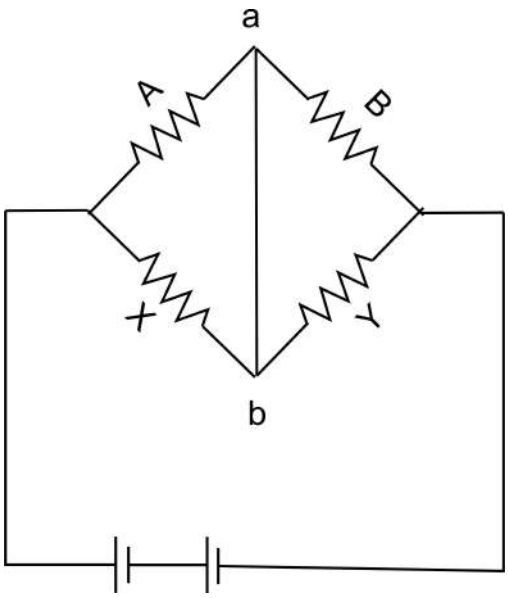
VITEEE 2024

Physics

Q. 1 In a wheatstone bridge X=Y and A>B. The direction of current between a and b will be



Option 1:
from a to b

Option 2:
from b to a

Option 3:
from b to a through c

Option 4:
from a to b through c

Correct Answer:
from b to a

Solution:
As we learnt

unbalanced condition -

$$V_B > V_D$$

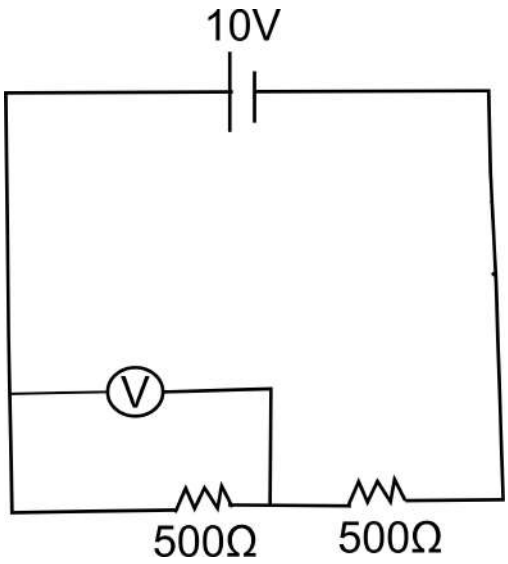
$$(V_A - V_B) < (V_A - V_D)$$

- wherein

Current will flow from A to B

Same current will go from x and y but current through B is gretaer than current through a. Hence some current has to flow from b to a.

Q. 2 A voltmeter of resistance 1000Ω is connected across a resistance 500Ω in a given circuit.What will be the reading of voltmeter?



Option 1:
4

Option 2:
2

Option 3:
6

Option 4:
1

Correct Answer:
4

Solution:

$$R_{eq} = \frac{1000 * 500}{1500} + 500$$

$$= 500 + \frac{1000}{3} = \frac{2500}{3}\Omega$$

$$I = \frac{10}{\left(\frac{2500}{3}\right)}A = \frac{3}{250}A$$

Potential Difference across Voltmeter

V=IR

$$I_v = \left(\frac{3}{250}\right).\frac{R_2}{R_1 + R_2} = \left(\frac{3}{250}\right) * \frac{500}{1500}$$

$$I_v = \frac{1}{250}A$$

Potential Difference$= \frac{1}{250} * 1000V = 4V$

Q. 3 According to Newton's law of viscous force velocity gredient $\left(\frac{du}{dx}\right)$related to viscous force 'F" as -

Option 1:

$$F \propto \frac{1}{\left(\frac{d\Theta}{dx}\right)}$$

Option 2:

$$F \propto \left(\frac{d\Theta}{dx}\right)^2$$

Option 3:

F is independent of velocity gredient .

Option 4:

None of these

Correct Answer:

None of these

Solution:

As we learn

Velocity gradient -

Viscous force directly proportional to Velocity gradient

- wherein

$$F\alpha\frac{dv}{dx}$$

$$F\alpha\frac{dv}{dx}$$

Q. 4 A force of 20 N acts on a body of mass 20 Kg for 10 sec . Change in momentum is

Option 1:
200 Kgm/s

Option 2:
100 Kgm/s

Option 3:
50 Kgm/s

Option 4:
30 Kgm/s

Correct Answer:
200 Kgm/s

Solution:
As we have learned

Impulse Momentum Theorem -

$$\vec{F}=\frac{d\vec{p}}{dt}$$

$$\int_{t_1}^{t_2}\vec{F}dt=\int_{p_1}^{p_2}\vec{dp}$$

- wherein

If $\triangle t$ is increased, average force is decreased

By impulse momentum theorem

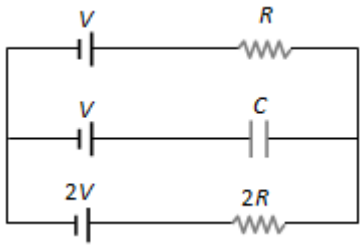
$$F\Delta t=\Delta p$$

$$20\times 10=\Delta P$$

Change in momnentum

= 200 Kgm/s

Q. 5 In the given circuit, with steady current, the potential drop across the capacitor must be



Option 1:
V

Option 2:
V/2

Option 3:
V/3

Option 4:
2V/3

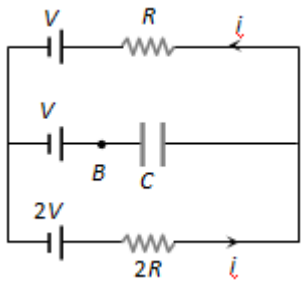
Correct Answer:
V/3

Solution:
As we have learnt,

Kirchhoff's Law -

$$\sum q = 0$$

-



at steady state capacitor act as open circuit

Moving anticlockwise from A

$$-iR - V + 2V - 2iR = 0$$

$$\Rightarrow iR = V/3$$

$$V_C = iR + V - V = iR$$

Potential drop across C = V/3

Q. 6 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:

$A + B + C$

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. 7 An ac supply gives 20V rms which passes through a 10ω resistance. The power dissipated in it is-

Option 1:

50 watt

Option 2:

90 watt

Option 3:
40 watt

Option 4:
30 watt

Correct Answer:
40 watt

Solution:
As we have learnt,

Average power -

$$P_{av} = i_{rms}^{2} R = \frac{V_{rms}^{2} R}{Z^{2}}$$

-

$$P_{avg} = V_{rms} I_{rms} \cos\phi \quad [as\ \phi = 0]$$
$$P_{avg} = \frac{V_{rms}^{2}}{R} = \frac{20^{2}}{10} = 40\ watt$$

Q. 8 If E is the electric field intensity of an electrostatic field, then the electrostatic energy density is proportional to

Option 1:
E

Option 2:
E^2

Option 3:
$\frac{1}{E^2}$

Option 4:
E^3

Correct Answer:
E^2

Solution:
As we learned

Electric Field -

The space around a charge in which another charged particle experiences a force is said to have electric field in it.

Electrostatic energy density $\frac{dU}{dV} = \frac{1}{2}K\varepsilon_0 E^2$

Hence, electrostatic energy density is proportional to E^2.

Correct option is 2.

Q. 9 If the electric flux entering and leaving an enclosed surface respectively is ϕ_1 and ϕ_2 the electric charge inside the surface will be

Option 1:
$(\phi_1 + \phi_2)\varepsilon_0$

Option 2:
$(\phi_2 - \phi_1)\varepsilon_0$

Option 3:
$(\phi_1 + \phi_2)/\varepsilon_0$

Option 4:
$(2\phi_2 + \phi_1)/\varepsilon_0$

Correct Answer:
$(\phi_2 - \phi_1)\varepsilon_0$

Solution:
As we have learned

if Electric field is variable -

$$\phi = \int \vec{E} \cdot d\vec{A}$$

-

$$\phi_{net} = 1/\varepsilon_0 \times Q_{enc} \Rightarrow Q_{enc} = (\phi_2 - \phi_1)\varepsilon_0$$

Q. 10 Which of the following statment is correct:

i) Static friction is always greater than kinetic friction

ii) Coeficient of static friction is always greater than the coeficient of kinetic friction.

iii) Limiting friction is always greater than kinetic friction

iv) Limiting friction is never less than static friction

Option 1:
(ii), (iii), (iv)

Option 2:
(i), (ii), (iii)

Option 3:
(i), (iii), (iv)

Option 4:
(i), (ii), (iv)

Correct Answer:
(ii), (iii), (iv)

Solution:
As we learn

Kinetic or Dynamic Friction -

$f_K \ \alpha \ R$

$f_K = \mu_K R$

$f_K =$ kinetic friction

$\mu_K =$ coefficient of kinetic friction

R = reaction

- wherein

$f_K < F_l$

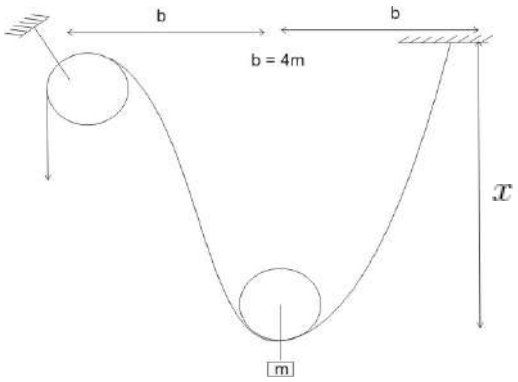
$\therefore \ \mu_K < \mu_s$

$\mu_K =$ depends on the nature of surface in contact.

Theory based

Correct option is 1

Q. 11 One end is pulled down at constant velocity v . What is the velocity of mass m when the x = 3m



Option 1:
-v/6

Option 2:
3v/4

Option 3:
-5v/6

Option 4:
-2v/3

Correct Answer:
-5v/6

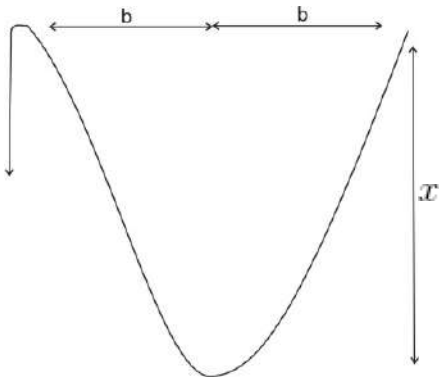
Solution:
As we have learned

Equation of contraint -

Length of string rod of a given system is constant, this can be used to relate the velocity of one part with the other this is useful.

- wherein

When number of variable is more than number of equation.



Using constrain equator

$$2\sqrt{x^2+b^2}+y=length\ \ of\ \ string$$

Differentiating w.r.t to time

$$\frac{2}{2\sqrt{x^2+b^2}}2\times\left[\frac{dx}{dt}\right]+dy/dt=0$$

$$dx/dt=-(v/2x)\sqrt{x^2+b^2}=-v/6\times 5=>-5v/6$$

Q. 12 Physical quantity which represents both the instantaneous value and direction of alternative quatity at any instant is called:

Option 1:
Peak value

Option 2:
rms value

Option 3:
phase

Option 4:
mean value

Correct Answer:
phase

Solution:
As we learn

Phase -

Which represents both the instantaneous value and direction of alternating quantity at any instant.

Q. 13 Two copper balls, each weighing 10g are kept in air 10 *cm* apart. If one electron from every 10^6 atoms is transferred from one ball to the other, the coulomb force between them is (atomic weight of copper is 63.5)

Option 1:

$2.0 \times 10^{10} N$

Option 2:

$2.0 \times 10^{4} N$

Option 3:

$2.0 \times 10^{8} N$

Option 4:

$2.0 \times 10^{6} N$

Correct Answer:

$2.0 \times 10^{8} N$

Solution:

As we learned

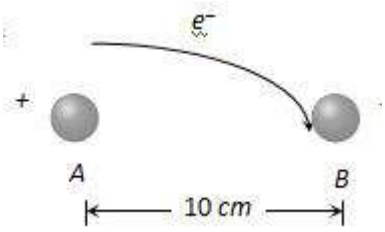
Properties of Charge -

Transferable

- wherein

It can be transferred from one body to another.

Number of atoms in given mass = $\frac{10}{63.5} \times 6.02 \times 10^{23} = 9.48 \times 10^{22}$



Transfer of electron between balls = $\frac{9.48 \times 10^{22}}{10^6} = 9.48 \times 10^{16}$

Hence magnitude of charge gained by each ball.

$Q = 9.48 \times 10^{16} \times 1.6 \times 10^{-19} = 0.015\, C$

Force of attraction between the balls $F = 9 \times 10^9 \times \frac{(0.015)^2}{(0.1)^2} = 2 \times 10^8 N$

Q. 14 In radio therapy, x-rays are used to -

Option 1:
Defect bone fractures

Option 2:
Treat cancer by controlled exposure

Option 3:
Defect heart diseases

Option 4:
Defect fault in radio receiving circuits

Correct Answer:
Treat cancer by controlled exposure

Solution:
As we learn

Application of X-Ray -

- X Ray diffraction

- To analyse composition of material

- Radio therapy

- Medicine & surgery

In radio therapy x-rays are used to treat cancer.

Q. 15 The length of a wire of a potentiometer is 100cm and emf of its standard cell is E volt.It is employed to measure the emf of a battery whose internal resistance is 0.5Ω. If the balance point is obtained at l=30cm from the positive end,emf of the battery is

Option 1:
$\frac{30E}{100}$

Option 2:
$\frac{30E}{100.5}$

Option 3:
$\frac{30E}{100-0.5}$

Option 4:
$\frac{30\left(E-50i\right)}{100}$

Correct Answer:
$\frac{30E}{100}$

Solution:
As we learnt

Potential gradient -

Potential difference per unit length of wire

- wherein

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

Using the principle of potentiometer $v\alpha l$

$$\frac{V}{E}=\frac{l}{L}\ or\ V=\frac{l}{L}E=\frac{30E}{100}$$

Q. 16 A metallic disc of radius 0.1 m is rotated about its centre with angular velocity $20\pi\ rad/sec$ in a uniform magnetic field of 0.1T with its plane perpendicular to the field. The emf induced across the radius of the disc is-

Option 1:
$2\pi\times10^{-2}V$

Option 2:
$\pi\times10^{-3}V$

Option 3:
$\frac{\pi}{2}\times10^{-2}V$

Option 4:
$3\pi\times10^{-2}V$

Correct Answer:

$\pi \times 10^{-3} V$

Solution:

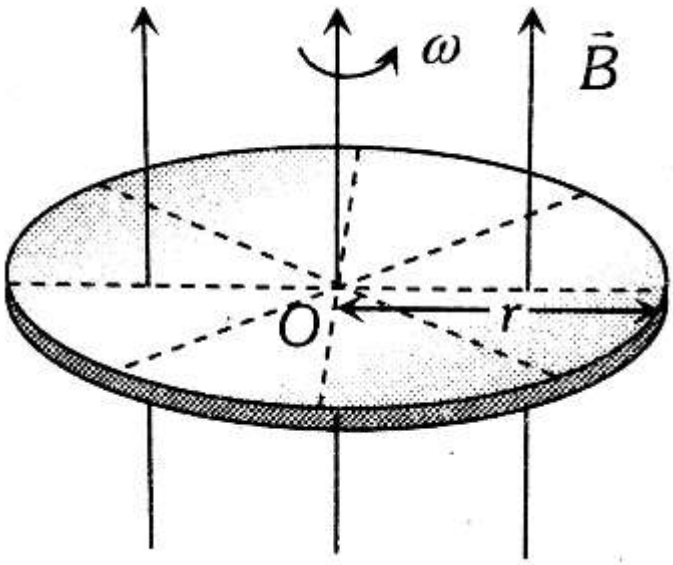
As we have learnt,

Motional E.m.f due to rotational motion -

Metal Disc

$$\varepsilon = \frac{1}{2} B w r^2$$

- wherein



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

$$= \frac{1}{2} \times (0.1) \times 2\pi \times (0.1)^2$$

$$= \pi \times 10^{-2} V$$

Q. 17 Infrared radiation is detected by -

Option 1:

Nanometer

Option 2:
Photometer

Option 3:
Pyrometer

Option 4:
Spectrometer

Correct Answer:
Pyrometer

Solution:
As we learn

Infrared Radiations -

Medium is not requuired for the propagation of these radiation.

Infrared radiation is detected by pyrometer.

Q. 18 State which of the following is correct

Option 1:
$Joule = coulomb \times volt$

Option 2:
Joule = coulomb/volt

Option 3:
$Joule = volt \times ampere$

Option 4:
Joule = volt/ampere

Correct Answer:
$Joule = coulomb \times volt$

Solution:

As we know, Potential difference=Work done/charge

So, unit will be V=Joule/Coulomb

Joule=Volt x coulomb

Q. 19 Faraday's law of EMI is defined as

Option 1:

$\oint \underset{B}{\rightarrow} \cdot \underset{dS}{\rightarrow} = 0$

Option 2:

$\oint \underset{E}{\rightarrow} \cdot \underset{dl}{\rightarrow} = \frac{-d\varnothing_B}{dt}$

Option 3:

$\oint \underset{E}{\rightarrow} \cdot \underset{dS}{\rightarrow} = \frac{q}{E_0}$

Option 4:

None of the above

Correct Answer:

$\oint \underset{E}{\rightarrow} \cdot \underset{dl}{\rightarrow} = \frac{-d\varnothing_B}{dt}$

Solution:

As we learned

Faraday's law -

$$\int \vec{E}.\vec{dl} = \frac{-d\phi_B}{dt}$$

- wherein

line integral of electric field is rate of charge of magnetic flux.

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Faraday's law $\oint \underset{E}{\rightarrow} \cdot \underset{dl}{\rightarrow} = \frac{-d\varnothing_B}{dt}$

Q. 20 Infinite charges are lying at *x* = 1, 2, 4, 8…*meter* on the *X*-axis and the value of each charge is *Q*. The value of the intensity of electric field and potential at point *x* = 0 (if Q= $1\mu C$) due to these charges will be respectively

Option 1:
$12 \times 10^9 QN/C, 1.8 \times 10^4 V$

Option 2:
$Zero, 1.2 \times 10^4 V$

Option 3:
$6 \times 10^9 QN/C, 9 \times 10^3 V$

Option 4:
$4 \times 10^9 QN/C, 6 \times 10^3 V$

Correct Answer:
$12 \times 10^9 QN/C, 1.8 \times 10^4 V$

Solution:
As we learned

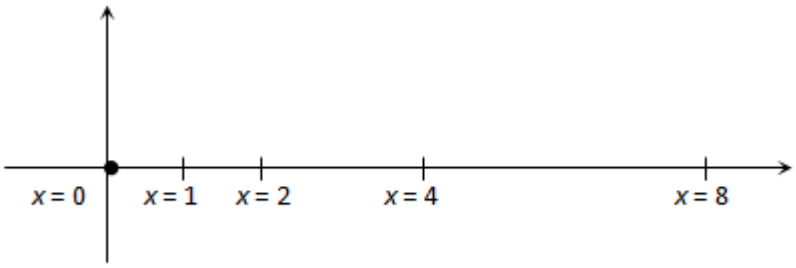
Potential of a System of Charge -

$$V = \sum_{i=1}^{i=n} \frac{kQ_i}{r_i}$$

-

By the superposition, Net electric field at origin

''



$$E = kQ\left[\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{4^2} + \frac{1}{8^2} + \cdots \infty\right]$$

$$E = kQ\left[1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \cdots \infty\right]$$

$1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \cdots \infty$ is an infinite geometrical progression it's sum can be obtained by using the formula

$S_\infty = \frac{q}{1-r}$; Where *a* = First term, *r* = Common ratio.

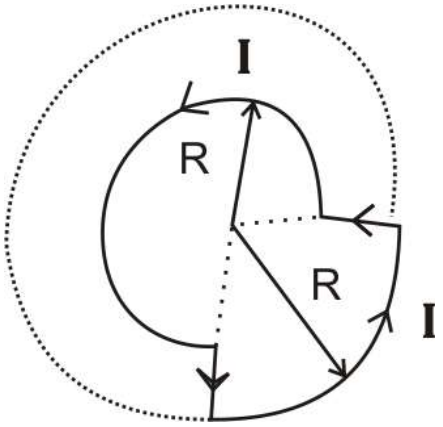
Here a=1 and $r = \frac{1}{4} so, 1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \cdots \infty = \frac{1}{1-1/4} = \frac{4}{3}.$

Hence $E = 9 \times 10^{9\times} Q \times \frac{4}{3} = 12 \times 10^9 QN/C$

Electric potential at origin $V = \frac{1}{4\pi\varepsilon_0}\left[\frac{1\times10^{-6}}{1} + \frac{1\times10^{-6}}{2} + \frac{1\times10^{-6}}{4} + \frac{1\times10^{-6}}{8} + \cdots\infty\right]$

$9\times10^9\times10^{-6}\left[1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\cdots\infty\right] = 9\times10^3\left[\frac{1}{1-\frac{1}{2}}\right] = 1.8\times10^4 volt$

Q. 21 What is the magnetic field at the common coutre of the wire circuit as shown in figure



Option 1:

$\frac{\mu o I}{8}\left[\frac{3}{R_1} + \frac{1}{R_2}\right]$

Option 2:

$\frac{\mu o I}{4}\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$

Option 3:

$\frac{\mu o I}{8}\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$

Option 4:

$Zero$

Correct Answer:

$$\frac{\mu oI}{8}\left[\frac{3}{R_1}+\frac{1}{R_2}\right]$$

Solution:
As we learn

Arc subtends angle (2pie-theta) at the centre -

$$B=\frac{\mu_0}{4\pi}.\frac{(2\pi-\theta)}{r}$$

$$\vec{B_1}=\frac{\mu_0 I}{R_1}.\frac{\frac{3\pi}{2}}{4\pi}=\frac{3}{8}\frac{\mu_0 I}{R_1}\odot$$

$$\vec{B_2}=\frac{\mu_0 I}{R_2}.\frac{\frac{\pi}{2}}{4\pi}=\frac{1}{8}\frac{\mu_0 I}{R_1}\odot$$

Q. 22 Electric field due to charge cylinder at a distance r will be (If cylinder is non cunducting, Radius given is R)

Option 1:

$$\frac{\lambda}{\pi\epsilon_0 R}$$

Option 2:

$$\frac{\lambda}{2\pi\epsilon_0}\log_e r+c$$

Option 3:
0

Option 4:

$$\frac{\lambda}{2\pi\epsilon_0 r}$$

Correct Answer:

$$\frac{\lambda}{2\pi\epsilon_0 r}$$

Solution:
As we have learnt

Charged Cylinder if P lies outside -

If Point P lies outside the cylinder

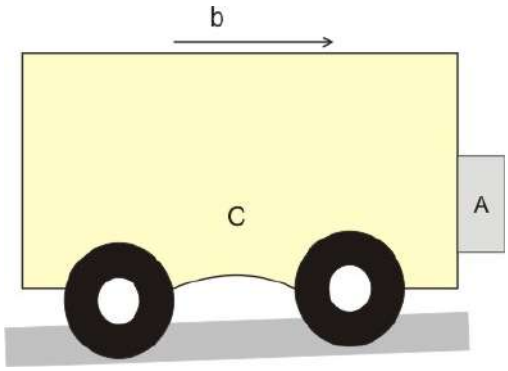
$$E_{out} = \frac{\lambda}{2\pi\varepsilon_0 r}$$

$$V_{out} = \frac{-\lambda}{2\pi\varepsilon_0}\log_e r + c$$

For conducting and non conducting both when r > R

$$E = \frac{\lambda}{2\pi\epsilon_0 r}$$

Q. 23 As shown here, in the figure, a cart C moving with acceleration 'b'. If the coefficient of friction between the block A and the cart is μ then what is the maximum value of 'b' so that the block A does not fall.



Option 1:
μg

Option 2:
$\mu^2 g$

Option 3:
$\frac{g}{\mu}$

Option 4:
$\frac{g}{\mu^2}$

Correct Answer:
$\frac{g}{\mu}$

Solution:

Sticking of a Block With Accelerated Cart -

While solving with the help of the concept of pseudo force.

When a cart moves with some acceleration toward right then a pseudo force (ma) acts on block toward left.

This force (ma) is an action force by a block on the cart.

Now block will remain static w.r.t. block. If friction force= μR≥mg

For equilibrium condition

$$\mu ma \geq mg$$

$$a \geq \frac{g}{\mu}$$

R = ma

$$\therefore \quad a_{min} = \frac{g}{\mu}$$

$$F_{min} = (M+m)\frac{g}{\mu}$$

Pseudo force (ma) acts on block towards left

F_{min} = Minimum force

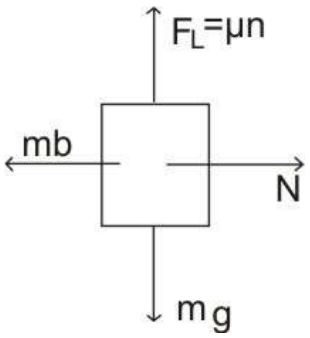
a_{min} = minimum acceleration cart

M, m are masses of the cart and block respectively

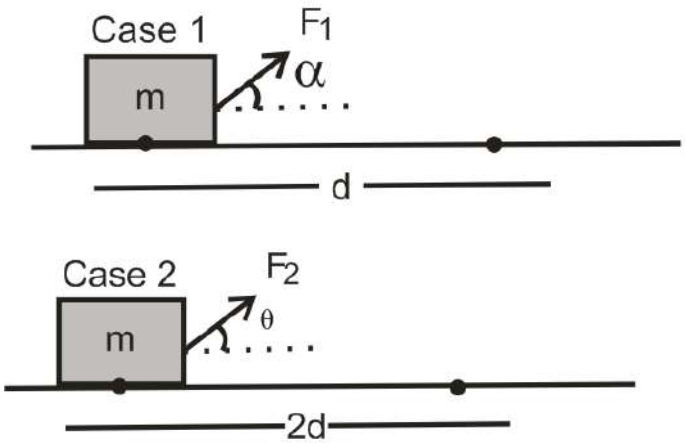
So, by using this concept -

Force acting on block A

$$W = f_L = mg = \mu(mb) \Rightarrow b = \frac{g}{\mu}$$



Q. 24



If for both case work done to displace block through a corresponding distance with the help of corresponding force is same. Then find the ratio of $\left(\frac{F_1}{F_2}\right)$

Option 1:

$\frac{\cos\theta}{\cos\alpha}$

Option 2:

$\frac{\cos\alpha}{\cos\theta}$

Option 3:

$\frac{2\cos\theta}{\cos\alpha}$

Option 4:

$\frac{2\cos\alpha}{\cos\theta}$

Correct Answer:
$\frac{2\cos\theta}{\cos\alpha}$

Solution:
As we learned

Definition of work by constant force -

$$W = FS\cos\Theta$$

Or work is defined as

The product of magnitude of force (F) magnitude of displacement (S) and cosine of the angle between them (Θ)

So using

$$W = F \cdot S \cdot \cos\theta$$

$$W_1 = F_1 \times d \times \cos\alpha$$

$$W_2 = F_2 \times 2d \times \cos\theta$$

as $W_1 = W_2$

So $\frac{F_1}{F_2} = \frac{2\cos\theta}{\cos\alpha}$

Q. 25 The process of transfer of heat from one place to other place without heating the intervening medium is called -

Option 1:
Conduction

Option 2:
Convection

Option 3:
Radiation

Option 4:
Wave motion

Correct Answer:
Radiation

Solution:
As we learn

Radiation -

The process of the transfer of heat from one place to anoter place without heating the interveing medium.

Q. 26 Two charge +q and -q are situated at a certain distance. At the point exactly midway between them

Option 1:
Electric field and potential both are zero

Option 2:
Electric field is zero but potential is not zero

Option 3:
Electric field is not zero but potential is zero

Option 4:
Neither electric field nor potential is zero

Correct Answer:
Electric field is not zero but potential is zero

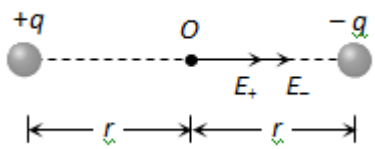
Solution:
As we learned

If at any point E = 0 -

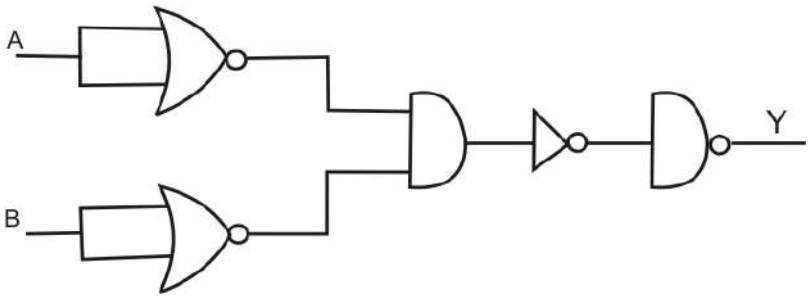
V = constant

-

At O, $E \neq 0$, $V = 0$



Q. 27



The truth table for the above logic circuit is same as that of :

Option 1:
NOR

Option 2:
OR

Option 3:
AND

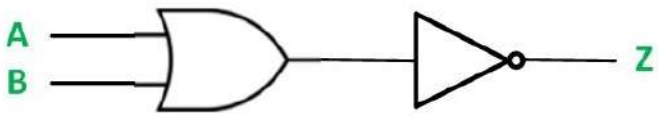
Option 4:
NAND

Correct Answer:
NOR

Solution:
As we learn

NOR Gate -

NOT + OR Gate

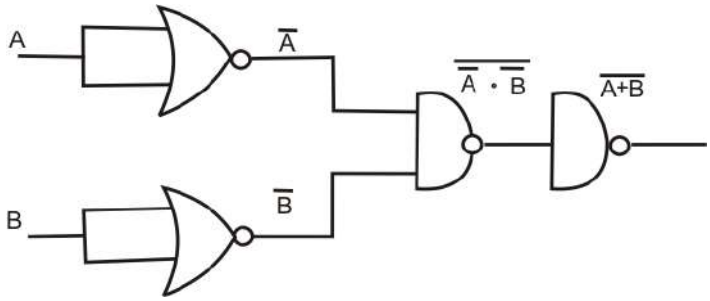


- wherein

$Y = \overline{A + B}$

A and B are input

Y is out put



The output (y) of two input (A,B) NOR gate is :

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

Q. 28 In a process of nuclear fission, p divides into two nucleous Q and R their binding energies are E_P, E_Q and E_R respectively, then -

Option 1:
$E_Q + E_R = E_P$

Option 2:
$E_Q + E_R > E_P$

Option 3:
$E_Q + E_R < E_P$

Option 4:
$E_Q E_R = E_P$

Correct Answer:
$E_Q + E_R > E_P$

Solution:
As we learn

Binding energy -

$$B.E = [Zm_p + (A-Z)m_n - M_x]\,c^2$$

amount of energy released when nucleons come together to form a nuclei.

M_x = mass of nuclei formed

- wherein

$$m_p - mass\ of\ proton$$

$m_n - mass\ of\ neutron$

$Z - atomic\ number$

$A - atomic\ mass$

$$E_Q + E_R > E_P$$

Q. 29 A rod is made of two rod of different material and lenght as shown in the figure . The equivalent thermal cunductivity of combined rod is -

Option 1:
K

Option 2:
2K

Option 3:
3K

Option 4:
4K

Correct Answer:
K

Solution:
As we learn

In Series Combination -

$$R_{eq} = R_1 + R_2 + R_3 - - - - - - - - - - R_n$$

Equivalent Thermal Conductivity Series -

$$K_s = \frac{n}{\frac{1}{K_1} + \frac{1}{K_2} + - - - - - - - - - \frac{1}{K_n}}$$

- wherein

For n slabs of equal length.

$$K_s = \frac{l_1 + l_2}{\frac{l_1}{K_1} + \frac{l_2}{K_2}} = \frac{5X}{\frac{X}{K} + \frac{4X}{K}} = K$$

Q. 30 If radius of the Al_{13}^{27} nucleus is taken to be R_{Al}, then the radius of Te_{53}^{125} nucleus is nearly:

Option 1:
$\left(\frac{53}{13}\right)^{\frac{1}{3}} R_{Al}$

Option 2:
$\left(\frac{5}{3}\right) R_{Al}$

Option 3:
$\left(\frac{3}{5}\right) R_{Al}$

Option 4:
$\left(\frac{13}{3}\right) R_{Al}$

Correct Answer:
$\left(\frac{5}{3}\right) R_{Al}$

Solution:
Radius of nucleus is given by

$$R = R_0 A^{\frac{1}{3}}$$

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

$$\frac{R_{Al}}{R_{Te}} = \left(\frac{A_{Al}}{A_{Te}}\right)^{\frac{1}{3}} = \frac{3}{5}$$

$$R_{Te} = \frac{5}{3} R_{AI}$$

Q. 31 In polar materials , dipole moment of all dipoles in the absence of electric field is

Option 1:
Q

Option 2:
IA

Option 3:
QI

Option 4:
zero

Correct Answer:
zero

Solution:
Polar Dielectric -

Net dipole moment zero in the absence of an electric field.

Q. 32 The Gauss's law of magnetism is represented by:

Option 1:
$\oint \vec{E}.d\vec{l} = \frac{-d\phi_E}{dt}$

Option 2:
$\oint \vec{B}.d\vec{l} = \mu_0 i$

Option 3:
$\oint \vec{B}.d\vec{s} = 0$

Option 4:
$\oint \vec{B}.d\vec{s} = \frac{q}{\epsilon_0}$

Correct Answer:
$\oint \vec{B}.d\vec{s} = 0$

Solution:
As we learn

Gauss's law for magnetism -

$\oint \vec{B}.d\vec{S} = 0$

- wherein

Total magnetic flux passing through a closed area is equal to zero.

$$\oint \vec{B}.d\vec{s} = 0$$

Q. 33 The number of images formed by two plane mirrors inclined at an angle 72^0 of an object placed asymmetrically between mirrors is

Option 1:
5

Option 2:
Infinite

Option 3:
6

Option 4:
7

Correct Answer:
5

Solution:
as we learn

Combination of two plane Mirror -

No. of image formed

a) If $\frac{360^0}{\theta}$ even number

Number of image =$\frac{360^0}{\theta} - 1$

b) If $\frac{360^0}{\theta}$ odd number

Number of image = $\frac{360^0}{\theta} - 1$

If object is placed on the angle bisector.

b) If $\frac{360^0}{\theta}$ odd number

Number of image = $\frac{360^0}{\theta}$

If object is not placed on the angle bisector.

$$n = \frac{360^0}{\theta} = \frac{360^0}{72} = 5$$

since n is odd and it is not placed on angle bisector hence number of images is n = 5

Q. 34 The action of a nib split at the top is explained by -

Option 1:
Gravity flow

Option 2:
Fluid pressure

Option 3:
Viscosity

Option 4:
Capillary action

Correct Answer:
Capillary action

Solution:
As we learn

Capillary -

If a tube of very narrow bore is dipped in a liquid, the liquid in the capillary either ascends or descends .

- wherein

A towel soaks water.

it is explained by capillary action.

Q. 35 Two light waves having the same wavelength λ in vacuum are in phase initially. Then first ray travels a path of length L_1 through a medium of refractive index μ_1. The second ray travels a path of length L_2 through refractive index μ_2. The two waves are combined to observe interference effect the phase difference between the two when they interfere is:

Option 1:
$\frac{2\pi}{\lambda}(L_1 - L_2)$

Option 2:
$\frac{2\pi}{\lambda}(\mu_1 L_1 - \mu_2 L_2)$

Option 3:
$\frac{2\pi}{\lambda}(\mu_2 L_1 - \mu_1 L_2)$

Option 4:
$\frac{2\pi}{\lambda}\left(\frac{L_1}{\mu_1} - \frac{L_2}{\mu_2}\right)$

Correct Answer:
$\frac{2\pi}{\lambda}(\mu_1 L_1 - \mu_2 L_2)$

Solution:
As we learnt

Optical Path -

$x' = \mu \cdot x$

- wherein

$x' =$ Distance travelled in vacuum

$x =$ Distance travelled in a medium of refractive index μ

Optical path length = μL

Path difference $\Delta x = \mu_1 L_1 - \mu_2 L_2$

Phase difference $\Delta\phi = \frac{2\pi}{\lambda}(\mu_1 L_1 - \mu_2 L_2)$

Chemistry

Q. 1 Percentages of free space in hcp structure is :

Option 1:
32%

Option 2:
26%

Option 3:
54%

Option 4:
74%

Correct Answer:
26%

Solution:
As we learn

Hexagonal close packing -

Total number of atom per unit cell = 6

Packing fraction = 0.74

Coordination number = 12

- wherein

It is an ABAB type packing.

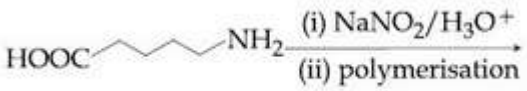
Volume of unit cell = $= 24\sqrt{2}r^3$

$Volume of six spheres = 6 \times \frac{4}{3}\pi r^3$

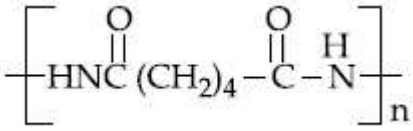
$\therefore$ packing fraction $= \frac{8\pi r^3}{24\sqrt{2}r^3} = 0.74$

Volume empty space =26%

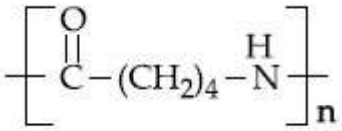
Q. 2 The polymer obtained from the following reactions is :



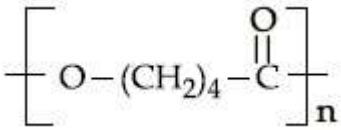
Option 1:



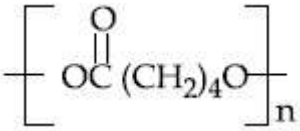
Option 2:



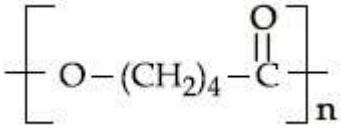
Option 3:



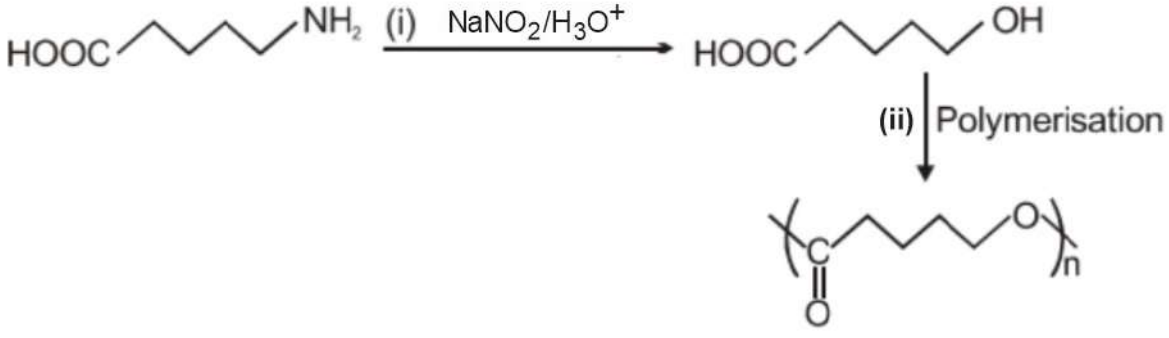
Option 4:



Correct Answer:



Solution:
The reaction occurs as



Hence, the correct answer is Option (3)

Q. 3 Poatsh alum is used in

Option 1:
Tanning of leather

Option 2:
purification of water

Option 3:
As antiseptic

Option 4:
All of these

Correct Answer:
All of these

Solution:
As we have learned

Use of Potash Alum -

1. For tanning of leather
2. As mordant in dyeing and calico printing
3. As antiseptic

Poatsh alum used in purificationof water , water proofing of textile , tanning of leather and alsoused as antiseptic

Q. 4 Which of the following properties can be described to Branched chain polymers?

a) Irregular Packing

b) Three dimensional packed structure

c) Bakelite

d) Molecules are two dimensional

Option 1:
a,d

Option 2:
a,b

Option 3:
b,c

Option 4:
c,d

Correct Answer:
a,d

Solution:
Bakelite is a cross-linked polymer, irregular packing and two-dimensional molecules are properties of branched-chain polymers.

Option 1 is correct.

Q. 5 When Cu reacts with dil HNO_3 it forms -

Option 1:
NO

Option 2:
NO_2

Option 3:
NH_3

Option 4:
N_2O_3

Correct Answer:
NO

Solution:
As we have learnt,

Preparation of nitric acid in laboratory -

By the action of cold dil. HNO_3 on copper turnings

- wherein

$$3Cu + dil\ 8HNO_3 \rightarrow 3Cu\left(NO_3\right)_2 + 4H_2O + 2NO$$

$$3Cu + dil\ 8HNO_3 \rightarrow 3Cu\left(NO_3\right)_2 + 4H_2O + 2NO$$

Q. 6 Paschen series and Bracket series lies in region

Option 1:
Ultraviolet and Infrared respectively

Option 2:
Visible and infrared respectively.

Option 3:
Both lies in infrared region

Option 4:
Ultraviolet and visible respectively.

Correct Answer:
Both lies in infrared region

Solution:
As we learned

Paschen, Bracket and Pfund Series spectrums -

Infrared Region

Paschen and Bracket series are in the infrared region.

Q. 7 Which of the following is example of monotrophy -

Option 1:
Diamond and graphite

Option 2:
Oxygen and ozone

Option 3:
A band b both

Option 4:
None

Correct Answer:
A band b both

Solution:
As we have learned

Monotropy -

Only one allotrope is stable under normal condition, the other being unstable

- wherein

Eg. diamond and graphite, oxygen and ozone

Only one alotrope is stable under normal condition , the other being unstable

---

Q. 8 Reaction of NH_3 with air passed over heated Pt

Option 1:
NO

Option 2:
N_2O

Option 3:
N_2O_3

Option 4:
N_2O_5

Correct Answer:
NO

Solution:
As we leaen

Ostwald process -

Reaction of ammonia with air when passed over heated Pt

- wherein

$$4NH_3 + 5O_2 \overset{Pt, 1075K}{\rightarrow} 4NO + 6H_2O$$

$$4NH_3 + 5O_2 \overset{Pt, 1075K}{\rightarrow} 4NO + 6H_2O$$

Q. 9 What is the major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide?

Option 1:
Benzoic Acid

Option 2:
Salicyladahyde

Option 3:
Salicylic Acid

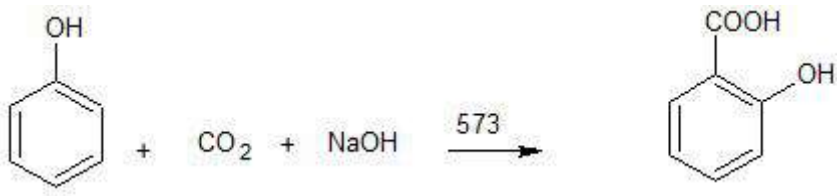
Option 4:
Phthalic Acid

Correct Answer:
Salicylic Acid

Solution:
As we learned

Kolbe's Schmidth reaction -

Phenoxide ion undergo electrophilic substitution with CO_2, a weak electrophile.



Q. 10 Which of the following can behave as both bronsted acid and bronsted base :-

Option 1:
HNO_3

Option 2:
NaOH

Option 3:
NH_3

Option 4:
KOH

Correct Answer:
NH_3

Solution:
As we learned

Bronsted - Lowry Acids and Bases -

According to bronsted lowry theory, acid is a substance that is capable of donating a hydrogen ion H^+ and bases are substance that are capable of accepting H^+ ion.

- wherein

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + \bar{O}H$$

$$NH_4^+ \rightarrow add\ proton$$

$$\bar{O}H \rightarrow lose\ proton$$

NH_3 can accept and release ' H^+ ' so it can behave as bronsted and bronsted acid

---

Q. 11 Which one of the following element is most electronegative?

Option 1:
Flourine

Option 2:
Sulphur

Option 3:
Oxygen

Option 4:
Bromine

Correct Answer:
Flourine

Solution:
As we learnt

Variation of electronegativity along group -

Electronegativity generally decreases down a group in the periodic table.

- wherein

e.g. from fluorine to astatine.

Electronegativity decreases as we move down the group and increases as we move from left to right in a period.

Q. 12 When conc. H_2SO_4 react with C it evolve

Option 1:
CO_2

Option 2:
SO_2

Option 3:
H_2O

Option 4:
ALL of these

Correct Answer:
ALL of these

Solution:
As we have learned

Properties of Sulfuric acid -

It reacts with more electropositive metal to evolve H_2 and produces SO_2 on heating with less electropositive metals than hydrogen

$$C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$$

Q. 13 Phenol $\xrightarrow[Cone.H_2SO_4]{NaNO_2}$ Green color

Green colour $\xrightarrow{H_2O}$ Red colour $\xrightarrow{NaOH}$ Blue color

Option 1:
Gattermamn

Option 2:
Hofmann

Option 3:
Liebermann

Option 4:
Reimer-Tiemann

Correct Answer:
Liebermann

Solution:
As we learned

Libermann's nitroso reaction -

This reaction is employed as a test of phenol.

- wherein

Liebermann

Liebermann Xlitroso test:

This reaction is employed as a test of phenol.

Q. 14 If the first ionisation energy of H - atom is 13.6 e.v. then the second ionisation energy of $He-^{+}$

Option 1:
$27.2e.v.$

Option 2:
$40.8e.v.$

Option 3:
$54.4e.v.$

Option 4:
$108.8e.v.$

Correct Answer:
$54.4e.v.$

Solution:

As we learned

The total energy of electron in nth orbit -

$$E_n = -13.6\,\frac{z^2}{n^2} eV$$

Where z is the atomic number

Ionization energy of an atom is

$$I.E. = 13.6 \times \frac{z^2}{n^2} e.v.$$

Thus second ionization energy for He^+ is given by

$$I.E. = \frac{13.6 \times (2^2)}{P1^2} = 54.4 e.v.$$

Q. 15 Transparent soaps are made by dissolving soap in which of the following solvent?

Option 1:
Methanol

Option 2:
Acetone

Option 3:
DMSO

Option 4:
Ethanol

Correct Answer:
Ethanol

Solution:
Transparent soaps are made by dissolving the soap in **ethanol** and then evaporating the excess solvent.

The correct option is 4.

Q. 16 Which of the following reactions leads to the formation of 2-propanol:-

Option 1:

$$CH_3-\underset{\underset{O}{||}}{C}-CH_3 \overset{NaBH_4}{\rightarrow}$$

Option 2:

$$CH_3-\underset{\underset{O}{||}}{C}-CH_3 + Mg\ amalgam + conc.HCl$$

Option 3:

$$CH_3CH_2MgBr + HCHO \overset{H_3O^+}{\rightarrow}$$

Option 4:

All of these

Correct Answer:

$$CH_3-\underset{\underset{O}{||}}{C}-CH_3 \overset{NaBH_4}{\rightarrow}$$

Solution:

As we learned

Alcohol formation by reduction of Ketones -

Yields secondary alcohol

- wherein

$$RCOR' \overset{NaBH_4}{\rightarrow} RCH(OH)R$$

$$CH_3-\underset{\underset{O}{||}}{C}-CH_3 \overset{NaBH_4}{\rightarrow} CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$$

Q. 17 The complex, $[Cu(H_2O)_6]^{2+}$ has d^9 electronic configuration and has one unpaired electron, which of the following statements are true?

1) The complex is octahedral

2) It is outer sphere complex

3) It is diamagnetic

4) Coordination number of this compound is 6

Option 1:
1,2,3,4

Option 2:
1,2,3

Option 3:
2,3

Option 4:
1,2,4

Correct Answer:
1,2,4

Solution:
As we have learned

Metallic character of transition elements -

Transition elements have relatively low ionisation energies and have one or two electrons in their outer most energy level (ns^1 or ns^2).As a result, metallic bonds are formed.The unpaired d- electron also result in the formation of the metallic bond.

Since there are 6 H_2O molecules attached as the ligand, thus its coordination number is 6 and its geometry is octahedral but since it has 1 unpaired electron thus the complex is paramagnetic.

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

Q. 18 Which of the following are electronegativity scales?

Option 1:
Pauling's Scale

Option 2:
Mullikin's Scale

Option 3:
Alfred and Rochow's Scale

Option 4:
All of these

Correct Answer:
All of these

Solution:
As we learnt

Scale of electronegativity -

A number of numerical scales of electronegativity of elements have been developed.

- wherein

e.g. Pauling scale, mullikan jaffe scale etc.

All of these scales are electronegativity scales

Q. 19 Example of zeolite is –

Option 1:
ZSM – 3

Option 2:
ZSM – 2

Option 3:
ZSM – 4

Option 4:
ZSM - 5

Correct Answer:
ZSM - 5

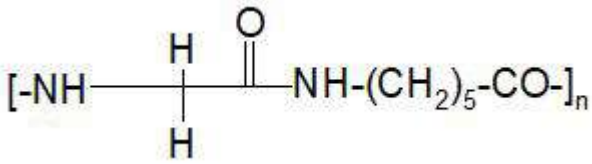
Solution:
As we learnt,

Zeolites

ZMS-5 (Zeolite Socony Mobil-5) is an aluminosilicate zeolite which belongs to the pentasil family of zeolites which have chemical formula $Na_nAl_nSi_{96-n}O$

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

Q. 20 The following structure belongs to which polymer



Option 1:
Polyhydroxy Butyrate

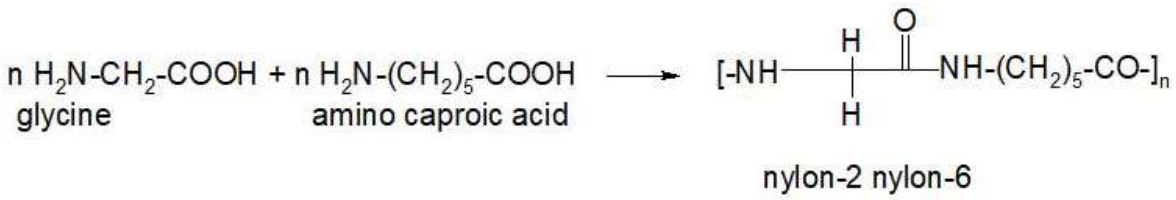
Option 2:
Buna-N

Option 3:
Nylon2-nylon-6

Option 4:
Thiokal

Correct Answer:
Nylon2-nylon-6

Solution:
Nylon2-nylon6 is an alternating polyamide copolymer of glycine and aminocaproic acid and is biodegradable



Option 3 is correct.

Q. 21 Splitting of spectral lines under the influence of electric field is called

Option 1:
Zeeman effect

Option 2:
Stark effect

Option 3:
Photoelectric effect

Option 4:
None of these

Correct Answer:
Stark effect

Solution:
As we learned

Stark effect -

Splitting of spectral lines in the presence of an electric field.

Splitting of spectral lines under the influence of electric field is called stark effect.

Q. 22 In which case change in entropy is negative?

Option 1:
Evapouration of water

Option 2:
Expansion of a gas at constant temperature

Option 3:
Sublimation of solid to gas

Option 4:
$2H_{(g)} \rightarrow H_{2(g)}$

Correct Answer:
$2H_{(g)} \rightarrow H_{2(g)}$

Solution:
$2H_{(g)} \rightarrow H_{2(g)}$

degree of randomness decreases

$\therefore$ entropy decreases and is negative.

Hence, the option number (4) is correct.

Q. 23 Which one of the following is not an antibiotic?

Option 1:
Ofloxacin

Option 2:
Penicillin

Option 3:
Oxytocin

Option 4:
Ampicillin

Correct Answer:
Oxytocin

Solution:
Oxytocin is not an antibiotic but is a hormone that's produced in the hypothalamus and released into the bloodstream by the pituitary gland. Its main function is to facilitate childbirth, which is one of the reasons it is called the "love drug" or "love hormone."

Therefore, 3rd option is correct.

Q. 24 If the solubility of CL_2 gas in water at STP is 0.0729 m , calculate Henrry constant ?

Option 1:
815.5

Option 2:
822.5

Option 3:
840.5

Option 4:
838.5

Correct Answer:
822.5

Solution:
As we learn

Henry's Law -

The mass of a gas dissolved in a given mass of solvent at any temperature is proportional to the pressure of the gas above the solvent.

- wherein

This amount decrease with increase in temperature.

Solubility of Cl_2 = 0.0729$\longrightarrow$0.0729 mole in 1 kg solvent

$$n_{solvent} = \frac{1000}{18} = 55.55 moles$$

$$\therefore x\ Cl_2 = \frac{0.0729}{0.0729 + 55.55}$$

$$= 0.0012$$

at STP , P = 0.987

$$P_{cl_2} = K_H \times Cl_2$$

$$P_{cl_2} = K_H \times Cl_2$$

$$K_H = \frac{0.987}{0.0012} = 822.5\ bar$$

Q. 25 Hydrolysis of PCl_3 gives -

Option 1:
H_3PO_4

Option 2:
H_3PO_3

Option 3:
PH_3

Option 4:
$POCl_3$

Correct Answer:
H_3PO_3

Solution:
As we have learnt,

Properties of phosphorus trichloride -

Colourless oily liquid, hydrolyses in presence of moisture

- wherein

$$PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$$

$$PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$$

Q. 26 Which statement is correct:

Option 1:
O_2, Cu^{2+}, C_r^{3+} — will show Diamagnetism

Option 2:
$H_2O, Nacl, C_6H_6$ — will show Antiferromagnetism

Option 3:
$Fe_3O_4, MgFe_2O_4, ZnFe_3O_4$—will show Ferrimagnetism

Option 4:
MnO, C_rO_2, H_2O_2 — will show Ferrimagnetism

Correct Answer:
$Fe_3O_4, MgFe_2O_4, ZnFe_3O_4$—will show Ferrimagnetism

Solution:
As we learn

Ferromagnetism -

A type of material that is highly attracted to magnets and have high magnetic susceptibility.

- wherein

Examples:

(1) Iron, Nickel, Cobalt

(2) $MgOFe_2O_3$

$Fe_3O_4, MgFe_2O_4, ZnFe_3O_4$ — are Ferrimagnetic substances.

Q. 27 Which of the following set contains isotopes.

Option 1:
$7^{N^{14}}, 6^{c^{13}}, 5^{B^{11}}$

Option 2:
$6^{c^{13}}, 6^{c^{14}}$

Option 3:
$1^{H^3}, 2^{He^4}$

Option 4:
Both A and C

Correct Answer:
$6^{c^{13}}, 6^{c^{14}}$

Solution:
As we learned

Line Spectrum of Hydrogen-like atoms -

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

- wherein

Where R is called Rhydberg constant, R = 1.097 X 10^7 , Z is atomic number

n_1= 1,2 ,3....

n_2= n_1+1, n_1+2 .....

in isotopes atomic No is the same.

Q. 28 In which of the following arrangements, the order is not according to the property indicated against it?

Option 1:
Li<K<Na<Rb Increasing metallic radius

Option 2:
I<Br<F<Cl Electron gain enthalpy (Without negative sign)

Option 3:
B<Cl<O<N Increasing first Ionisation enthalpy

Option 4:
$Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$ Increasing ionic size

Correct Answer:
I<Br<F<Cl Electron gain enthalpy (Without negative sign)

Solution:
As we move down the group Zeff increases & the electron gain enthalpy also increases with the negative sign.

ELECTRON GAIN ENTHALPY	kJ mol^{-1}
FLUORINE	-333
CHLORINE	-348
BROMINE	-324
IODINE	-295
ASTATINE	-270.1

With the negative sign, the order should be

Cl<F<Br<I

But without negative sign order will be

I<Br<F<Cl Electron gain enthalpy.

Q. 29 Which of the following is used in the reaction called saponification?

Option 1:
Strong base

Option 2:
Strong acid

Option 3:
Hydrogen

Option 4:
Nickel

Correct Answer:
Strong base

Solution:
Soaps containing sodium salts are formed by heating fat (i.e., glyceryl ester of fatty acid) with an aqueous sodium hydroxide solution. This reaction is known as saponification.

In a Saponification reaction, fat or oil reacts with a strong base (NaOH) to give soap molecules.

Option 1 is correct.

Q. 30 Which of the following can be classified as polysaccharides ?

a) cellulose

b) starch

c) maltose

d) aldohexose

Option 1:
a,b,c

Option 2:
b,c,d

Option 3:
a,b

Option 4:
c,d

Correct Answer:
a,b

Solution:
As we have learnt,

Polysaccharides are carbohydrates that give a large number of monosaccharides units upon hydrolysis. Cellulose , Starch are polysaccharides.

Maltose is a disaccharide and aldohexose is a monosaccharide.

It is to be noted that aldohexose represents a family of carbohydrates having six carbon atoms and also having an aldehyde functional group. It represents the Glucose family consisting of Glucose and its different stereoisomers.

Hence, the correct answer is Option (C)

Q. 31 Which one of the following is true about floating soaps?

Option 1:
These are made by beating tiny air bubbles before their hardening

Option 2:
These are made by dissolving soap in ethanol, then evapourating excess solvent

Option 3:
These are made by adding substances of medicinal value like dettol etc.

Option 4:
The soaps contain gycerol and rosin forming sodium resoinate for lather

Correct Answer:
These are made by beating tiny air bubbles before their hardening

Solution:
Soaps that float in water are made by beating tiny air bubbles before their hardening.

The correct option is 1.

Q. 32 Isomers have essentially identical

Option 1:
Structural formula

Option 2:
Chemical properties

Option 3:
Molecular formula

Option 4:
Physical properties

Correct Answer:
Molecular formula

Solution:
Isomers have essentially identical with the molecular formula only.

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

Q. 33 Glucose upon reaction with the reagent A produces Gluconic Acid as given below:

$$CH_2OH(CHOH)_4CHO + A \longrightarrow CH_2OH(CHOH)_4COOH$$

What is A?

Option 1:
Br_2/H_2O

Option 2:
$HI,\ heat$

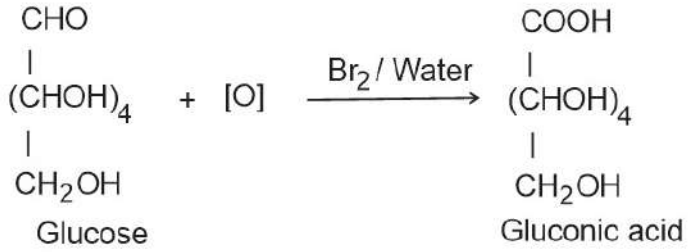
Option 3:
HNO_3

Option 4:
NH_2OH

Correct Answer:
Br_2/H_2O

Solution:
As we have learnt,

Oxidation of glucose with mild oxidising agents like bromine water produces Gluconic acid



Hence, the correct answer is Option (1)

Q. 34 Structure and Hybridisation of XeO_2F_2 is

Option 1:
Tetrahedral,sp^3

Option 2:
see saw, sp^3d

Option 3:
see saw, sp^3d^2

Option 4:
triangular bipyramidal, sp^3d^2

Correct Answer:
see saw, sp^3d

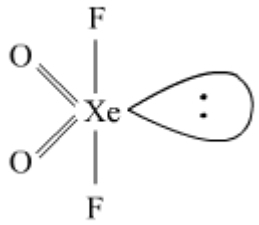
Solution:
As we learnt

Structure of XeO2F2 -

Sp^3d hybridised and see saw structure

- wherein

Xenon dioxy difluoride



See saw structure

Q. 35 For a given equilibrium

$2A + B \rightleftharpoons C + D$

Initial concentration of A and B are 2 M and 1 M respectively. At equilibrium, concentration of C is 0.5 M then find K_c

Option 1:
9

Option 2:
1

Option 3:
1/9

Option 4:
2/9

Correct Answer:
2/9

Solution:
as we learn

Features of equilibrium constant -

Expression for equilibrium constant is applicable only when concentrations of the reactants and products have attained constant value at equilibrium state.

	$2A$	$+$	B	$\rightleftharpoons$	C	$+$	D
$t=0$	2		1		$-$		$-$
$t=t_{eq}$	1.5		0.5		0.5		0.5

$$K_c = \frac{0.5 \times 0.5}{(1.5)^2 \times 0.5} = \frac{2}{9}$$

Maths

Q. 1 Find the angle between the line and plane where equation of line is $r = \hat{i} + \hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$ and the equation of plane $r.(\hat{i} - \hat{j} + \hat{k}) = 2$

Option 1:
$sin^{-1}\sqrt{3}/4$

Option 2:
$sin^{-1}\sqrt{3/2}$

Option 3:
$sin^{-1}\sqrt{3/4}$

Option 4:
None of the above

Correct Answer:
$sin^{-1}\sqrt{3/4}$

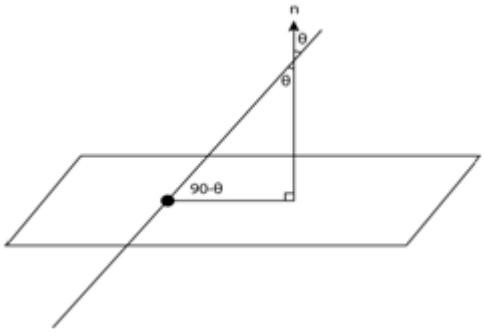
Solution:
As we have learnt

Angle between line and Plane (vector form) -

The angle between a line $\vec{r} = \vec{a} + \lambda\vec{b}$ and the plane $\vec{r}.\vec{n} = d$ is given by

$$\sin\Theta = \frac{\vec{b}.\vec{n}}{\left|\vec{b}\right||\vec{n}|}$$

- wherein



$r = a + \lambda b and r.n = p$

$sin\theta = |b.n/|b||n|| = |(\hat{i} - \hat{j} + \hat{k})(\hat{i} - \hat{j} + \hat{k})/\sqrt{1+1+1}\sqrt{1+1+1}$

$sin\theta = 1 + 1 + 1/2\sqrt{3} = \sqrt{3}/2$

$\theta = sin^{-1}\sqrt{3}/2$

Q. 2 Find harmonic mean of following observation :

x	2	3	4	5
f	4	5	3	2

Option 1:

$\frac{840}{289}$

Option 2:

$\frac{240}{189}$

Option 3:

20.5

Option 4:

None of these

Correct Answer:
$\frac{840}{289}$

Solution:
As we learned

Harmonic Mean -

For discreted frequency distribution

$$H = \frac{\sum_{i=1}^{n} f_i}{\sum_{i=1}^{n} f_i x_i}$$

-

$$H = \frac{4+5+342}{\frac{4}{2}+\frac{5}{3}+\frac{3}{4}+\frac{2}{5}} = \frac{14}{\frac{120+100+45+34}{60}} = \frac{14 \times 60}{289} = \frac{840}{289}$$

Q. 3 Find the interval in $(0, \frac{\pi}{2})$ where sin 5x is increasing?

Option 1:
$(0, \pi)$

Option 2:
$(\pi, 2\pi)$

Option 3:
$\left(0, \frac{\pi}{2}\right) \cup \left(\frac{3\pi}{2}, \frac{5\pi}{2}\right)$

Option 4:
$\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$

Correct Answer:
$\left(0, \frac{\pi}{2}\right) \cup \left(\frac{3\pi}{2}, \frac{5\pi}{2}\right)$

Solution:
As we learned

Monotonicity condition for Trigonometric function -

If trigonometric functions are given in the form of sinKx, cosPx, and so on then we check

$$\frac{dy}{dx} > 0, \quad \frac{dy}{dx} < 0$$

according to quadrants

- wherein

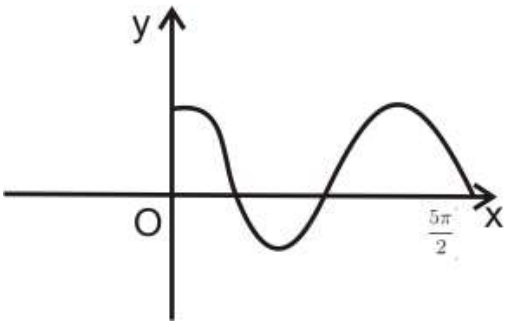
Follow:

"Add sugar to coffee" - for finding positive trigonometric functions in different quardrants.

$$f(x) = sin5x$$

$$f'(x) = 5cos5x$$

$$5x\epsilon \left(0, \frac{5\pi}{2}\right)$$



$$f'(x) > 0 for x\epsilon(0, \pi/2) \cup \left(\frac{3\pi}{2}, \frac{5\pi}{2}\right)$$

Q. 4 The plane containing the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$ and parallel to the line $\frac{x}{1} = \frac{y}{1} = \frac{z}{4}$ passes through the point

Option 1:
(1, -2, 5)

Option 2:
(1, 0, 5)

Option 3:
(0, 3, -5)

Option 4:
(-1, -3, 0)

Correct Answer:
(1, 0, 5)

Solution:
Line is $\frac{x-1}{1}=\frac{y-2}{2}=\frac{z-3}{3}$

The normal vector of plane is

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ 1 & 1 & 4 \end{vmatrix} = 5\hat{i}-\hat{j}-\hat{k}$$

As the point (1, 2, 3) lies on the line, so it also lies on the plane

So equation of the plane is

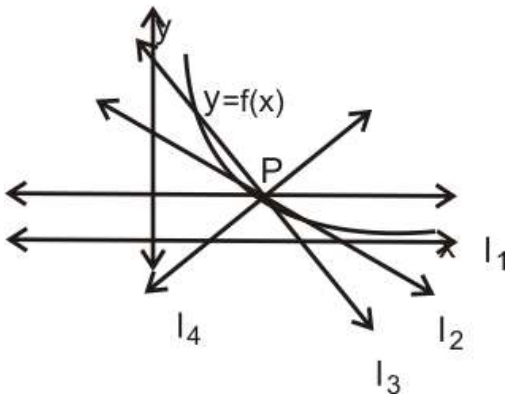
5(x - 1) - (y - 2) - (z - 3) = 0

5x - y - z = 5 - 2 - 3 = 0

5x - y - z = 0

It passes through (1,0,5)

Q. 5 which of the following is a tangent to the curve at (p).



Option 1:
l_1

Option 2:
l_2

Option 3:
L_3

Option 4:
l_4

Correct Answer:
l_2

Solution:
As we learned

Tangent -

The tangent t a curve at a point P on it is defined as the limiting position of the secant PQ as the point Q approaches the point P provided such a limiting position exists.

Q. 6 Consider the system of linear equations

$$3x + ay + 9z = 0$$
$$x + 2y + bz = 0$$
$$x + 2y + 3z = 0$$

The system has a unique solution if

Option 1:
$a = 6, b \neq 3$

Option 2:
$a = 6, b = 3$

Option 3:
$a \neq 6, b \neq 3$

Option 4:
$a \neq 6, b = 3$

Correct Answer:
$a \neq 6, b \neq 3$

Solution:
As we have learnt,

Solution of a homogeneous system of linear equations -

Let $Ax = 0$

If A is non-singular then the system of equations will have a unique solution that is trivial soluion

$$\Delta = \begin{vmatrix} 3 & a & 9 \\ 1 & 2 & b \\ 1 & 2 & 3 \end{vmatrix} = 3(6-2b) - a(3-b) + 9(2-2) = 0$$

$$= 18 - 6b - 3a + ab = 0$$

$$= (a-6)(b-3) = 0$$

For Unique solution $\Delta \neq 0$

So, $a \neq 6, b \neq 3$

Q. 7 Find the value of I = $\int 3x^{-2/3}(1+x^{2/3})^{-1}dx$

Option 1:
$3\tan^{-1}(x^{1/3}) + C$

Option 2:
$9\tan^{-1}(x^{1/3}) + C$

Option 3:
$9\sec^{-1}(x^{1/3}) + C$

Option 4:
$9\sec^{-1}(x^{1/3}) + C$

Correct Answer:
$9\sec^{-1}(x^{1/3}) + C$

Solution:
As we have learned

Case for special type of indefinite integration -

$$\int x^m(a+bx^n)^p dx$$

When P is an integer if $P > 0$ then apply expanded form

$P < 0$ then we put $x = t^k$

- wherein

Where k is the common denominator of m and n

$$let, x = t^k, where\ k\ is\ LCM\ of\ m\ and\ n$$

$$x = t^3 \Rightarrow dx = 3t^2 dt$$

$$I = 3\int \frac{3t^2}{t^2(1+t^2)}dt = 9\tan^{-1}(t) + C$$

$$= 9\ tan^{-1}(\sqrt[3]{x}) + C$$

Q. 8 In cartesian coordinate system point A = (3,5) and B = (2,7) , if point 'C' divides AB in ratio 3:5 point 'C' is :

Option 1:
(21/8,50/8)

Option 2:
(19/8,50/8)

Option 3:
(21/8,46/8)

Option 4:
(19/8,46/8)

Correct Answer:
(21/8,46/8)

Solution:
As we have learned

Section formula -

$$x = \frac{mx_2 + nx_1}{m+n}$$

$$y = \frac{my_2 + ny_1}{m+n}$$

- wherein

If P(x,y) divides the line joining A(x_1,y_1) and B(x_2,y_2) in ration $m : n$

C

$$x_c = \frac{3x_B + 5x_A}{3+5} = \frac{3\times 2 + 5\times 3}{3+5} = 21/8$$

$$y_c = \frac{3y_B + 5y_A}{3+5} = \frac{3\times 7 + 5\times 5}{3+5} = \frac{46}{8}$$

Q. 9 Let $f(x) = \begin{Bmatrix} e^{1/x} & x \neq 0 \\ 0 & x = 0 \end{Bmatrix}$

then

Option 1:
$f(x)$ is continous at x= 0

Option 2:
$f(x)$ is continous from left at x= 0

Option 3:
$f(x)$ is continous from right at x= 0

Option 4:
Limit exists at x=0 but not equal to f(0)

Correct Answer:
$f(x)$ is continous from left at x= 0

Solution:
As we have learned

Condition for discontinuity -

$1.\ L \neq R$

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

limit of function at x = a does not exist.

$2.\ L = R \neq V$

limit exist but not equal to x = a

$$\lim_{x\to 0^-} f(x) = \lim_{x\to 0^-} e^{1/x} = 0$$

$$\lim_{x\to 0^+} f(x) = \lim_{x\to 0^+} e^{1/x} = \infty$$

$$f(0) = 0$$

For (A) All three are not equal to disconitnous at x=0

For (B) LHL = f(0) $\therefore$ it will be continous from left at x=0

For (C) LHL $\neq$ f(0) $\therefore$ it will be continous from right at x=0

For (D) LHL $\neq$ RHL so limit doesn't exist

Q. 10 The angle formed by tangent drawn at (0, 0) to the curve $y^3 + y + x = 0$ with positive x-axis is ?

Option 1:

$\frac{\pi}{6}$

Option 2:

$\frac{\pi}{4}$

Option 3:

$\frac{\pi}{3}$

Option 4:

$\frac{3\pi}{4}$

Correct Answer:

$\frac{3\pi}{4}$

Solution:
As we have learnt,

Geometrical interpretation of dy / dx -

Slope of tangent line is $tan\Theta$ where θ is the angle made by the line with the +ve direction of x axis.

$$\therefore \quad \frac{dy}{dx} = tan\theta$$

$$y^3 + y + x = 0 \Rightarrow 3y^2\frac{\mathrm{d}y}{\mathrm{d}x} + \frac{\mathrm{d}y}{\mathrm{d}x} + 1 = 0 \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = \frac{-1}{1+3y^2}$$

Now, slope of the tangent at (0,0) = $\frac{\mathrm{d}y}{\mathrm{d}x}$ at (0,0) = -1

$$\tan\theta = -1 \Rightarrow \theta = \frac{3\pi}{4}$$

Q. 11 $\lim\limits_{x \to 0} \frac{Sin3x}{tan2x} = ?$

Option 1:

$\frac{2}{3}$

Option 2:

$\frac{-1}{2}$

Option 3:

$\frac{3}{2}$

Option 4:

1

Correct Answer:

$\frac{3}{2}$

Solution:

As we learned

Condition of Trigonometric Limits -

$$\lim_{x \to 0} \frac{sinx}{x} = 1$$

$$\lim_{x \to 0} \frac{tanx}{x} = 1$$

- wherein

$because \quad \frac{sinx}{x} < 1$ (in the neighbourhood of x=0)

$\frac{tanx}{x} > 1$ (in the neighbourhood of x=0)

$$\lim_{x \to 0} \frac{Sin3x}{tan2x} = \frac{\lim\limits_{x \to 0} \left(\frac{Sin3x}{3x}\right) * 3}{\lim\limits_{x \to 0} \left(\frac{Sin2x}{2x}\right) * 2}$$

$= \frac{1*3}{1*2} = \frac{3}{2}$

Q. 12 A is skew-symmetric matrix of order n and X is 1xn column matrix, then XAX^T is

Option 1:
Identity matrix

Option 2:
Null matrix

Option 3:
Matrix is invertible.

Option 4:
$-i$ (Identity matrix)

Correct Answer:
Null matrix

Solution:
As we have learnt

Property of Transpose -

$(\alpha A)' = \alpha A'$

$(AB)' = B'A'$

- wherein

α being scalar ; A' is transpose of A

X is 1 x n matrix , X^T is n x 1 matrix and A is n x n matrix so, XAX^T is 1 x 1 matrix.

Let $XAX^T = \lambda$

$(XAX^T)^T = (X^T)^T(A)^T(X)^T \ \ (Since \ A^T = -A)$

$= X(-A)X^T = -XAX^T$

$[\lambda] = -[\lambda]$

$\lambda = 0$

XAX^T is null matrix.

Q. 13 Find the equation of the plane containing the line of intersection of the plane $x + y + z = 5$ and $2x + 3y + 4z + 5 = 0$ and passing through the point (0,0,0)

Option 1:
$3x + 4y + 5z = 50$

Option 2:
$3x + 4y + 5z = 0$

Option 3:
$5 + 4y + 3 = 5$

Option 4:
$3x + 4y + 3 = 10$

Correct Answer:
$3x + 4y + 5z = 0$

Solution:
As we have learnt

Equation of any plane passing through the line of intersection of two planes (Cartesian form) -

The equation of any plane passing through the line of intersection of two planes

$ax + by + cz + d = 0$ and

$a_1x + b_1y + c_1z + d_1 = 0$ is given by

$(ax + by + cz + d) + \lambda (a_1x + b_1y + c_1z + d_1) = 0$

$(x + y + z + -5) + \lambda(2x + 3y + 4z + 5) = 0$

This plane is passing through (0,0,0). So

$-5 + 5\lambda = 0$

$\lambda = 1$

Q. 14 A line segment with the initial point and terminal point is called:

Option 1:
Ray

Option 2:
Collinear line

Option 3:
Directed line segment

Option 4:
Bi-directional line segment

Correct Answer:
Directed line segment

Solution:
As we have learnt

Directed line segment -

A is called the initial point and B is called the terminal point.

Q. 15 The statement " Oil is not dangerous to health" and the staements "Oil is dangerous to health ". Are

Option 1:
Complimentary of each other

Option 2:
Supplementary of each other

Option 3:
Negation of each other

Option 4:
Conjunction of each other

Correct Answer:
Negation of each other

Solution:
As we have learned

Negation -

The negation of a statement is generally formed by introducing the word "no" or statement "it is not the case that"

Q. 16 $\int e^{x^2+4x+8}x(x+2)dx = Ae^{g(x)} + C$ Then roots of g(x) are ?

Option 1:
real

Option 2:
complex

Option 3:
purely imaginary

Option 4:
none of these

Correct Answer:
complex

Solution:
As we have learned

Indefinite integrals for Exponential functions -

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(e^{x}\right)=e^{x}$$

$$\int e^{x}dx=e^{x}+c$$

- wherein

$$\because \int a^{x}dx=\frac{a^{x}}{log_{e}a}$$

first we need to $\int$ to get g(x)

substitute

;

$$t=x^{2}+4x+8$$

$$dt=(2t+4)dx=2(x+2)dx$$

$$dx=\frac{1}{2(x+2)}dt$$

$$Our \int becomes$$

$$=\int \frac{e^{t}}{2}dt$$

$$=\frac{1}{2}\int e^{t}dt=1/2e^{t}+C$$

$$t = x^2 + 4x + 8$$

Undo substitution :

$$Ae^{g(x)} + C = 1/2e^{x^2+4x+8} + C$$

compare LHS and RHS

$$x^2 + 4x + 8$$

g(x) =

$$roots\ of\ \ g(x) = \frac{-4 \pm \sqrt{16 - 32}}{2} = -2 \pm 2i$$

roots are complex

Q. 17 The number of way in which 8 girls and 4 boys can be seated on a round table such that particular B1(boy) and particular G1(girl) can never sit adjacent to each other

Option 1:

$7 \times 9!$

Option 2:

$8 \times 9!$

Option 3:

$9!$

Option 4:

10! x 9

Correct Answer:

10! x 9

Solution:

As we have learned

Conditions for Circular Permutation -

The number of circular permutations of n distinct things = (n - 1)!

-

Rule of circular permutation.

NO. of ways = total - When B1 and G1 sit together

Total way to seat 12 people = 11!

When B1 and G1 sit together = 10! x 2!

= 9! (110 - 20) = 10! x 9

Q. 18 If *x* is so small that its two and higher power can be neglected and $(1-2x)^{-1/2}(1-4x)^{-5/2}=1+kx$ then *k* =

Option 1:
1

Option 2:
-2

Option 3:
10

Option 4:
11

Correct Answer:
11

Solution:
As we learned

Binomial Theorem for Rational index -

$$(1+x)^n=1+nx+\frac{n(n-1)x^2}{2!}+\frac{n(n-1)(n-2)x^3}{3!}+------$$

- wherein

use ${}^nc_r=\frac{n!}{r!(n-r)!}$

$n>0$

$(1-2x)^{-1/2}(1-4x)^{-5/2}=1+kx$

$\left[1+\frac{(-1/2)(-2x)}{1!}+\frac{(-1/2)(-3/2)(-2x)^2}{2!}+\ldots\right]\left[1+\frac{(-5/2)(-4x)}{1!}+\frac{(-5/2)(-7/2)(-4x)^2}{2!}+\ldots\right]$

$=1+kx$

Higher power can be neglected. Then

$$\left[1+\frac{x}{1!}\right]\left[1+\frac{10x}{1!}\right]=1+kx;1+10x+x=1+kx;k=11$$

Q. 19 Let $f(x)=x^3-9x$ then $f(x)$ has

Option 1:
Local minima at $x = -\sqrt{(3)}$

Option 2:
local minima at $x = \sqrt{(3)}$

Option 3:
Local maxima at $x = \sqrt{(3)}$

Option 4:
No local minima or maxima

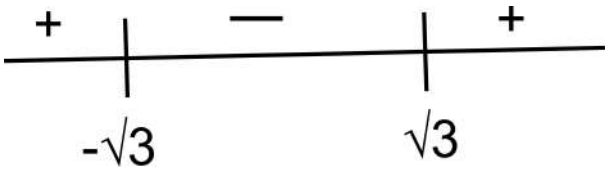
Correct Answer:
local minima at $x = \sqrt{(3)}$

Solution:
As we have learned

Methods to find points of Local maxima and Local minima -

At points of local maxima and local minima the slope of tangent drawn to the curve is zero.For local maximum dy / dx changes from positive to negative and for local minimum dy / dx change negative to positive.

$$f'(x) = 3x^2 - 9 = 3(x^2 - 3) = 3(x + \sqrt{3})(x - \sqrt{3})$$



$\rightarrow$ f'(x) changes sign from negative to positive at x= $+\sqrt{3}$ and from positive to negative at x=$-\sqrt{3}$ so local minima at x= $+\sqrt{3}$ and local maxima at x = $-\sqrt{3}$

Q. 20 Let $f(x) = \{[x]; x \neq 1 : 1; x = 1$ then at x=1

$$f(x) = \begin{cases} [x] & x \neq 1 \\ 1 & x = 1 \end{cases}$$

Option 1:
f(x) is continous

Option 2:
f(x) is continous from left

Option 3:
f(x) has non - removable discontinuity

Option 4:
f(x) has removable discontinuty

Correct Answer:
f(x) has non - removable discontinuity

Solution:
As we have learned

Irremovable discontinuity -

A function f is said to possess irremovable discontinuity if at x = a the left hand limit is not equal to the right hand limit so limit does not exist $L \neq R$

$$\lim_{x \to a^-} f(x) \neq \lim_{x \to a^+} f(x)$$

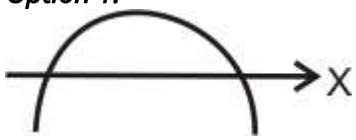
-

$$LHL = \lim_{x \to 1^-} [x] = 0; RHL = \lim_{x \to 1^+} [x] = 1; f(1) = [1] = 1$$

$\therefore (A), (B), (D)$ are false

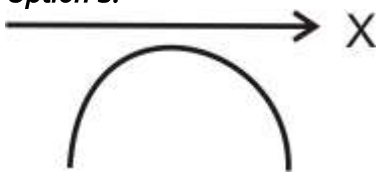
Q. 21 For which of the following graphs; $-3x^2 + 7x - \frac{49}{12}$ is the correct expression

Option 1:



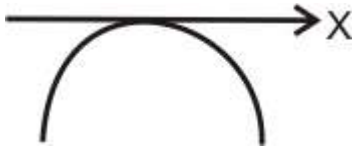
Option 2:

Option 3:



Option 4:
None of these

Correct Answer:



Solution:
As we learned

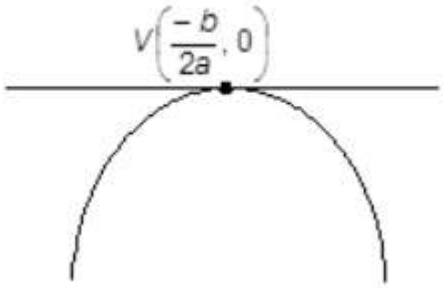
Quadratic Expression Graph when a< 0 & D = 0 -

Real and equal roots of

$f(x) = ax^2 + bx + c$

& $D = b^2 - 4ac$

- wherein



$a = -3 < 0$

$D = 49 - 49 = 0$

Q. 22 If 10 AM's are inserted between two numbers, then 7^{th} AM is which term of this 12 term AP?

Option 1:
7^{th}

Option 2:
8^{th}

Option 3:
9^{th}

Option 4:
10^{th}

Correct Answer:
8^{th}

Solution:
As we have learnt,

Inserting n AMs between a and b -

$a_1, A_1, A_2, A_3, A_4, - - - - A_n, b$ are in AP

- wherein

a is the first term

b is the $(n+2)^{th}$ term of the AP.

a is first term of an AP

b is last term of an AP

$a, a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9, a_{10}, b$

So, A_1 is second term of the AP

So, a_7 will be 8th term of the AP

Q. 23 What is the slope of normal at (1 , -1) on the curve $2x^2 - y^2 - 1 = 0$

Option 1:
2

Option 2:
-2

Option 3:
$\frac{-1}{2}$

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

Correct Answer:

$\frac{1}{2}$

Solution:

As we learned

Slope of Normal -

$$M_T \times M_N = -1$$

$$\therefore\ M_N = \frac{-1}{M_T}$$

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

- wherein

Where (x_1, y_1) is the point on the curve.

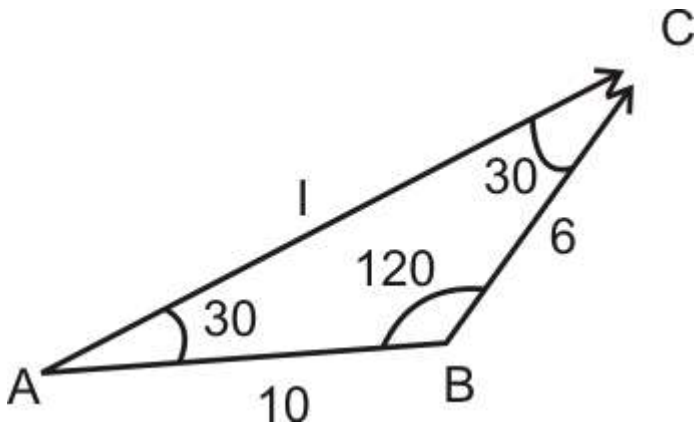
$$4x - 2y\, y^1 = 0$$

$$\Rightarrow y^1 = \frac{2x}{y}$$

$$y^1 \mid (1, -1) = -2$$

$$So, M_n = \frac{1}{2}$$

Q. 24 In a triangle ABC length of projection of $\vec{AB}$ on BC is



Option 1:

5

Option 2:
3

Option 3:
$5\sqrt{3}$

Option 4:
$3\sqrt{3}$

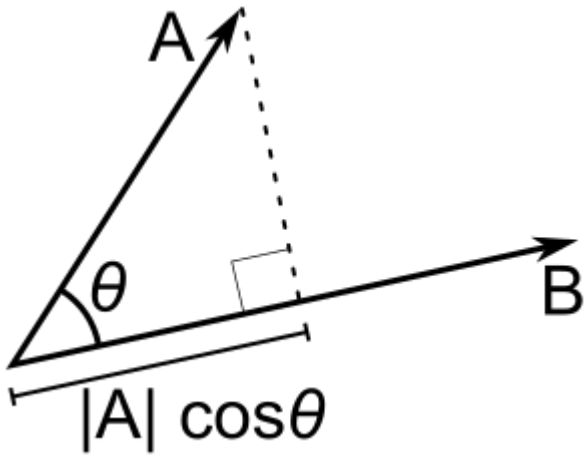
Correct Answer:
5

Solution:
As we have learned

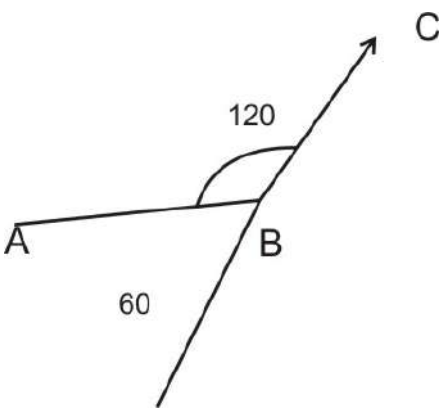
Projection of vector a on vector b -

$$\vec{a}\cos\Theta = \frac{\vec{a}.\vec{b}}{\left|\vec{b}\right|}$$

- wherein



length of projection = AB * cos 60



= AB / 2 = 5

Q. 25 Which of the following is true for any point P(x,y) on the curve y=f(x). X>C,Y>C

Option 1:

Eq. of tangent at P is $y - y_1 = \frac{dy}{dx}(x + x_1)$

Option 2:

Eq. of normal at P is $\frac{dy}{dx}(y - y_1) = (x_1 - x)$

Option 3:

Both (a) and (b)

Option 4:

None of these

Correct Answer:

Eq. of normal at P is $\frac{dy}{dx}(y - y_1) = (x_1 - x)$

Solution:

As we learnt

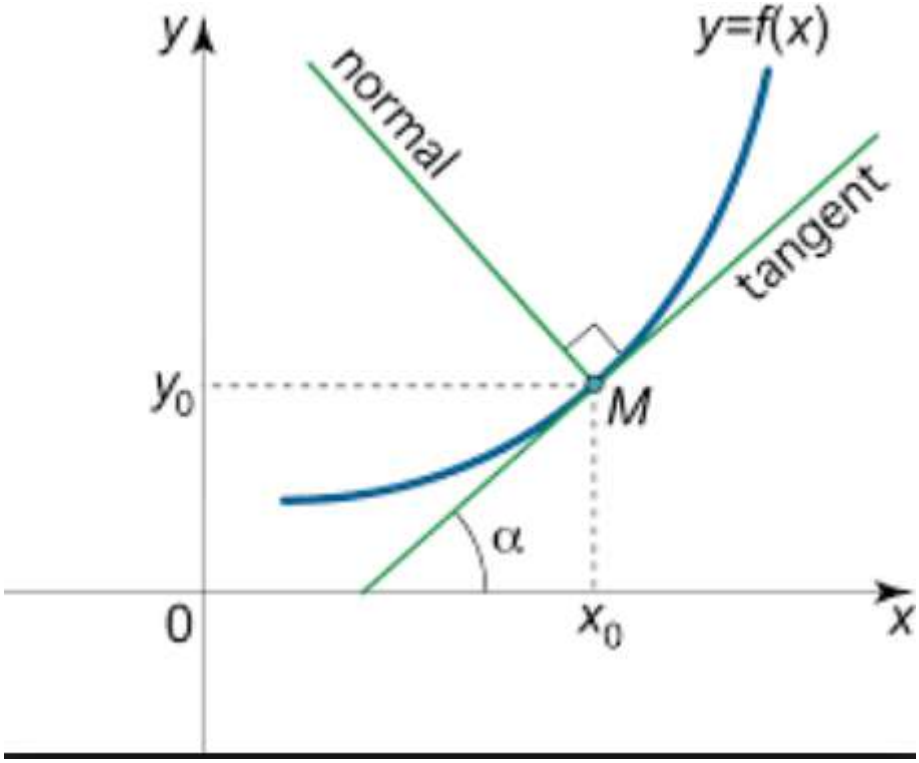
Geometrical Applications -

$P(x, y)$ be any point on

$y = f(x)$. Let tangent and normal at $P(x, y)$ meets

X - axis, Y - axis at T and N.

- wherein



Eq of Normal at point P

is $\frac{dy}{dx}(y - y_1) = (x_1 - x)$

Q. 26 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.

$[z] = 2 * 2 = 4$

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. 27 The first term of an AP is -1 and sum of first 10 terms of an AP is -100 then find the last term of the AP.

Option 1:
-17

Option 2:
-15

Option 3:
-19

Option 4:
-21

Correct Answer:
-19

Solution:
As we have learnt,

Sum of n terms of an AP -

$$S_n = \frac{n}{2}\left[2a + (n-1)\,d\right]$$

and

Sum of n terms of an AP

$$S_n = \frac{n}{2}\left[a + l\right]$$

- wherein

$a \rightarrow$ first term

$d \rightarrow$ common difference

$n \rightarrow$ number of terms

$$\Rightarrow -100 = \frac{10}{2}\left[-1 + l\right]$$

$$-20 = -1 + l$$

$$-19 = l$$

Q. 28 If 3 AM's are inserted between $\frac{1}{2}$ and 3 then find 3rd AM.

Option 1:

$\frac{16}{8}$

Option 2:

$\frac{17}{8}$

Option 3:

$\frac{18}{8}$

Option 4:

$\frac{19}{8}$

Correct Answer:

$\frac{19}{8}$

Solution:

As we have learnt,

Formula for nth Arithmetic mean (AM) -

$$A_n = a + n\,\frac{(b-a)}{n+1}$$

- wherein

a is the first term, b is the last term, n is number of mean inserted .

$\Rightarrow A_1, A_2, A_3$ are three AMs between $\frac{1}{2}$ and 3

$\frac{1}{-}2, A_1, A_2, A_3, 3$

$$d = \frac{b-a}{n+1} = \frac{3-\frac{1}{2}}{3+1} = \frac{5}{8}$$

$$A_3 = a + 3d = \frac{1}{2} + \frac{15}{8} = \frac{4+15}{8} = \frac{19}{8}$$

Q. 29 Match the column

z	$\bar{z}$
$(I) 2+3i$	$(p) -1-i$
$(II)\ i$	$(q) 4$
$(iii)\ 4$	$(r) -i$
$(iv) -1+i$	$(s) 2-3i$

Option 1:

$(i)-(s)\,;(ii)-(r)\,;(iii)-(q)\,;(iv)-(p)$

Option 2:

$(i)-(p)\,;(ii)-(q)\,;(iii)-(r)\,;(iv)-(s)$

Option 3:

$(i)-(r)\,;(ii)-(p)\,;(iii)-(s)\,;(iv)-(q)$

Option 4:
$(i)-(s)\,;(ii)-(r)\,;(iii)-(p)\,;(iv)-(q)$

Correct Answer:
$(i)-(s)\,;(ii)-(r)\,;(iii)-(q)\,;(iv)-(p)$

Solution:
As we learned

Conjugate of a Complex Number -

$z=a+ib \Rightarrow \bar{z}=a-ib$

- wherein

$\bar{z}$ denotes conjugate of z

Q. 30 Match the following

z		Arg(z)	
$(i)\,1-i$		(p)	$\frac{-2\pi}{3}$
$(ii)\,2+2\sqrt{3}i$		(q)	$\frac{-\pi}{4}$
$(iii)\,-\sqrt{3}+i$		(r)	$\frac{5\pi}{6}$
$(iv)\,-1-\sqrt{3}i$		(s)	$\frac{\pi}{3}$

Option 1:
$(i)-(q)\,;(ii)-(s)\,;(iii)-(p)\,;(iv)-(r)$

Option 2:
$(i)-(q)\,;(ii)-(s)\,;(iii)-(r)\,;(iv)-(p)$

Option 3:
$(i)-(p)\,;(ii)-(r)\,;(iii)-(q)\,;(iv)-(s)$

Option 4:
None of these

Correct Answer:
$(i)-(q)\,;(ii)-(s)\,;(iii)-(r)\,;(iv)-(p)$

Solution:
As we learned

Definition of Argument/Amplitude of z in Complex Numbers -

$\theta = tan^{-1}|\frac{y}{x}|, z \neq 0$

$\boldsymbol{\theta, \pi - \theta, -\pi + \theta, -\theta}$ are Principal Argument if z lies in first, second, third or fourth quadrant respectively.

$1 - i \rightarrow tan\Theta = 1$ & 4^{th} quadrant

$2 + 2\sqrt{3}i \rightarrow tan\Theta = \sqrt{3}$ & 1^{st} quadrant

$-\sqrt{3} + i \rightarrow tan\Theta = \frac{1}{\sqrt{3}}$ & 2^{nd} quadrant

$-1 - \sqrt{3}i \rightarrow tan\Theta = \sqrt{3}$ & 3^{rd} quadrant

Q. 31 Find arithmetic mean of the following observations

x	2	9	7	5
f(frequency)	5	2	5	2

Option 1:
3.7

Option 2:
5.2

Option 3:
9

Option 4:
7

Correct Answer:
5.2

Solution:
As we learned

ARITHMETIC Mean -

In case of discrete frquency distribution:

If the observations x_1, x_2, ...x_n occur with frequencies f_1, f_2, ...f_n then

$$\bar{x} = \frac{f_1x_1 + f_2x_2 + \cdots f_nx_n}{f_1 + f_2 + f_3 + \cdots f_n}$$

$$= \frac{\sum_{i=1}^{n} f_ix_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n} f_ix_i$$

- wherein

where

$$N = \sum_{i=1}^{n} f_i$$

$$\bar{x} = \frac{2 \times 5 + 9 \times 2 + 7 \times 5 + 5 \times 2}{5 + 2 + 5 + 2}$$

$$= \frac{73}{14} \approx 5.2$$

Q. 32 P(x,y,z) is such that its distance from x-axis is $\sqrt{3}$ from y-axis is $\sqrt{5}$ and from z-axis is 2, then $x^2 + y^2 + z^2$ equals

Option 1:
3

Option 2:
4

Option 3:
5

Option 4:
6

Correct Answer:
6

Solution:
As we have learned

Distance from Co-ordinate axes -

Consider a point $P(x, y, z)$

Distance from X-axis is $\sqrt{y^2 + z^2}$

Distance from Y-axis is $\sqrt{x^2 + z^2}$

Distance from Z-axis is $\sqrt{x^2 + y^2}$

Distance for X-axis =$\sqrt{y^2+z^2}=\sqrt{3}\Rightarrow y^2+z^2=3$

Distance for Y-axis = $\sqrt{x^2+z^2}=\sqrt{5}\Rightarrow x^2+z^2=5$

Distance for Z-axis =$\sqrt{x^2+y^2}=2\Rightarrow x^2+y^2=4$

Adding all, we get

$2(x^2+y^2+z^2)=12$

$\Rightarrow x^2+y^2+z^2=6$

$\therefore$ Option (D)

Q. 33 Arrangement of things can be termed as

Option 1:
Selection

Option 2:
Combination

Option 3:
Permutation

Option 4:
Collection

Correct Answer:
Permutation

Solution:

Permutations -

Permutation means arrangement of things.

- wherein

Like or alike things.

Q. 34 If $y=e^{\sin^2 x}$; dy/dx equals

Option 1:
$e^{\cos^2 x}$

Option 2:
$e^{\sin 2x}$

Option 3:
$\sin 2x \cdot e^{\sin^2 x}$

Option 4:
$e^{\sin 2x} \cdot 2\cos 2x$

Correct Answer:
$\sin 2x \cdot e^{\sin^2 x}$

Solution:
As we have learned

Chain Rule for differentiation (indirect) -

Let y = f(x) is not in standard form then

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

$$ex: \ y = sin(ax + b)$$

$$Let \ u = (ax + b)$$

$$then \ y = sin \ u$$

$$so \ \frac{dy}{du} = cos \, u \ and \ \frac{du}{dx} = a$$

$$\therefore \frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx} = a \, cos \, u$$

$$= a \, cos(ax + b)$$

- wherein

$$Where \ y = f(u) \ and \ u = f(x)$$

$$\frac{dy}{dx} = \frac{dy}{dx} \cdot \frac{du}{dx}$$

Let $u = \sin^2 x, v = \sin x$ then u= v^2 and $y = e^u$

$$\Rightarrow \frac{dy}{dx} = \frac{de^u}{du} * \frac{dv^2}{dv} * \frac{d(\sin x)}{dx}$$

$$\Rightarrow \frac{dy}{dx} = e^u 2v * \cos x = e^{\sin^2 x} * 2\sin x * \cos x$$

$$\Rightarrow \frac{dy}{dx} = e^{\sin^2 x} \sin 2x$$

Q. 35 A is a orthogonal matrix where $A = \begin{bmatrix} 5 & 5\alpha \\ 0 & \alpha \end{bmatrix}$. Then find the value of α.

Option 1:
1

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

Option 3:
$\frac{1}{25}$

Option 4:
None of these

Correct Answer:
None of these

Solution:
As we have learnt

Orthogonal matrix -

$$AA' = I$$

- wherein

A' is transpose matrix of matrix A and i is identity matrix

Orthogonal matrix

$$AA^T = I, A^T = \begin{bmatrix} 5 & 0 \\ 5\alpha & \alpha \end{bmatrix} AA^T = \begin{bmatrix} 5 & 5\alpha \\ 0 & \alpha \end{bmatrix} \begin{bmatrix} 5 & 0 \\ 5\alpha & \alpha \end{bmatrix}$$

$$= \begin{bmatrix} 25(1+\alpha^2) & 5\alpha^2 \\ 5\alpha^2 & \alpha^2 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

No value of 2 exist

Q. 36 $f(x)=\left(\frac{\log x}{\sin x}+e^{x}\right)$ is differentiable in

Option 1:
$x \in \mathbb{R}$

Option 2:
$x \in \mathbb{R}-\{0\}$

Option 3:
$x>0$

Option 4:
$x \in \phi$

Correct Answer:
$x>0$

Solution:
As we have learnt,

Properties of differentiable functions -

The sum, difference, product and quotient of two differentiable functions is differentiable.

e^{x} : domain is $x \in \mathbb{R}$

$\log x$: domain is $x>0$

Common domain: $x>0$

Q. 37 Three point $\vec{a}, \vec{b}, \vec{c}$ are collinear if $\lambda \vec{a}+\mu \vec{b}+\nu \vec{c}=0$ where

Option 1:
$\lambda+\mu+\nu=1$

Option 2:
$\lambda+\mu+\nu=2$

Option 3:
$\lambda+\mu+\nu=-1$

Option 4:
$\lambda+\mu+\nu=0$

Correct Answer:
$\lambda + \mu + \nu = 0$

Solution:
As we have learnt

Test of Collinearity -

$\vec{a}, \vec{b}, \vec{c}$ are collinear iff $x\vec{a} + y\vec{b} + z\vec{c} = 0$ where $x + y + z = 0$

$x(\vec{b} - \vec{a}) = y(\vec{c} - \vec{b})$

$(x + y)\vec{b} - x\vec{a} - y\vec{c} = 0$

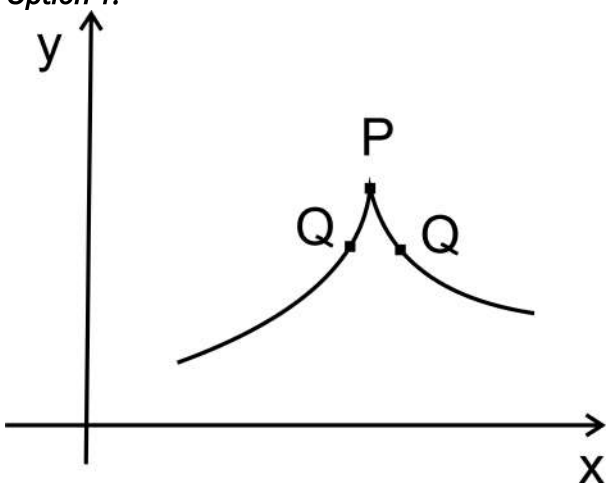
$-x\vec{a} + (x + y)\vec{b} - y\vec{c} = 0$

$\lambda\vec{a} + \mu\vec{b} + \nu\vec{c} = 0$

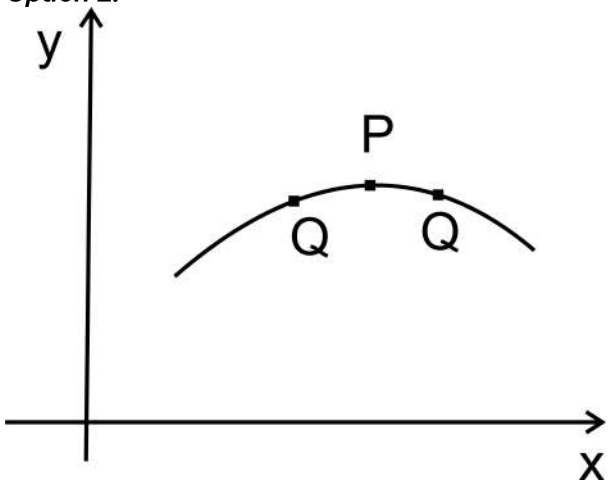
where $\lambda + \mu + \nu = -x + (x + y) - y = 0$

Q. 38 In which of the following, limiting position of the second PQ exists as the point Q approaches the point P, so that tengent can exist at P?

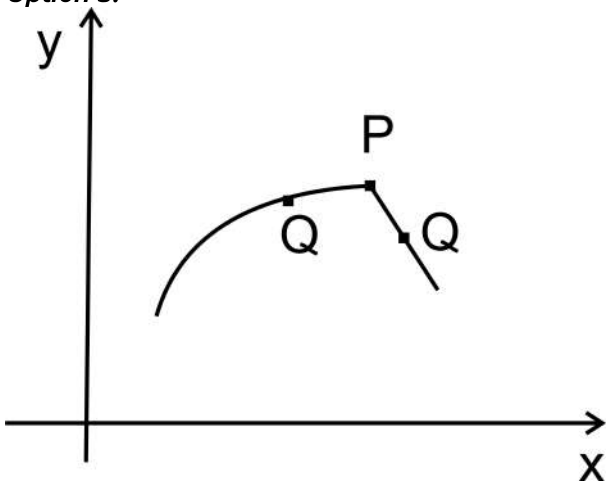
Option 1:



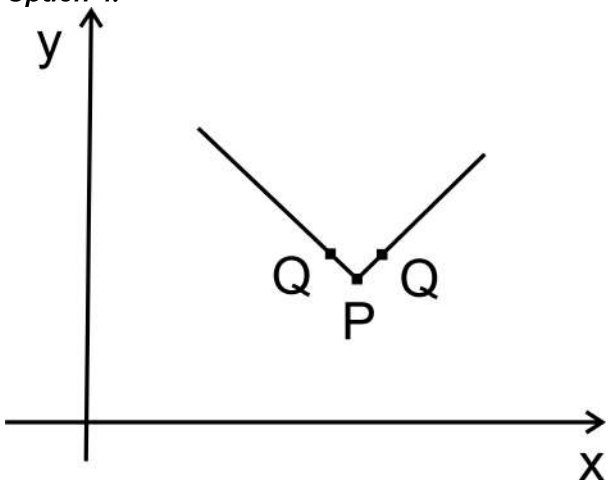
Option 2:



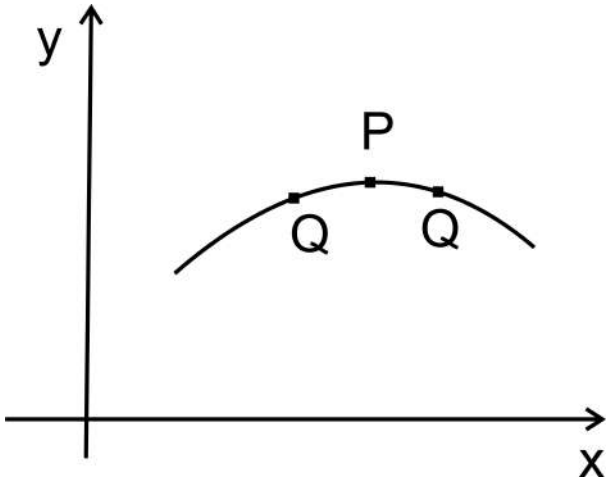
Option 3:



Option 4:



Correct Answer:



Solution:
As we learned

Tangent -

The tangent t a curve at a point P on it is defined as the limiting position of the secant PQ as the point Q approaches the point P provided such a limiting position exists.

- wherein

In (A), (C), (D) there is a corner at P in each case, so under limiting case there is no limiting position of secant PQ.

Only (B) will give limiting position of second PQ.

Q. 39 f, g are continuous at $'a'$. Then which of the following is true?

Option 1:
$f \pm g$ is continuous at $x = A$

Option 2:
$f \cdot g$ is continuous at $x = A$

Option 3:
$\frac{f}{g}$ is continuous at $x = A$ & $g(a) \neq 0$

Option 4:
All of the above

Correct Answer:
All of the above

Solution:
As we have learnt,

Properties of Continuous function -

If f, g are two continuous functions at a point a of their common domain D.Then $f \pm g$ fg are continuous at a and if $g(a) \neq 0$ then

$\frac{f}{g}$ is also continuous at x = a.

Q. 40 What is the probability of getting one facecard from a deck and 2 in a dice throw if these two are dependent events such that probability of obtaining a face card is 1/12 if 2 occurs in a dice throw ?

Option 1:
3/78

Option 2:
1/36

Option 3:
1/72

Option 4:
None of these

Correct Answer:
1/72

Solution:
As we learned from

Multiplication Theorem of Probability -

If A and B are any two events then

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

where $B \neq \phi$

$$P(F \cap 2) = P(2).P(F/2)$$

$$= \frac{1}{6} \times \frac{1}{12}$$

$$= \frac{1}{72}$$

English

Q. 1 Find out the correct prepositions.

Please do not interfere ____my life.

Option 1:
in

Option 2:
on

Option 3:
about

Option 4:
with

Option 5:
into

Correct Answer:
in

Solution:
When it is a generalized concept, we use in with interfere.

Q. 2 Change the speech.

He said to Amit, "Sheena will leave for Delhi tomorrow."

Option 1:
He told Amit that Sheena will leave for Delhi tomorrow.

Option 2:
He told Amit that Sheena left for Delhi the next day.

Option 3:
He told Amit that Sheena would leave for Delhi the next day.

Option 4:
He told Amit that Sheena would have left for Delhi tomorrow.

Option 5:
He told Amit that Sheena would be leaving for Delhi tomorrow.

Correct Answer:
He told Amit that Sheena would leave for Delhi the next day.

Solution:
While changing the speech, from direct to indirect, we remove the quotation marks and use a conjunction or a verb. Here, the verb is told. Idiomatically and grammatically, only the last sentence is appropriate.

Q. 3 Change the speech.

Bala's mother, "Will you lock the door, Bala ?"

Option 1:
Bala's mother asked Bala if he would lock the door.

Option 2:
Bala's mother asked Bala if he can lock the door.

Option 3:
Bala’s mother said lock the door.

Option 4:
Bala's mother told Bala that he need not lock the door.

Option 5:
Bala's mother asked Bala if he had locked the door.

Correct Answer:
Bala's mother asked Bala if he would lock the door.

Solution:
Rest of the options change the meaning.

Q. 4 Find out the correct antonym for the given word:

Validate

Option 1:
Refute

Option 2:
Buttress

Option 3:
Support

Option 4:
Rectify

Option 5:
Substantiate

Correct Answer:
Refute

Solution:
Validate means to prove or certify. Refute means to disprove of something.

Q. 5 Find out the odd one out among the following words:

Option 1:
Profane

Option 2:
Blasphemous

Option 3:
Ungracious

Option 4:
Irreverent

Option 5:
Sacrilegious

Correct Answer:
Ungracious

Solution:
Where the options denote disrespect towards religion, ungracious means being rude or discourteous to people.

Aptitude

Q. 1 In a certain code, INSTITUTION is written as NOITUTITSNI. How is PERFECTION written in that code?

Option 1:
NOICTEFREP

Option 2:
NOITCEFERP

Option 3:
None of these

Option 4:
NOITCEFREP

Option 5:
NOITCEFRPE

Correct Answer:
NOITCEFREP

Solution:
The complete world has written in the reverse form.

PERFECTION => NOITCEFREP

Q. 2 **Directions :** In a certain code language, the codes for some words are as follows

NATION - agvnab

REMOTE - rzgrbi

STAIR - efgnv

FORMAL - bensyz

COMMON - zabzpb

FOR - ebs

What is code for 'AMERICAN'?

Option 1:
nzrevpna

Option 2:
nzrespna

Option 3:
None of these

Option 4:
nzreqpna

Option 5:
nzlespna

Correct Answer:
nzrevpna

Solution:
In the first word, the letter N is repeated and so is the code a. Hence, for N, the code is a. Similarly, from the second word, the code for E is 'r'. In first and sixth words the letter o is common and so is the code b. Hence, the code for o is b. In the fifth word, the letter m is repeated and so is the code z. Hence, the code for m is z. Similarly, the codes for the remaining letters can be determined.
The letters and their respective codes are as follows:
Letter: A C E F I L M N O R S T
Code letter: n p R s v y z a b e f G
The code for 'AMERICAN' is nzrevpna.

Q. 3 4, 8, 12, 7, 11, 18, 9, ----------, 22

Option 1:
12

Option 2:
15

Option 3:
13

Option 4:
7

Option 5:
11

Correct Answer:
13

Solution:
4, 8, 12, 7, 11, 18, 9, ----------, 22

In this series, third number is the sum of first two numbers like 4+8=12, 7+11= 18

So, at the end, 9+x= 22

x= 13

Q. 4 CDF, EFH, HIK, ----------, TUW, EFH

Option 1:
MNP

Option 2:
LMO

Option 3:
MOP

Option 4:
OMP

Option 5:
MNO

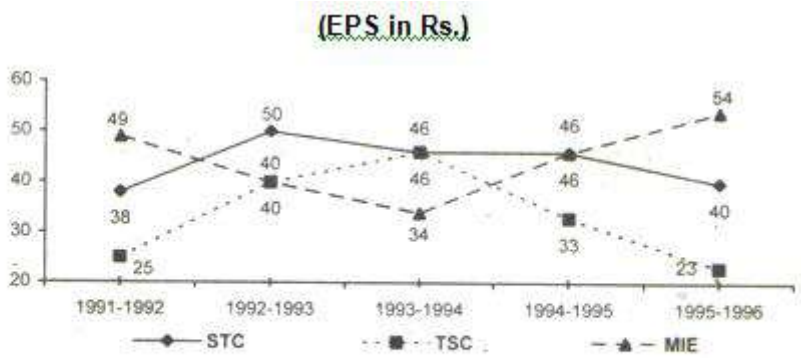
Correct Answer:
MNP

Solution:
CDF, EFH, HIK, ----------, TUW, EFH

The pattern is 2 consecutive letters, followed by skipping 1 letter, and then the 3rd letter. The solution is finding the pattern of the starting letter. Initially it's C, and then it skips 1 letter to E,followed by skipping 2 letters to H, and then skipping 4 letters to M, and then 6 letters to T.

So, H+5=M, I+5=N, K+5=P

Q. 5 **Directions :** These question is based on the line graph given below which represents the Earnings Per Share (EPS) of three companies STC, TSC and MIE for the years 1991-1992 to 1995-1996.



$$EPS = \frac{\text{Profit available for Shareholders}}{\text{Number of Shares}}$$

If STC has to pay 10% of the profit available for share-holders as tax in the year 1993-1994, then the tax payable for 12,000 shares is

Option 1:
Rs. 62, 200

Option 2:
Rs. 55, 200

Option 3:
Rs. 60, 000

Option 4:
Rs. 57, 200

Option 5:
Rs. 50, 000

Correct Answer:
Rs. 55, 200

Solution:
Profit for STC for year 1993- 1994 = 12000 x 46 = 552000

So TAX to be paid = 10 % of 552000 = 55200

Q. 6 Which year will have the same Calendar as that of 2002?

Option 1:
2010

Option 2:
2011

Option 3:
2009

Option 4:
2013

Option 5:
2008

Correct Answer:
2013

Solution:
There should be 0 odd days between the years to have the same calendar.

So going through all the options,

Option(1) = Odd day between 2002 & 2010 = 1 + 1 + 2 + 1 + 1 + 1 + 2 + 1 = 10/7 => 3

Option(2) = Odd day between 2002 & 2011 = 1 + 1 + 2 + 1 + 1 + 1 + 2 + 1 + 1 = 11/7 => 4

Option (3) = Odd day between 2002 & 2009 = 1 + 1 + 2 + 1 + 1 + 1 + 2 = 9/7 => 2

Option (4) = Odd day between 2002 & 2013 = 1 + 1 + 2 + 1 + 1 + 1 + 2 + 1 + 1 + 1 + 2 = 14/7 => 0

Option (5) = Odd day between 2002 & 2008 = 1 + 1 + 2 + 1 + 1 + 1 + 1 = 8/7 => 1

So, Answer is Option (4) 2013.

Q. 7 **Direction :** Study the following table and answer the questions based on it.

Expenditures of a Company (in Lakh Rupees) per Annum Over the given Years

Year	Item of Expenditure				
	Salary	Fuel and Transport	Bonus	Interest on Loans	Taxes
1998	288	98	3.00	23.4	83
1999	342	112	2.52	32.5	108
2000	324	101	3.84	41.6	74
2001	336	133	3.68	36.4	88
2002	420	142	3.96	49.4	98

The ratio between the total expenditure on Taxes for all the years and the total expenditure on Fuel and Transport for all the years respectively is approximately?

Option 1:
14:12

Option 2:
10:13

Option 3:
15:18

Option 4:
5:8

Option 5:
4:7

Correct Answer:
10:13

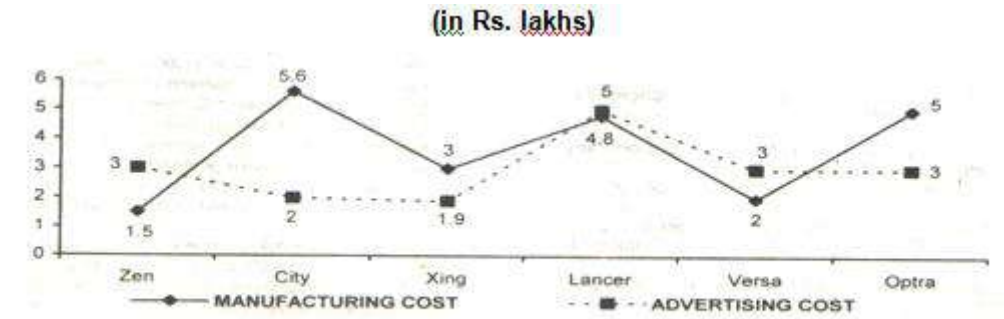
Solution:

Required ratio = $\frac{(83 + 108 + 74 + 88 + 98)}{(98 + 112 + 101 + 133 + 192)}$

$\frac{10}{13}$

10 : 13

Q. 8 **Directions : The question is based on the line graph below.**



Total Cost = Manufacturing Cost + Advertising Cost

In a certain year, 30, 000 "City" cars, are produced, and are sold at Rs. 9.3 lacs/car. If 2% of the total profit is given as a bonus to the 2,040 engineers, the amount received by each engineer as bonus is (in Rs.)

Option 1:
5, 000

Option 2:
50, 000

Option 3:
5 lacs

Option 4:
42, 000

Option 5:
None of these

Correct Answer:
50, 000

Solution:
Profit = 3000 x (9.3 – 7.6) = 51 Cr.

Now 2 % of 51 Cr. = 1.02 Cr.

Bonus per engineer = $\frac{1.02}{2040} = 50,000$

Q. 9 K is 40 m South-West of L. If M is 40 m South-East of L, then M is in which direction of K?

Option 1:
East

Option 2:
West

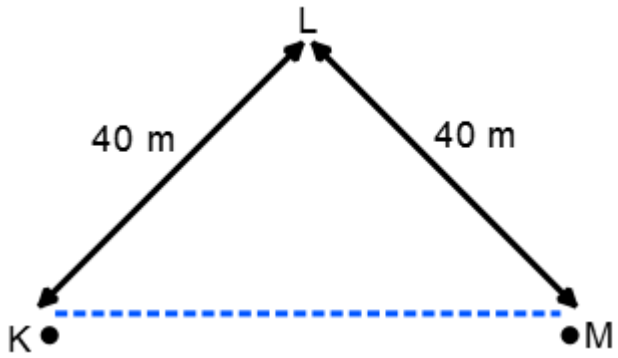
Option 3:
North

Option 4:
South

Option 5:
North- East

Correct Answer:
East

Solution:



Hence M is in the East of K.

Q. 10 In a certain code, MENTION is written as LNEITNO. How is PATTERN written in that code?

Option 1:
ATAETNR

Option 2:
OTAETNR

Option 3:
OTAESNR

Option 4:
None of these

Option 5:
STAETNR

Correct Answer:
OTAETNR

Solution:
In this, the starting word -1 and rest interchanged

M-1 => L

EN => NE

PATTERN = OTAETNR