r+2}=a:b:c$$

$$\frac{a(b+c)}{b^2-ca}=\frac{{}^nc_{r-1}({}^nc_r+{}^nc_{r+1})}{{}^nc_r^2-{}^nc_{r-1}^nc_{r+1}}=\frac{{}^nc_{r-1}({}^{n+1}c_{r+1})}{{}^nc_r^2-{}^nc_{r-1}^nc_{r+1}}$$

$$\frac{\frac{n!}{(r-1)(n-r+1)!}\times\frac{(n+1)!}{(r+1)!(n-r)}}{\frac{n!\times n!}{(r!)^2((n-r)!)^2}-\frac{n!}{(r-1)(n-r+1)!}\times\frac{n!}{(r+1)(n-r-1)!}}$$

$$= \frac{\frac{(n+1)}{(r+1)(n-r+1)(n-r)}}{\frac{nr-r^2+r+n-r+1+nr+r^2}{r(n-r)(r+1)(n-r+1)}}$$

$$= r$$

Q. 10 What is the equation of an upward opening parabola with distance between its focus and directrix as 7 and passing through origin as vertex

Option 1:
$x^2 = 7y$

Option 2:
$y^2 = 7x$

Option 3:
$x^2 = -14y$

Option 4:
$x^2 = 14y$

Correct Answer:
$x^2 = 14y$

Solution:
As we have learned

Standard equation of parabola -

$$x^2 = 4AY$$

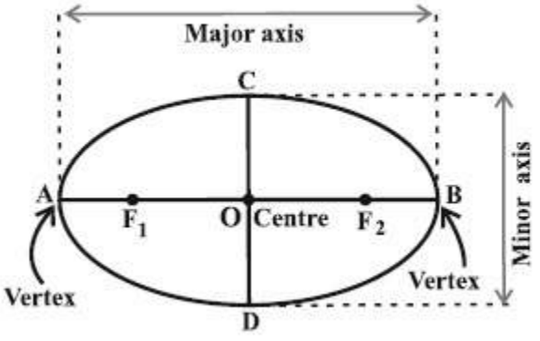
- wherein

Solution:
As we have learned

Minor axis -

The line segment through the centre and perpendicular to the major axis.

- wherein



Q. 12 Write the equation of rectangular hyperbola in standard form with x-axis as transverse axis and origin as center with length of transverse axis as 8

Option 1:
$x^2 - y^2 = 64$

Option 2:
$x^2 - y^2 = 16$

Option 3:
$x^2/4 - y^2/4 - 1$

Option 4:
none of these above

Correct Answer:
$x^2 - y^2 = 16$

Solution:

As we have learned

General equation (cartesian form) -

-

$$\text{Here, } 2a = 8 \Rightarrow a = 4$$

$$so, x^2 - y^2 = 16$$

Q. 13 What is the equation of tangent at (-3,5) on the hyperbola $20x^2 - 4y^2 = 80$

Option 1:
3x+y +4 = 0

Option 2:
x+3y-4 = 0

Option 3:
y = 3x+4

Option 4:
none of these

Correct Answer:
3x+y +4 = 0

Solution:
As we have learned

Equation of Tangent to Hyperbola -

$$\frac{xx_1}{a^2} - \frac{yy_1}{b^2} = 1$$

- wherein

For the Hyperbola

and

(x_1, y_1)

$$\frac{x^2}{4} - \frac{y^2}{20} = 1$$

$$At(-3, 5); tangent\ \ is \rightarrow$$

$$\frac{-3x}{4} - \frac{5y}{20} = 1$$

$$-15x - 5y = 20$$

$$15x + 5y + 20 = 0$$

$$3x + y + 4 = 0$$

Q. 14 Find $z^{\bar{n}} =$?, if $\bar{z} = 1 - 4i$ & $n = 2$

Option 1:
$1 + 8i$

Option 2:
$15 + 8i$

Option 3:
$-15 - 8i$

Option 4:
None of these

Correct Answer:

Solution:
As we learned

Properties of Conjugate of Complex Number -

$(\bar{z})^n = \overline{z^n}$

- wherein

$\bar{z}$ denotes conjugate of z.

$$\begin{aligned} z^{\bar{n}} &= (\bar{z})^n \\ &= (1-4i)^2 \\ &= 1-16-8i \\ &= -15-8i \end{aligned}$$

Q. 15 Modulus of 2 complex no's are 4 and 7 and modulus of sum of these complex numbers is 9, then $z_1\bar{z}_2 + \bar{z}_1 z_2 =$

Option 1:
16

Option 2:
2

Option 3:
11

Option 4:
0

Correct Answer:
16

Solution:
As we learned

Property of Modulus of z(Complex Number) -

$$|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 + z_1.\bar{z_2} + z_2.\bar{z_1}$$

- wherein

|.| denotes modulus of z

$\bar{z}$ denotes conjugate of z

$$|z_1| = 4, |z_2| = 7,$$

$$|z_1 + z_2| = 9$$

So, $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 + z_1\bar{z_2} + \bar{z_1}z_2$

81=16+49+$z_1\bar{z_2} + \bar{z_1}z_2$

$$z_1\bar{z_2} + \bar{z_1}z_2 = 16$$

Q. 16 What is the polar term of $z = -4 + 4i$

Option 1:

Option 2:

$4\sqrt{2}\left(Cos\frac{3\pi}{4}+iSin\frac{3\pi}{4}\right)$

Option 3:

$4\sqrt{2}\left(Cos\frac{\pi}{4}-iSin\frac{\pi}{4}\right)$

Option 4:

$4\left(Cos\frac{3\pi}{4}-iSin\frac{3\pi}{4}\right)$

Correct Answer:

$4\sqrt{2}\left(Cos\frac{3\pi}{4}+iSin\frac{3\pi}{4}\right)$

Solution:
As we learned

Polar Form of a Complex Number -

$z=r(cos\theta+isin\theta)$

- wherein

r= modulus of z and θ is the argument of z

Here, $|z|=\sqrt{16+16}=4\sqrt{2}$

&, Arg

(2nd quadrant and $\tan\theta = -1$)

Q. 17 What is the euler form of complex number $z = 2\sqrt{3} - 2i$

Option 1:
$4e^{\frac{-i\pi}{6}}$

Option 2:
$4\sqrt{2}e^{\frac{-i\pi}{3}}$

Option 3:
$4e^{\frac{-i\pi}{3}}$

Option 4:
None of these

Correct Answer:
$4e^{\frac{-i\pi}{6}}$

Solution:
As we learned

Euler's Form of a Complex number -

$z = re^{i\theta}$

- wherein

r denotes modulus of z and θ denotes argument of z.

Arg $(z) = \frac{-\pi}{6}$

$\left(tan\Theta = \frac{i}{\sqrt{3}} \text{ and } 4^{th} quadrant\right)$

So, $z = 4e^{\frac{-i\pi}{6}}$

Q. 18 What is the argument of zw, such that $\arg(z) = \frac{2\pi}{3}$ and $\arg(w) = \frac{\pi}{2}$.

Option 1:

$\arg(zw) = \frac{7\pi}{6}$

Option 2:

$\arg(zw) = \frac{-5\pi}{6}$

Option 3:

$\arg(zw) = \frac{\pi}{6}$

Option 4:

None of these

Correct Answer:

$\arg(zw) = \frac{-5\pi}{6}$

Solution:

As we learned

Normal form -

- wherein

p is the length of the perpendicular segment from the origin and ω is the angle made by this perpendicular with +ve x-axis.

$\sqrt{3}x - y = 8\sqrt{3}$

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

$\cos 30x - \sin 30y = 4\sqrt{3}$

$\cos\left(\frac{\pi}{6}\right)x - \sin\left(\frac{\pi}{6}\right)y = 4\sqrt{3}$

Q. 20 For what value of angle β between intersecting plane and vertical axis of adouble napped circular cone with α as semi vertical angle , we get ellipse ?

Option 1:
$\beta < 90^\circ$

Option 2:
$\alpha < \beta < 90^\circ$

Option 3:
$0 < \beta < \alpha$

Option 4:
$\beta = \alpha$

Correct Answer:
$\alpha < \beta < 90^\circ$

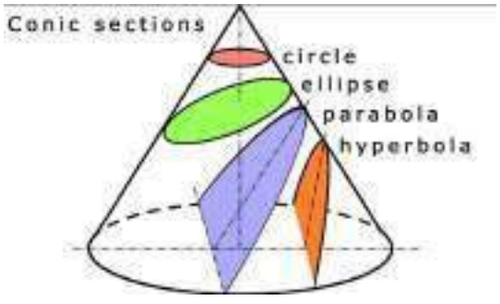
Solution:

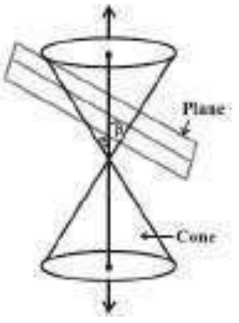
As we have learned

Di erent conic sections -

We get an ellipse when $\alpha < \beta < 90^\circ$

- wherein





Q. 21 Find the equation of circle whose center is in 2nd quadrant and radius is 3 units , Also , the circle touches both the axes

Option 1:
$x^2 + y^2 - 3x + 3y - 9 = 0$

Option 2:
$x^2 + y^2 + 6x + 6y + 9 = 0$

Option 3:
$x^2 + y^2 + 6x - 6y + 9 = 0$

Option 4:
none of these

Correct Answer:
$x^2 + y^2 + 6x - 6y + 9 = 0$

Solution:
As we have learned

Circle touching both axes and radius r -

-

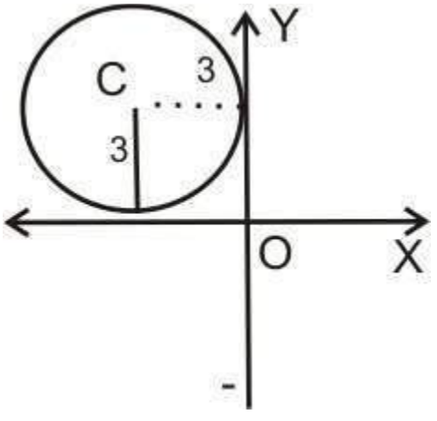
Hence

C = (-3,3)

= (-g,-f)

r = 3

$x^2 + y^2 + 6x - 6y + 9 = 0$



Q. 22 Find the parameter θ of a point (3,-4) on a circle whoese center is (2,-4 + $\sqrt{3}$) and radisu is 2 units

Option 1:
$2\pi/3$

Option 2:
$\pi/3$

Option 3:
$5\pi/3$

Option 4:

Correct Answer:
$5\pi/3$

Solution:
As we have learned

Parametric form -

$$x = h + r\cos\Theta$$

$$y = k + r\sin\Theta$$

- wherein

Circle having centre (h, k) and radius r.

x = 3 , y = -4

h = 2

$$k = -4 + \sqrt{3}$$

$$r = 2$$

$$3 = 2 + 2\cos\theta \Rightarrow \cos\theta = 1/2$$

$$-4 = -4 + \sqrt{3} + 2\sin\theta \Rightarrow \sin\theta = -\sqrt{3}/2$$

angle in the 4th quadrant

$$\theta = (-60) = -\pi/3$$

$$= 2\pi - \pi/3$$

$$= 5\pi/3$$