CAREERS 360

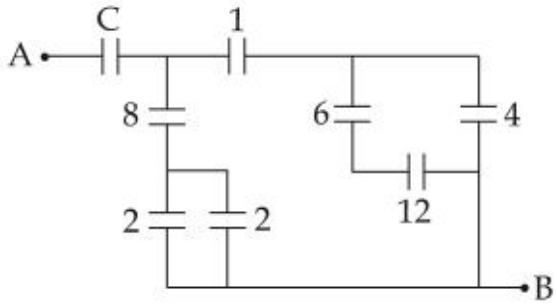
PREPARATION Series

WBJEE 2025

Sample Paper

Physics

Q. 1 In the following figure, the resultant capacitance between *A* and *B* is $1\mu F$. The capacitance *C* is



Option 1:
$32/11\mu F$

Option 2:
$11/32\mu F$

Option 3:
$23/32\mu F$

Option 4:
$32/23\mu F$

Correct Answer:
$32/23\mu F$

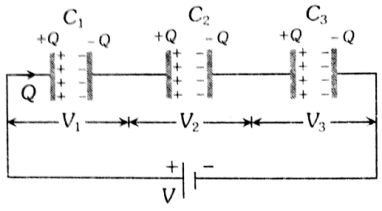
Solution:
For combination of capacitors,

Parallel Grouping -

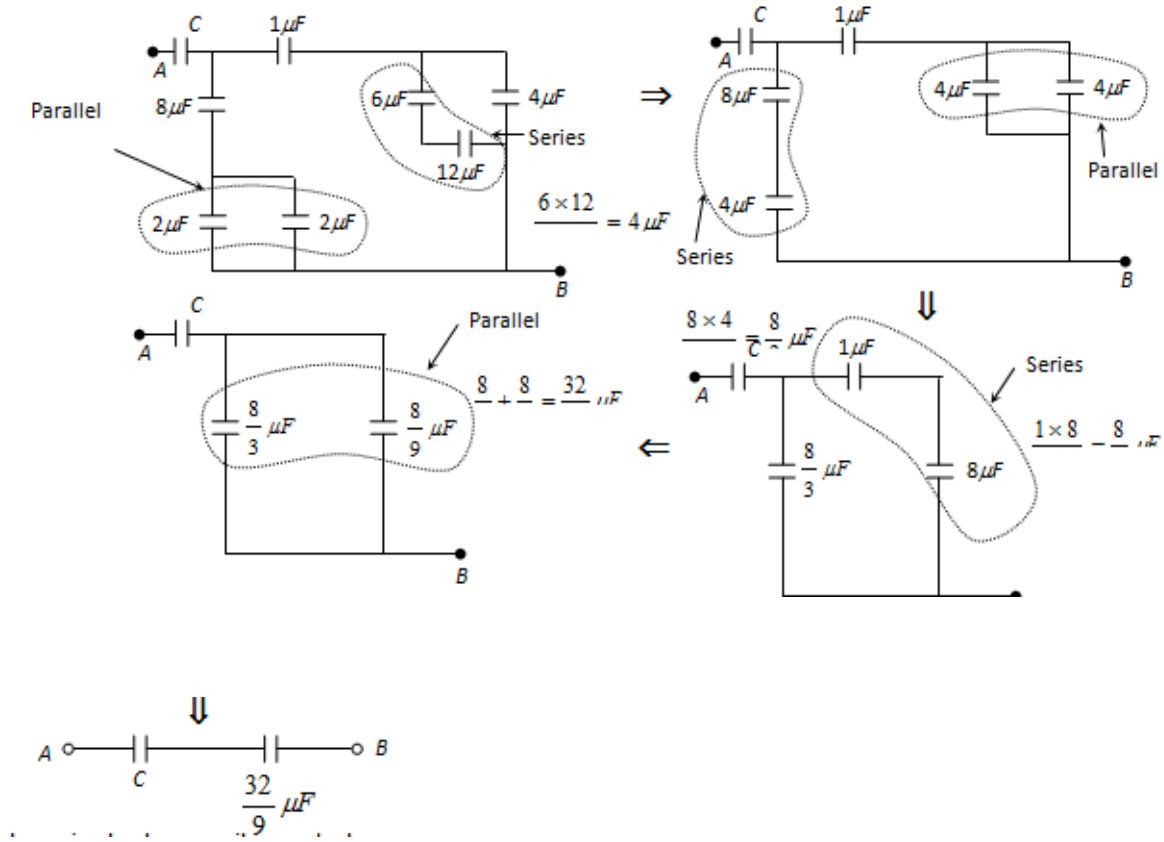
$$C_{eq} = C_1 + C_2 + \cdots$$

Series Grouping -

$$1/\mathrm{C}_{eq} = 1/\mathrm{C}_1 + 1/\mathrm{C}_2 + \ldots$$



Given network can be simplified as follows



Given that equivalent capacitance between *A* and *B* i.e., $C_{AB} = 1\mu F$

But $C_{AB} = \frac{C*32/9}{C+32/9}$

Hence,

$\frac{C*32/9}{C+32/9} = 1 \Rightarrow C = 32/23\mu F$

Hence, the answer is the option 4.

Q. 2 A $1\mu F$ capacitor and a $2\mu F$ capacitor are connected in parallel across a 1200-volt line. The charged capacitors are then disconnected from the line and from each other. These two capacitors are now connected to each other in parallel with terminals of unlike signs together. The charges on the capacitors will now be

Option 1:
$1800\mu C$

Option 2:
$400\mu C$ and $800\mu C$

Option 3:
$800\mu C$ and $400\mu C$.

Option 4:
$800\mu C$ and $800\mu \mathrm{C}$

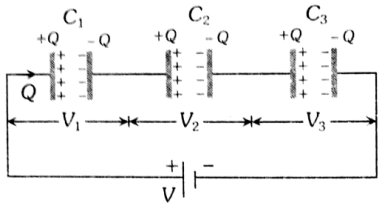
Correct Answer:
$400\mu C$ and $800\mu C$

Solution:
As we have learned

Series Grouping:

$$\frac{1}{C_{eq}}=\frac{1}{C_1}+\frac{1}{C_2}+\cdots$$

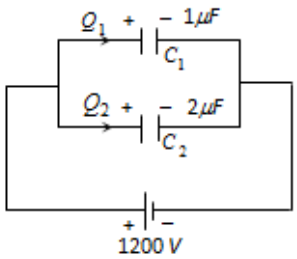
- wherein



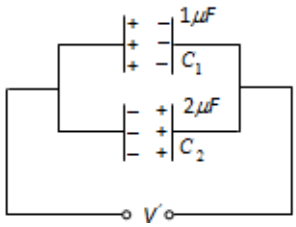
Initially, the charge on capacitors can be calculated as follows:

$\mathrm{Q1}=1\times 1200=1200\mu_{\mathrm{C}}$ and $\mathrm{Q2}=2\times 1200=2400\mu_{\mathrm{C}}$
Finally, when the battery is disconnected and unlike plates are connected together, then common potential

$$V'=\frac{Q_2-Q_1}{C_1+C_2}=\frac{2400-1200}{1+2}=400\ \mathrm{V}$$

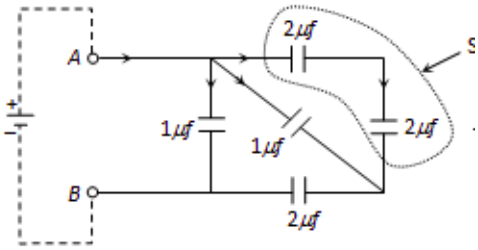


Hence, New charge on is C_1 is $1^{*}400=400\mu \mathrm{C}$ And New charge on is C_2 is $2^{*}400=800\mu \mathrm{C}$



Hence, the answer is option (2).

Q. 3 Five capacitors are connected as shown in the figure. The equivalent capacitance between the point A and B is



Option 1:
$1\mu f$

Option 2:
$2\mu f$

Option 3:
$3\mu f$

Option 4:
$4\mu f$

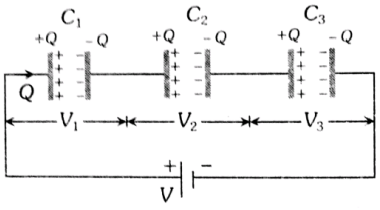
Correct Answer:
$2\mu f$

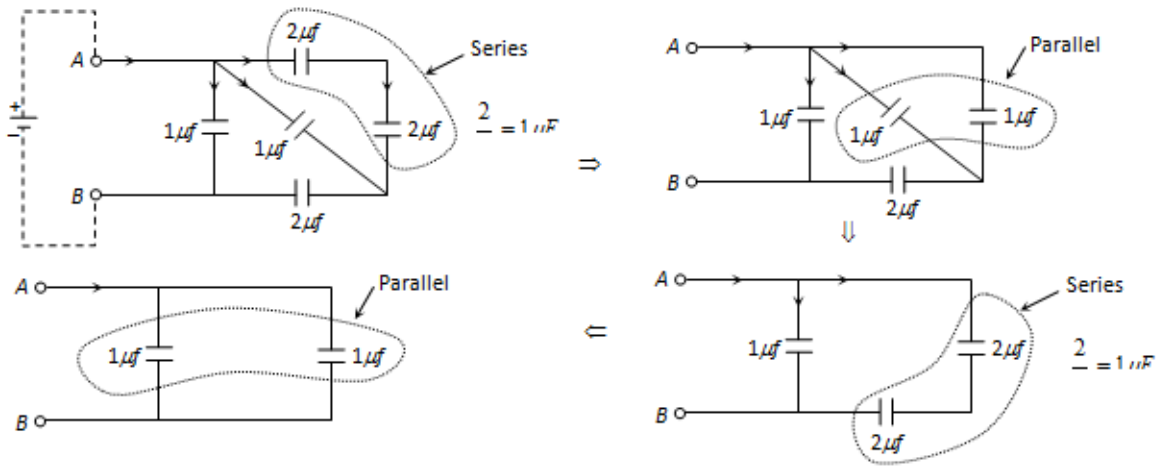
Solution:
As we have learned

Series Grouping -

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots$$

- wherein

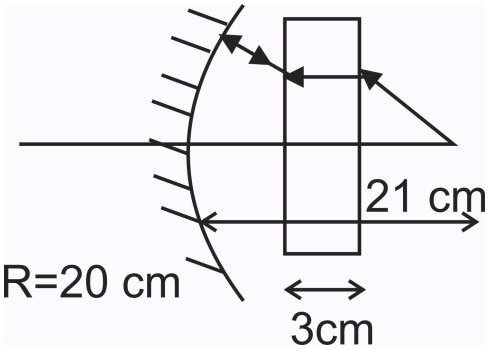




Hence equivalent capacitance between *A* and *B* is $2\mu f$

Hence, the answer is the option(2).

Q. 4 An object is placed on the principal axis of a concave mirror of focal length 10 cm at a distance of 21 cm from it. A glass slab is placed between the mirror and the object



The distance of the final image formed by the mirror is:

Option 1:
10cm

Option 2:
20cm

Option 3:
30cm

Option 4:
21cm

Correct Answer:
20cm

Solution:
As we learn

Refraction through parallel slab -

$$s = t\left(1 - \frac{1}{\mu}\right)$$

- wherein
$s =$ shifting of an object from slab
$t =$ thickness of slab
$\mu =$ Refractive Index of the slab.

$$\text{shift } = 3\left(1 - \frac{1}{\frac{3}{2}}\right) = 1 \text{ cm}$$

Therefore mirror object distance =(21-1)cm=20cm

Therefore object is at the centre of the curvature of the mirror. Hence light ray will retrace and image will formed at object itself.

Hence, the correct answer is option (b).

Q. 5 Dispersive power for crown glass if $\mu_v = 1.523, \mu_r = 1.5145$ is:

Option 1:
0.1639

Option 2:
0.1821

Option 3:
0.1764

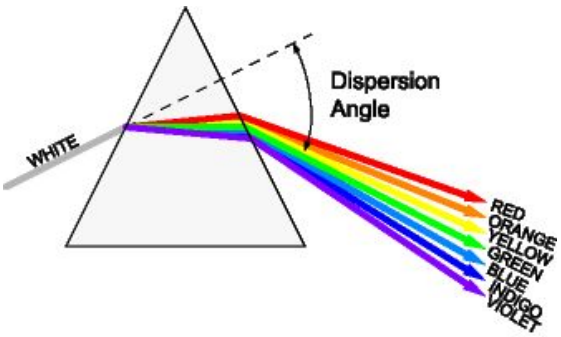
Option 4:
0.2123

Correct Answer:
0.1639

Solution:
As we learn

Dispersive power (ω) -

$\omega = \frac{\mu_v - \mu_r}{\mu_y - 1}$



- wherein

$\mu_v =$ Refractive index of violet
$\mu_r =$ The refractive index of red
$\mu_y =$ The refractive index of yellow
$= \frac{\mu_v + \mu_r}{2}$
$w = \frac{\mu_v - \mu_r}{\mu_y - 1}$
$\mu_y = \frac{\mu_v + \mu_r}{2} = 1.5187$
$\therefore w = \frac{1.523 - 1.5145}{1.5187 - 1} = 0.1639$

Hence, the answer is the option (1).

Q. 6 An object is placed at a depth of 10 cm inside a lake. The radius of the cone through which this object can be seen is (refractive index of water $= \frac{3}{2}$)

Option 1:
7.95 cm

Option 2:
8.95 cm

Option 3:
9.95 cm

Option 4:
6.95 cm

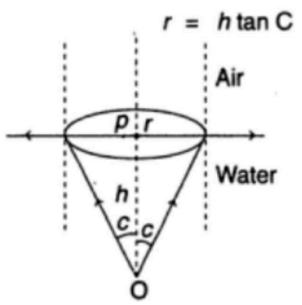
Correct Answer:
8.95 cm

Solution:
As we learn

The radius of the Circle of illuminance -

$r = \frac{h}{\sqrt{\mu^2 - 1}}$

- wherein



$$\Rightarrow h = 10\ \text{cm} \Rightarrow r = \frac{10\ \text{cm}}{\sqrt{\frac{9}{4}-1}} = \frac{10\ \text{cm} * 2}{\sqrt{5}}$$

$\mu = \frac{3}{2}$

$\text{r} = 8.95\ \text{cm}$

Hence, the answer is the option(2).

Q. 7 A body of mass m is placed on a weighing machine placed in lift is moving upward with acceleration a then the apparent weight of the body is

Option 1:
mg

Option 2:
ma

Option 3:
m(g-a)

Option 4:
m(g+a)

Correct Answer:
m(g+a)

Solution:
As we learn

The apparent weight of the body in a lift -

If mass m is placed on weighing machine which is placed in lift.

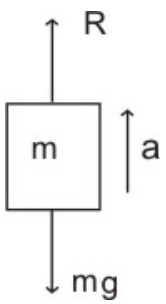
Actual weight = mg

Apparent weight = Reaction force

- wherein

R $\longrightarrow$ Reaction force is given by reading of weighing machine.

FBD of the block



$R - mg = ma$
$\Rightarrow R = m(g + a) R = m(g + a)$

weighing machine will give the reading of the reaction force

Hence, the answer is the option(4).

Q. 8 If a man of mass m is standing on a weighing machine which is placed in the lift. If the lift is at rest then the apparent weight of the man will be:

Option 1:
Equal to mg

Option 2:
less than mg

Option 3:
greater than mg

Option 4:
zero

Correct Answer:
Equal to mg

Solution:
The weight of an object is given by the formula: $W = mg$

where W is the weight, m is the mass of the object, and g is the acceleration due to gravity (approximately $9.81\ \mathrm{m/s^2}$ on the surface of the Earth).

When the lift is at rest, the only forces acting on the man are his weight (downward force) and the normal force exerted by the lift floor (upward force). Since the lift is not accelerating, these forces are balanced: $N = mg$

where N is the normal force (apparent weight). Therefore, the apparent weight of the man when the lift is at rest is: $N = mg$

When the lift is moving with a uniform velocity v, it is still not accelerating. The forces acting on the man remain the same as when the lift is at rest. There is no change in the gravitational force acting on him, and since there is no acceleration, the normal force (apparent weight) is still equal to his weight:$N = mg$

In both cases (when the lift is at rest and when it is moving with uniform velocity), the apparent weight of the man is: $N = mg$

So, the apparent weight of the man when the lift is at rest or moving with uniform velocity v is mg.

Hence, the answer is the option (1).

Q. 9 Choose the correct option regarding the Inelastic collision between two bodies.

Option 1:
Kinetic energy is conserved

Option 2:
Momentum is conserved

Option 3:
Both A & B

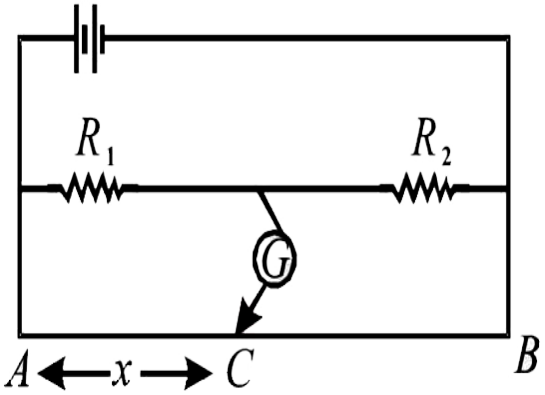
Option 4:
None of these

Correct Answer:
Momentum is conserved

Solution:
Inelastic Collision -
The law of conservation of momentum holds good but kinetic energy is not conserved.
- wherein
$\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2\neq\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2$
$m_1u_1+m_2u_2=m_1v_1+m_2$
m_1, m_2 : masses
u_1, v_1 : initial and final velocities of mass m_1
u_2, v_2 : initial and final velocities of mass m_2

Hence, The answer is the option (2).

Q. 10 In the shown arrangement of the experiment of a meter bridge if AC corresponding to null deflection of the galvanometer is x, what would be its value if the radius of the wire AB is doubled.?



Option 1:
x

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

Option 3:
4x

Option 4:
2x

Correct Answer:
x

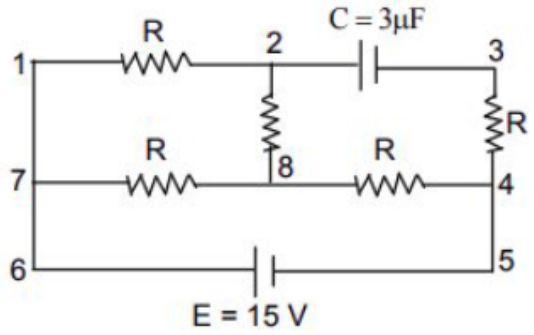
Solution:
At null point $\frac{R_1}{R_2} = \frac{R_3}{R_4} = \frac{x}{100-x}$
if radius of wire is doubled then the resistance of AC will change and the resistance of CB will also change.

But since $\frac{R_1}{R_2}$ does not change so $\frac{R_3}{R_4}$ should also not change at null point.

Therefore point C does not change

Hence, the correct answer is option (1).

Q. 11 In the circuit shown, the battery is ideal, with emf E = 15 V and it sends a current I in the circuit. All resistors are identical and each resistor has resistance R = 3Ω. The potential difference (in V) across the capacitor in a steady state is V_c =



Option 1:
12

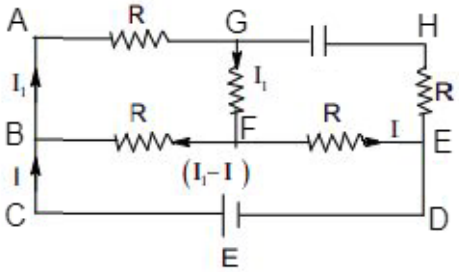
Option 2:
9

Option 3:
0

Option 4:
15

Correct Answer:
12

Solution:



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

For Loop AGFEDCA

$$-2I_1R - IR + E = 0$$
$$\Rightarrow \quad 6I_1 + 3I = 15 \ldots (1)$$

For Loop BECDB

$$(\mathrm{I_1}-\mathrm{I})\mathrm{R}-\mathrm{IR}+\mathrm{E}=0$$
$$-2\mathrm{IR}+\mathrm{I_1R}+\mathrm{E}=0$$
$$\Rightarrow \quad 3\mathrm{I_1}-6\mathrm{I}=-15$$
$$\Rightarrow \quad \frac{31_1}{2}-3\mathrm{I}=-\frac{15}{2}\ldots$$

Add (1) and (2), we get

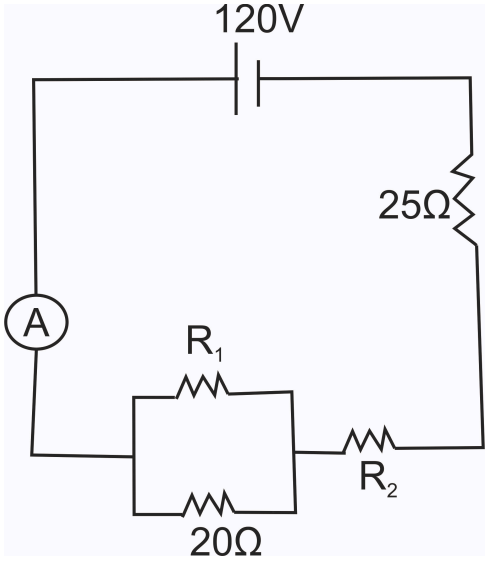
$$\left(\frac{3}{2}+6\right)I_1=15-\frac{15}{2}$$
$$\Rightarrow\left(\frac{3+12}{2}\right)I_1=\frac{30-15}{2}$$
$$\Rightarrow 15I_1=15$$
$$\Rightarrow I_1=1A$$
$$\Rightarrow 6+3I=15$$
$$\Rightarrow 31=9$$
$$\Rightarrow I=3\ \mathrm{A}$$

For Loop GHEFG

$$\mathrm{V_C}+\mathrm{I}(3)+\mathrm{I_1}(3)=0$$
$$\Rightarrow \quad \mathrm{V_C}=9+3=12\ \mathrm{V}$$

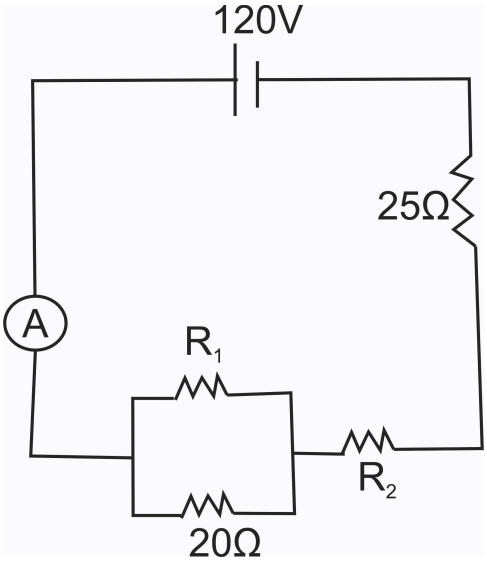
Hence, the answer is the option (1).

Q. 12 In the given circuit, the potential difference across R_2 is 40 V and ammeter reads 2 A. The value of R_1 is (in Ω)



Correct Answer:
60

Solution:



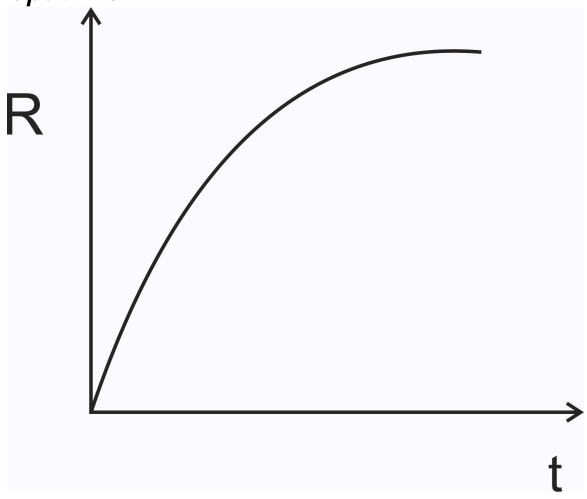
P.D. across $R_2 = I.R_2 = 40\ \text{V}$

$$I = 2A \Rightarrow R_2 = 20\Omega$$
$$R_{\text{eq}} = \left[\frac{20R_1}{20+R_1} + 25 + 20\right]\Omega = 45 + \frac{20R_1}{20+R_1}$$
$$I = 2A = \frac{120}{45 + \frac{20R_1}{20+R_1}} \text{ or } \frac{40R_1}{20+R_1} = 30$$
$$4R_1 = 60 + 3R_1 \text{ or } R_1 = 60\Omega$$

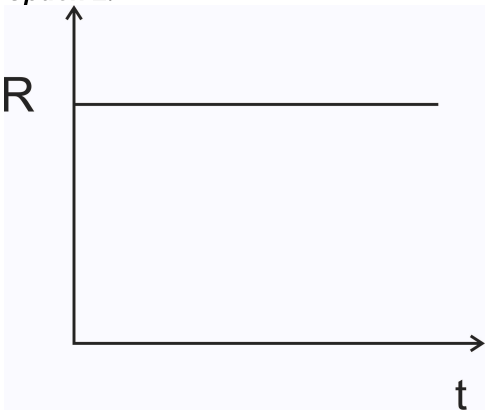
Hence, The answer is the option (1).

Q. 13 A radioactive nucleus X decays to a stable Y. Then time graph of rate formation of Y against t will be

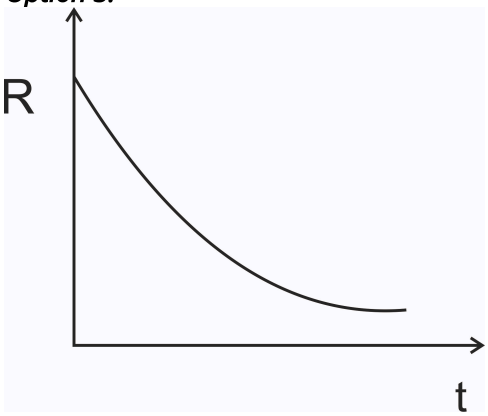
Option 1:



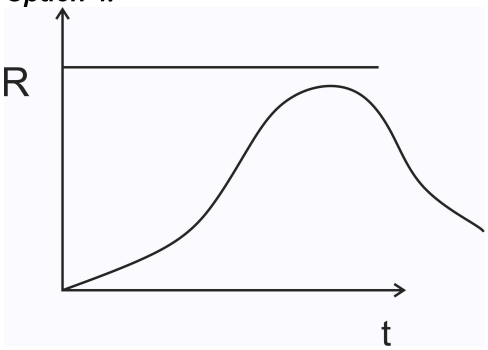
Option 2:



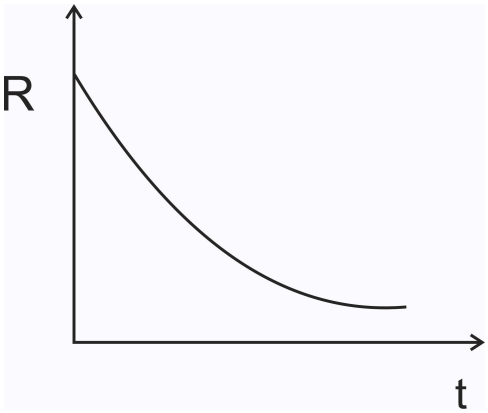
Option 3:



Option 4:



Correct Answer:



Solution:
As we learn

Radioactivity -

$$A = -\frac{dN}{dt}$$

$-$ wherein

Activity is measured in terms of disintegration per second Its SI unit is 'Becquerel'

$$N = N_0 \cdot e^{-\lambda t}$$

$$N_Y = N_0 \left(1 - e^{-\lambda t}\right)$$

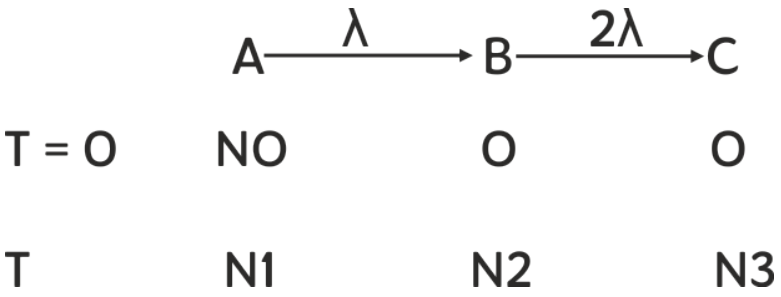
Rate of formation of Y is

$$\frac{dN}{dt} = +\lambda N_0 e^{-\lambda t}$$

Which decreases exponentially with time.

Hence, the answer is the option(3).

Q. 14



The ratio of N_1 to N_2 when N_2 is maximum is:

Option 1:

At no time this is possible

Option 2:

2

Option 3:

$\frac{1}{2}$

Option 4:

$\frac{lu^2}{2}$

Correct Answer:

2

Solution:

As we learn

Series decay:

$$A \xrightarrow{\lambda_1} B \xrightarrow{\lambda_2} C$$

$N_1 \quad N_2$

- wherein

Radioactive equilibrium is achieved when

$\lambda_1 N_1 = \lambda_2 N_2$

$\frac{dN_2}{dt} = \lambda N_1 - 2\lambda N_2$

For N_2 to be maximum

$\frac{dN_2}{dt} = 0$

$\lambda N_1 = 2\lambda N_2$

$\Rightarrow \frac{N_1}{N_2} = 2$

Hence, the answer is option (2).

Q. 15 What is the angular momentum of an electron in the lowest energy level of a hydrogen atom:

Option 1:

$\frac{h}{\pi}$

Option 2:

$\frac{2h}{\pi}$

Option 3:

$\frac{h}{2\pi}$

Option 4:

Zero

Correct Answer:

$\frac{h}{2\pi}$

Solution:

As we learn

Bohr quantization principle -

$mvr = \frac{nh}{2\pi}$

$2\pi r = n\lambda$

wherein

The angular momentum of an electron in a stationary orbit is quantized.

$mvr = \frac{nh}{2\pi} \Rightarrow L = \frac{nh}{2\pi}$

For n = 1

$L = \frac{h}{2\pi}$

Hence, the correct option is (3).

Q. 16 If the temperature of simple pendulum is increased then

Option 1:
It will become faster

Option 2:
It will become slower .

Option 3:
It will remain the same

Option 4:
None of these

Correct Answer:
It will become slower .

Solution:
As we learn
Loss of time in a time period -

$$\Delta T = \frac{1}{2}\alpha \Delta \theta T$$
$$\Delta T = \frac{1}{2}\alpha \Delta \theta (86400)$$

- wherein

Where T represents the total number of seconds in a day

$\mathrm{T} = 86,400\mathrm{sec}$

By increasing the temperature the time period will increase. It will become slower.

Hence, The answer is the option (2).

Q. 17 When a rod whose ends are rigidly fixed such as to prevent expansion or contraction then the thermal stress produced is -

Option 1:
$\gamma \alpha \Delta \Theta$

Option 2:
$\alpha\Delta\Theta$

Option 3:
$\frac{1}{2}\gamma\alpha\Delta\Theta$

Option 4:
$\frac{\alpha\Delta\Theta}{2\gamma}$

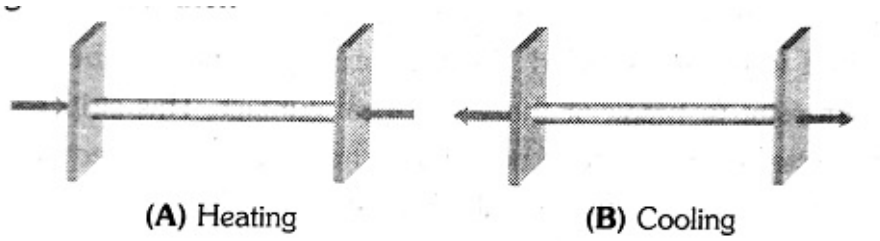
Correct Answer:
$\gamma\alpha\Delta\Theta$

Solution:
As we learn

Thermal Stress -

When a rod whose ends are rigidly fixed such as to prevent expansion or contraction.

- wherein



Thermal stress $=\gamma\alpha\Delta\Theta$

$$\left[\gamma=\frac{\text{Stress}}{\text{strain}}\right]$$

$\alpha-$ linear expansion

Hence, the correct option is (1).

Q. 18 When a rod is heated but prevented from expanding then the thermal stress produced is

Option 1:
Independent of material of rod

Option 2:
Independent of rise in temperature

Option 3:
Independent of length of rod .

Option 4:
None of these

Correct Answer:
Independent of length of rod .

Solution:
As we learn

Thermal Stress -

$Y\alpha\Delta\theta$
- wherein
$Y = \frac{\text{stress}}{\text{strain}}$

Thermal stress $= Y\alpha\Delta\theta$

Independent of the length of the rod.

Hence, the correct option is (3).

Q. 19 A.(A + B) is:

Option 1:
AB

Option 2:
B

Option 3:
A

Option 4:
1

Correct Answer:
A

Solution:
As we learn

Some Important relations -

$A + A = A$
$A \cdot A = A$
$A + 1 = 1$
$A \cdot 1 = 1$
$A \cdot 0 = 0$
$A + 0 = A$

A .A + AB = A + AB = A(1 + B) = A

Hence, the answer is option (3).

Q. 20 $\overline{E+\bar{C}D}=$

Option 1:
E . (C + D)

Option 2:
$\bar{E}\cdot(\bar{C}+\bar{D})$

Option 3:
$\bar{E}.(C+\bar{D})$

Option 4:
None of these

Correct Answer:
$\bar{E}.(C+\bar{D})$

Solution:
As we learn
De Morgan's theorem -
1) $\overline{A+B}=\bar{A}\cdot\bar{B}$
2) $\overline{A\cdot B}=\bar{A}+\bar{B}$
3) $\bar{A}+\bar{B}=A\cdot B$
4) $\bar{A}\cdot\bar{B}=A+B$
- wherein
A and B are input.

$$\begin{aligned}\overline{E+\bar{C}D}&=\bar{E}\cdot\overline{\bar{C}D}\\&=\bar{E}(\overline{\bar{C}}+\bar{D})\\&=\bar{E}(C+\bar{D})\end{aligned}$$

Hence, the correct answer is option (c).

Q. 21 Which of the following is true about expansion of gases -

i) Gases have only volume expansion

ii) Gases have only real expansion

Option 1:
only (i)

Option 2:
only (ii)

Option 3:
both (i) and (ii)

Option 4:
None of these

Correct Answer:
both (i) and (ii)

Solution:
As we learn

Expansion of Gases -

Gases have no definite shape therefore gases have only volume expansion

Expansion of container is negligible in comparison to gases therefore gases have only real expansion.

Hence, the answer is the option(3).

Q. 22 If β is the coefficient of pressure expansion of gases then the pressure of gases after increase in the temperature $\Delta\Theta$ is (P is initial pressure)

Option 1:
$P^1 = P(1 - \beta\Delta\Theta)$

Option 2:
$P^1 = P\beta\Delta\Theta$

Option 3:
$P^1 = P(1 + \beta\Delta\Theta)$

Option 4:
None of these

Correct Answer:
$P^1 = P(1 + \beta\Delta\Theta)$

Solution:
As we learn
Co-efficient of Pressure Expansion-

$\beta = \frac{\Delta P}{P_0}\frac{1}{\Delta \theta}$

- wherein

$P' = P(1 + \beta \Delta \theta)$

P' = Final pressure

$\beta = \frac{\Delta P}{P_0}\frac{1}{\Delta \theta}$
Final pressure

$P' = P(1 + \beta \Delta \theta)$
Hence, the answer is the option(3).

Q. 23 Which of the following is not true about heat of a system?

Option 1:
It is a scalar quantity

Option 2:
It is the form of energy

Option 3:
It's unit is joule

Option 4:
It can not change the temperature of body

Correct Answer:
It can not change the temperature of body

Solution:
The form of energy which is exchanged among various bodies or system on account of temperature difference is defined as heat.

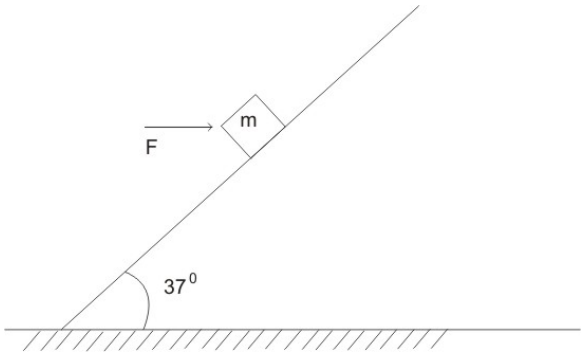
Temperature of a body can be changed by giving heat (temperature rises) or by removing heat (temperature falls) from body.

Heat is a scalar quantity.

There are various units of heat like Joule(J), erg, calorie(cal) etc.

Hence, the answer is the option (4).

Q. 24 A block of mass M lies on smooth inclined plane. A force of 15 N is applied horizontally on the block as shown. The magnitude of normal by inclined plane on the block is , if the block is in equilibrium condition



Option 1:
25 N

Option 2:
20 N

Option 3:
10 N

Option 4:
15 N

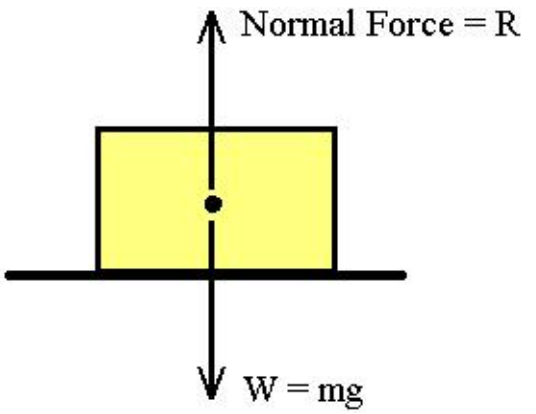
Correct Answer:
25 N

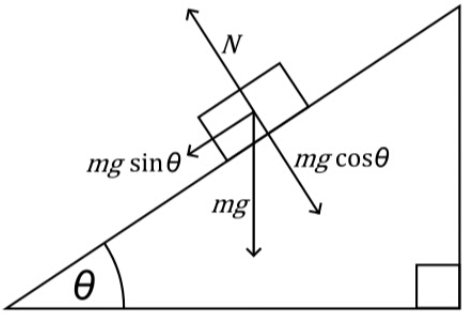
Solution:
As we have learned

Reaction or Normal Force -

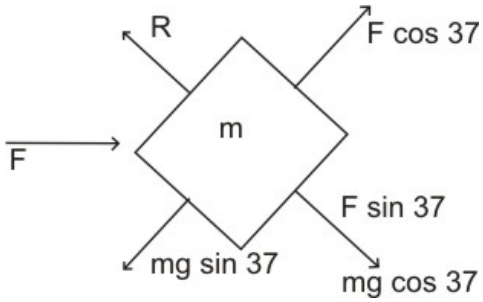
A force which is perpendicular to the surface in contact.

- wherein





for equilibrium



$mg\sin 37 = F\cos 37^\circ$
$mg3/5 = 15 \times 4/5 => mg = 20$
$R = F\sin 37 + mg\cos 37$
$15 \times 3/5 + 20 * 4/5 = 9 + 16 = 25N$
Hence, the answer is the option(1).

Q. 25 A force of 50 dynes is acted on a body of mass 5g which is at rest for an interval of 3 seconds, and then the impulse is

Option 1:
$0.15 \times 10^{-13}\text{Ns}$

Option 2:
$0.98 \times 10^{-3}\text{Ns}$

Option 3:
$1.5 \times 10^{-3}\text{Ns}$

Option 4:
$2.5 \times 10^{-3}\text{Ns}$

Correct Answer:
$1.5 \times 10^{-3}\text{Ns}$

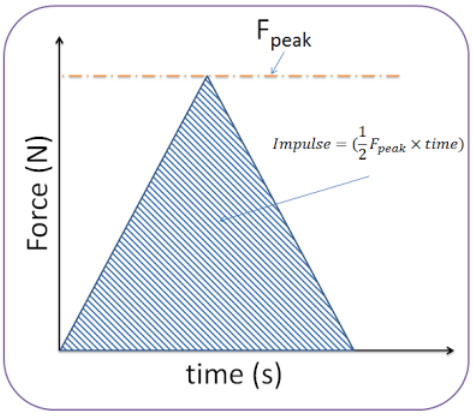
Solution:
As we have learned

Impulse

$$\vec{I} = \int_{t_1}^{t_2} \vec{F} \cdot dt$$

$$\left[MLT^{-1}\right]$$

wherein



$$F \times (\Delta t)$$

$$\text{Impulse } = 50 \times 10^{-5} \times 3 = 1.5 \times 10^{-3}\text{Ns}$$

Hence, the answer is option (3).

Q. 26 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 -

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

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

-wherein

If Δt is increased, the average force is decreased
By impulse-momentum theorem

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

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

Change in momentum

$$=200\mathrm{Kgm/s}$$

Hence, the answer is option (1).

Q. 27 Which of the following do not represent a physical quantity-

Option 1:
Length

Option 2:
Mass

Option 3:
Happiness

Option 4:
Time

Correct Answer:
Happiness

Solution:
As we learn

Physical quantity -

A quantity which can be measured and expressed in the form of laws is called a Physical quantity.

- wherein

A physical quantity is expressed completely by it's magnitude and unit.

Hence, the correct answer is the option (3).

Q. 28 For any physical quantity Q numerical value n is related to unit u by the relation-

Option 1:
$n\alpha u^2$

Option 2:
$n\alpha u$

Option 3:
$n\alpha \sqrt{u}$

Option 4:
$\mathrm{n}\,\alpha \frac{1}{u}$

Correct Answer:
$\mathrm{n}\,\alpha \frac{1}{u}$

Solution:
A quantity which can be measured and by which various physical phenomena can be explained in the form of laws is called a physical quantity. For example length, mass, time, force, etc.
Measurement is necessary to determine the magnitude of a physical quantity, to compare two similar physical quantities, and to prove physical laws or equations.

Physical quantity (Q) = Magnitude $\times$ Unit $= \mathrm{n} \times \mathrm{u}$
Where n represents the numerical value and u represents the unit.
nu = constant.

$\mathrm{n_1u_1} = \mathrm{n_2u_2} = \text{ constant}$
$n \propto \frac{1}{u}$
Hence, the answer is option (4).

Q. 29 A man which has a speed of 5km/h in still water crosses a river of width 1km along the shortest possible path in 15 minutes. The velocity of river water in km/h is :

Option 1:
3

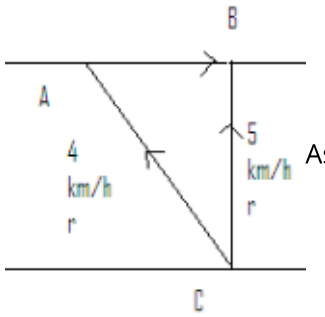
Option 2:
4

Option 3:
8

Option 4:
10

Correct Answer:
3

Solution:



As we learn

Boat - River Problem -

To cross the river in the shortest path

$t = \frac{d}{\sqrt{v^2-u^2}}$

- wherein

d = width of river

v = Speed of Boat w.r.t. river

u = speed of river

$\cos\theta = \frac{4}{5} \qquad \sin\theta = \frac{3}{5}$

Now, $V_R = 5 \times \frac{3}{5} = 3\ \mathrm{km/h}$

Hence, the answer is the option 1.

Q. 30 A man can swim in still water of 1m/s. He swim across the river flowing at 0.6m/s . The width of river is 100m. If he travels with the shortest possible time then time taken to cross the river is:

Option 1:
250s

Option 2:
100s

Option 3:
60s

Option 4:
40s

Correct Answer:
100s

Solution:
As we learn

Boat - River Problem -

To cross the river in the shortest time.

- wherein

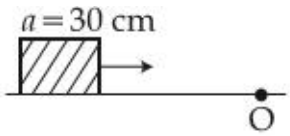
Time taken $t = \frac{d}{v}$

For $\mathrm{t_{min}}\overrightarrow{V_{mr}}$ should be perpendicular to the flow.

$$t = \frac{100}{1}$$
$$\mathrm{t} = 100\ \mathrm{s}$$

Hence, The answer is the option (2).

Q. 31 A cubical block of side 30 cm is moving with velocity 2 ms^{-1} on a smooth horizontal surface. The surface has a bump at a point O as shown in figure. The angular velocity (in rad/s) of the block immediately after it hits the bump, is :



Option 1:
5.0

Option 2:
6.7

Option 3:
9.4

Option 4:
13.3

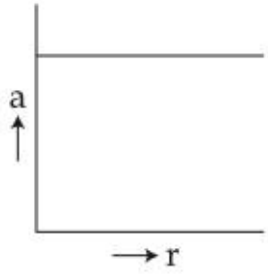
Correct Answer:
5.0

Solution:
Using Conservation of angular momentum

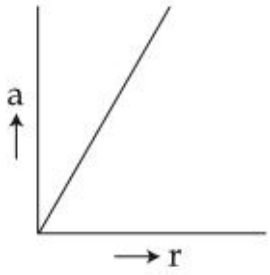
$$\mathrm{L} = \mathrm{IW}$$
$$mv\left(\frac{a}{2}\right) = \frac{2}{3}ma^2\omega$$
$$\omega = \frac{3v}{4a} = 5$$
Hence, the answer is option (1).

Q. 32 If a body moving in a circular path maintains a constant speed of 10 ms^{-1}, then which of the following correctly describes the relation between acceleration and radius?

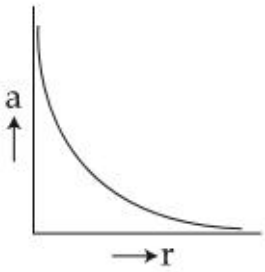
Option 1:



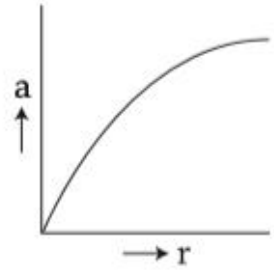
Option 2:



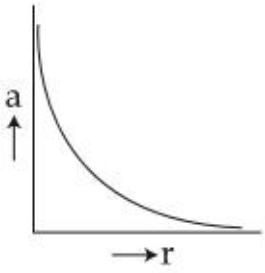
Option 3:



Option 4:



Correct Answer:



Solution:
As we learnt in

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.The acceleration produced by this force is centripetal acceleration.

a=\frac{v^2}{r}

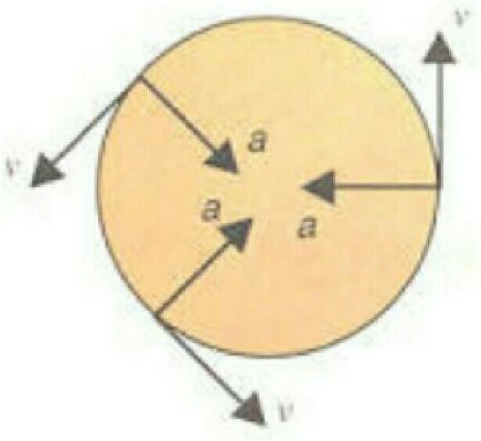


Figure Shows Centripetal acceleration

$$a = \frac{v^2}{r} \cdots |\vec{v}| = \text{ constant}$$
$$a \propto \frac{1}{r} \text{ or } ar = \text{ constant}$$

Therefore, the graph between a and r will be a hyperbola.

Hence, the answer is option (3).

Q. 33 A rifle fires a bullet. Immediately after the bullet is fired, which of the following is NOT true?

Option 1:
the rifle and the bullet have the same magnitude of momentum

Option 2:
the force on the rifle due to the bullet and the force on the bullet due to the rifle have the same magnitude

Option 3:
the rifle and the bullet do not have the same kinetic energy

Option 4:
the rifle and the bullet have the same kinetic energy

Correct Answer:
the rifle and the bullet have the same kinetic energy

Solution:
As we learned in

Perfectly Elastic Collision -

The law of conservation of momentum and that of Kinetic Energy hold good.

- wherein

$$\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2=\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2$$
$$m_1u_1+m_2u_2=m_1v_1+m_2v_2$$
$$m_1,m_2:\ \text{masses}$$

u_1, v_1: initial and final velocity of the mass m_1
u_2, v_2: initial and final velocity of the mass m_2

The rifle and the bullet have the same Kinetic energy.

Hence, the answer is the option (4).

Q. 34 Who among the following first gave the experimental velocity of G?

Option 1:
Cavendish

Option 2:
Copernicus

Option 3:
Brook Taylor

Option 4:
none of these

Correct Answer:
Cavendish

Q. 35 Two simple pendulums of length 5 m and 20 m respectively are given small linear displacement in one direction at the same time. They will again be in the phase when the pendulum of shorter length has completed how many oscillations

Option 1:
5

Option 2:
2

Option 3:
1

Option 4:
3

Correct Answer:
2

Solution:
As we learnt in

Time period of oscillation of simple pendulum -

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

- wherein

$\mathrm{I} =$ length of pendulum

$\mathrm{g} =$ acceleration due to gravity.

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

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

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

$\therefore N_S = 2$

Hence, the answer is the option(2).

More than one correct answer (36 to 40)

Q.36 The electric field of a plane electromagnetic wave $\overrightarrow{\mathbf{E}}(x, y, z, t)=E_0 \hat{n} e^{i k, \cdots}[(x+y+z)-c t]$ where c is the speed of light in free space. $\overrightarrow{\mathrm{E}}$ field is polarized in the $x-z$ plane. The speed of wave is v in the medium. Then

(A) $\hat{\mathrm{n}}=\hat{\mathrm{i}}-\hat{\mathrm{k}} ; \mathrm{v}=\mathrm{c}$.

(B) $\hat{\mathrm{n}}=\frac{\hat{\mathrm{i}}-\hat{\mathrm{k}}}{\sqrt{2}} ; v=\frac{\mathrm{c}}{\sqrt{3}}$.

(C) refractive index of the medium is $\sqrt{3}$.

(D) $\hat{\mathrm{n}}=\frac{\hat{\mathrm{i}}+\hat{\mathrm{k}}}{\sqrt{2}} ; v=\frac{c}{\sqrt{2}}$.

Q.37 Monochromatic light of wavelength $\lambda=4770$ is incident separately on the surfaces of four different metals $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . The work functions of $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D are $4.2 \mathrm{eV}, 3.7 \mathrm{eV} .3 .2 \mathrm{eV}$ and 2.3 eV , respectively. The metal/metals from which electrons will be emitted is / are

(A) A, B, C and D

(B) B, C and D

(C) C and D

(D) D only

Q. 38 Consider the integral form of the Gauss' law in electrostatics

$\overrightarrow{\mathrm{E}} \cdot \overrightarrow{\mathrm{dS}}=\frac{\mathrm{Q}}{\epsilon_0}$

Which of the following statements are correct?

(A) It contains law of Coulomb.

(B) It contains superposition principle.

(C) An elementary patch on the enclosing surface is a polar vector.

(D) An elementary patch on the enclosing surface is a pseudo-vector.

Q.39 A charged particle of charge q and mass m is placed at a distance $2R$ from the centre of a vertical cylindrical region of radius R where magnetic field varies as $\vec{B}=\left(4t^2-2t+6\right)\hat{k}$, where t is time. Then which of the following statement(s) is/are true?

(A) Induced electric field lines form closed loops.

(B) Electric field varies linearly with r if $\mathrm{r}<\mathrm{R}$, where r is the radial distance from the centerline of the cylinder.

(C) The charged particle will move in clockwise direction when viewed from top.

(D) Acceleration of the charged particle is $\frac{7 \mathrm{q}}{2 \mathrm{~m}}$ when $\mathrm{t}=2 \mathrm{sec}$.

Q.40 A uniform magnetic field B exists in a region. An electron of charge q and mass m moving with velocity v enters the region in a direction perpendicular to the magnetic field. Considering Bohr angular momentum quantization, which of the following statement(s) is/are true ?

(A) The radius of n^{th} orbit $\mathrm{r}_{\mathrm{n}} \propto \sqrt{\mathrm{n}}$.

(B) The minimum velocity of the electron is $\frac{\sqrt{\mathrm{qB} \hbar}}{\mathrm{m}}$.

(C) Energy of the n^{th} level $\mathrm{E}_{\mathrm{n}} \propto \mathrm{n}$.

(D) Transition frequency ω between two successive levels is independent of n .

Chemistry

Q. 1 Value of ΔG and ΔG^0 at equilibrium condition will be

Option 1:
$\Delta G \neq 0, \Delta G^0 = 0$

Option 2:
$\Delta G = 0, \Delta G^0 = 0$

Option 3:
$\Delta G \neq 0, \Delta G^0 \neq 0$

Option 4:
$\Delta G = 0, \Delta G^0 \neq 0$

Correct Answer:
$\Delta G = 0, \Delta G^0 \neq 0$

Solution:
as we learn

Thermodynamics of the reaction -

$\triangle G < 0$

- wherein

The reaction is spontaneous and proceeds in the forward direction.

at equilibrium condition $\Delta G = 0, \Delta G^0 \neq 0$

Hence, the answer is the option (4).

Q. 2 The order of relative case of dehydration of Alcohols :

Option 1:
1° alcohol $> 2^\circ$ alcohol $> 3^\circ$ alcohol

Option 2:
3° alcohol $>2^{\circ}$ alcohol $>1^{\circ}$ alcohol

Option 3:
2° alcohol $>1^{\circ}$ alcohol $>3^{\circ}$ alcohol

Option 4:
None of these

Correct Answer:
3° alcohol $>2^{\circ}$ alcohol $>1^{\circ}$ alcohol

Solution:
As we learned

Dehydration of alcohols -

Ease of dehydration

$3^{\circ}>2^{\circ}>1^{\circ}$
- wherein

$\mathrm{CH_3CH_2OH+\ Conc.\ H_2SO_4 \xrightarrow{443\ K} CH_2=CH_2+H_2O}$
$3^{\circ}\ \text{alcohol}\ >2^{\circ}\ \text{alcohol}\ >1^{\circ}\ \text{alcohol}$

Because of the stability order of carbonation formed

Hence, the answer is the option (2).

Q. 3 Alcohol reacts with hydrogen halides to form

Option 1:
Water

Option 2:
alkyl halide

Option 3:
Both (a) and (b)

Option 4:
None of these

Correct Answer:
Both (a) and (b)

Solution:
As we learned

Alcohol reaction with hydrogen halides -

Forms alkyl halides.

- wherein

$$\mathrm{ROH + HX \rightarrow RX + H_2O}$$
$$\mathrm{R - OH + HI \rightarrow R - I + H_2O}$$

Hence, the answer is the option (3).

Q. 4 Alcohols are converted into alkyl halides using

Option 1:
PBr_3

Option 2:
$SOCl_2$

Option 3:
P_4+I_2

Option 4:
All of the above

Correct Answer:
All of the above

Solution:
As we learned

Alcohols reaction with phosphorus trihalides -

Form alkyl halides

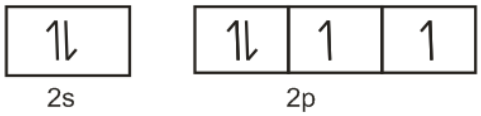
- wherein

$$\mathrm{ROH + PX_3 \rightarrow RX + H_3PO_3}$$
$$\mathrm{x = Cl, Br, I}$$
$$\mathrm{3ROH + PBr_3 \rightarrow 3RBr + H_3PO_3}$$
$$\mathrm{ROH \xrightarrow{P_4+I_2} R - I}$$
$$\mathrm{R - OH + SOCl_2 \rightarrow RCl + SO_2 + Cl_2}$$

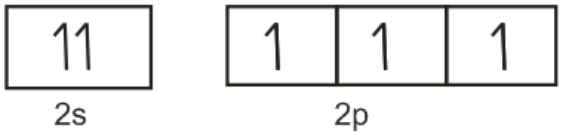
Hence, the answer is the option (4).

Q. 5 Which of the following sets violate the Hund's rule

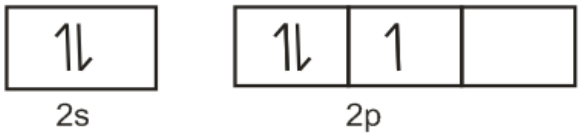
Option 1:



Option 2:

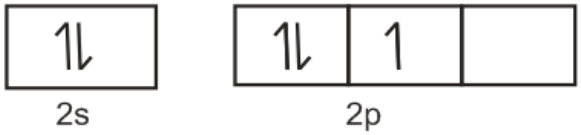


Option 3:



Option 4:
Both B and C

Correct Answer:



Solution:
As we learned

The pairing of electrons in generated orbitals occurs after the filling of unpaired electrons in each orbital.

Hence, the answer is the option (3).

Q. 6 Ratio of energy of two photons having wavelengths 4000 A^0 and 9000 A^0

Option 1:
4:9

Option 2:
9:4

Option 3:
16:81

Option 4:
81:16

Correct Answer:
9:4

Solution:
The energy (E) of a quantum of radiation -

$$E = hv$$

Where h is plank's constant and ν is frequency

$$E = \frac{\lambda C}{\lambda}$$
$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$$

Hence, the answer is the option (2).

Q. 7 Shape of 2s orbital is :-

Option 1:
Spherical with zero nodes

Option 2:
Spherical with one nodes

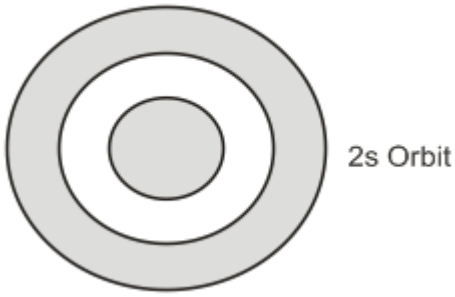
Option 3:
Dumble with one node

Option 4:
Dumble with zero node

Correct Answer:
Spherical with one nodes

Solution:
The shape of s orbital -

spherical



Hence, the answer is the option (2).

Q. 8 Isopropyl cation is

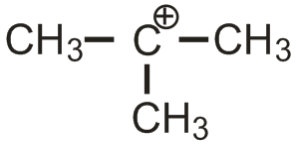
Option 1:
$CH_3-\overset{\oplus}{C}H_2$

Option 2:
$CH_3-CH_2-\overset{\oplus}{C}H_2$

Option 3:

$CH_3-\overset{\oplus}{C}H-CH_3$

Option 4:



Correct Answer:

$CH_3-\overset{\oplus}{C}H-CH_3$

Solution:
As we learned

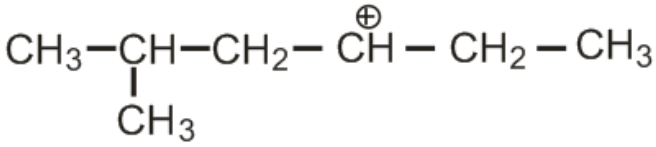
Isopropyl carbocation is a 2° cation.

$CH_3-\overset{\oplus}{C}H-CH_3$

It is an isopropyl cation.

Hence, the answer is the option (3).

Q. 9 How many α-Hydrogen atoms are there in the given carbocation?



Option 1:
4

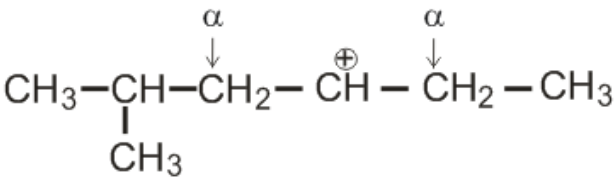
Option 2:
9

Option 3:
5

Option 4:
15

Correct Answer:
4

Solution:
As we learned



The Sp^3 carbon adjacent to $C^{\oplus}$ is $\alpha-$ carbon and the hydrogen attached to $\alpha - C$ are $\alpha - H$ there are $4\alpha - H$ is this cation

Hence, the answer is the option (1).

Q. 10 Which of the following does lead to the formation of ethanol:

Option 1:

$(C_2H_5)_2O \xrightarrow[\Delta]{\text{dil. } H_2SO_4}$

Option 2:

$CH_3COOH \xrightarrow{LiAlH_4}$

Option 3:

$CH_3CH_2COOHH \xrightarrow{LiAlH_4}$

Option 4:

None of these

Correct Answer:

$CH_3COOH \xrightarrow{LiAlH_4}$

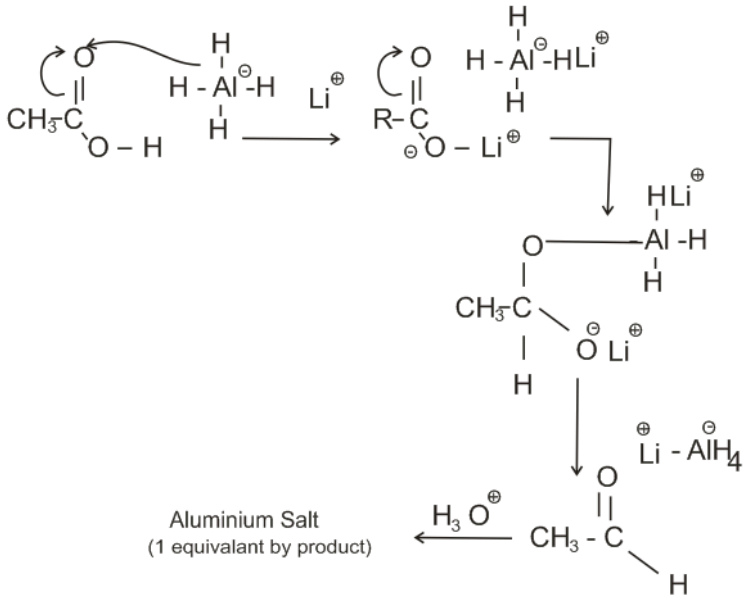
Solution:

As we learned

$CH_3COOH \xrightarrow{LiAlH_4} CH_3CH_3 - OH$ [Reduction of carboxylic Acid]

$CH_3COOH \xrightarrow{LiAlH_4} CH_3 - CH_2 - OH$

Mechanism



Hence, the answer is the option (2).

Q. 11 $CH_3COOCH_3 \xrightarrow[Ni/Pd/Pt]{H_2} 'A' + 'B'$

Now the products 'A' and 'B' are respectively

Option 1:
CH_3CH_2OH and $CH_3 - OH$

Option 2:
$CH_3 - OH$ and CH_3CHO :

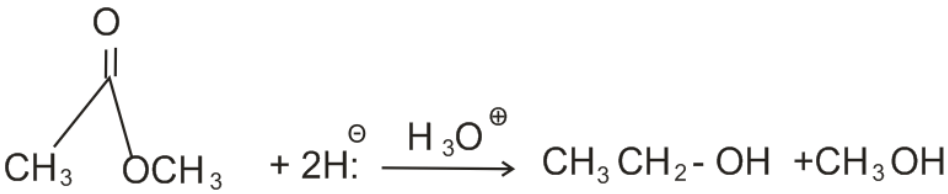
Option 3:
Both (a) and (b)

Option 4:
none of these.

Correct Answer:
CH_3CH_2OH and $CH_3 - OH$

Solution:

$$CH_3COOCH_3 \xrightarrow[H_2/Ni/pt/pd]{Reduction} CH_3CH_2 - OH + CH_3 - OH$$



Hence, the answer is the option (1).

Q. 12 Reduction of carboxyl compounds and ester to alcohol by using alcoholic sodium, the reaction is

Option 1:
Bouveault - Blanc Reduction

Option 2:
Schotten - Boumann Reaction

Option 3:
Arndt - eistert Reaction

Option 4:
None

Correct Answer:
Bouveault - Blanc Reduction

Solution:
As we learned,

Bouveault Balance reduction -

Reduction of carboxyl compounds and esters to alcohols by using alcoholic sodium.

- wherein

$$\mathrm{RCOOR'} \xrightarrow[\text{alcohol}]{\mathrm{Na}} \mathrm{RCH_2OH} + \mathrm{R'OH}$$

Hence the answer is the option (1)

Q. 13 Which of the following is true about photochemical smog?

Option 1:
It is reducing in nature

Option 2:
It is formed in water

Option 3:
It is a mixture of smoke and fog and Sulphur dioxide

Option 4:
It causes irritation in eyes

Correct Answer:
It causes irritation in eyes

Solution:
As we have learned,

Photochemical smog is an oxidizing smog formed in a warm, dry, and sunny climate. Its main constituents are Nitrogen oxides, unburnt hydrocarbons, Ozone, formaldehyde, and peroxyacetyl nitrate. It irritates the eyes. SO_2 is a component of classical smog and not Photochemical Smog.

Hence, the answer is the option (4).

Q. 14 Fill in the blanks with most appropriate option:

A protein in its _____ form , is biologically functional.

Option 1:
uncoiled

Option 2:
helical

Option 3:
altered

Option 4:
native

Correct Answer:
native

Solution:
As we have learnt,

Native protein - A protein with a unique three-dimensional structure and biological activity.

Protein is functional in its native form.

Hence, the answer is the option (4).

Q. 15 The process responsible for absorption of water in an egg after boiling it is _____

Option 1:
modification

Option 2:
Alteration

Option 3:
Denaturation

Option 4:
Absorption

Correct Answer:
Denaturation

Solution:
As we have learnt,

Denaturation of protein - The change in the shape of the protein that disrupts its function. Secondary and tertiary structures are destroyed but the primary structure remains intact.

It occurs due to :

1. Temperature change
2. pH change
3. UV rays
4. X-rays, etc

Denaturation of protein takes place and the globular proteins present in it change and absorb all the water by hydrogen bonding.

Hence, the answer is the option (3).

Q. 16 In extraction of Al_2O_3 by bayers process the main impurity is

Option 1:
$Al(OH)_3$

Option 2:
FeO

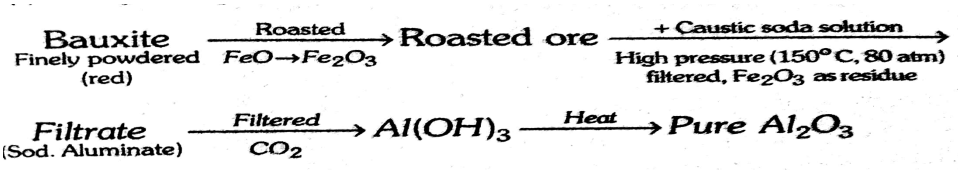
Option 3:
Cr_2O_3

Option 4:
Fe_2O_3

Correct Answer:
Fe_2O_3

Solution:
Bayer's Process - Use to refine red bauxite containing Fe_2O_3 as main impurity

- wherein



The main impurity in extraction of alumina is Fe_2O_3.

Hence, the answer is the option (3).

Q. 17 In Hall's process a precipitate which on heating gives Al_2O_3 hence the precipitae is

Option 1:
$Al_2O_3 \cdot H_2O$

Option 2:
$Al(OH)_3$

Option 3:
Al_2O_3

Option 4:
$AL_2(SO_4)_3$

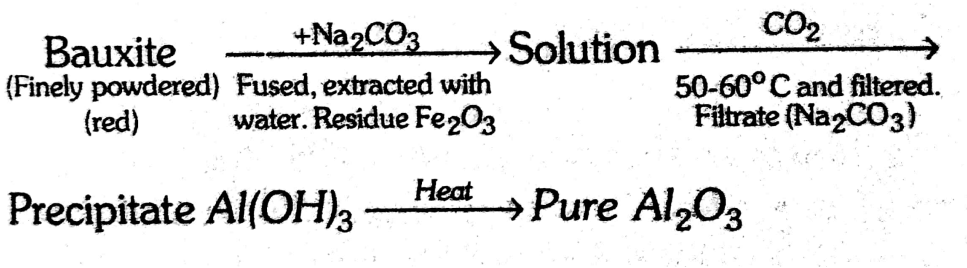
Correct Answer:
$Al(OH)_3$

Solution:
As we have learned

Hall's Process -

Use to refine red bauxite containing Fe_2O_3 as the main impurity

- wherein



$$Al(OH)_3 \xrightarrow{\text{Heat}} Al_2O_3$$

precipitate pure

Hence, the answer is the option (2).

Q. 18 The SRP values for the following elements are given

$$P^{+3} + 3e \rightarrow P \quad \epsilon^0 = 1.70v$$
$$Q^{2+} + 2e \rightarrow Q \quad \epsilon^0 = -2.1v$$
$$R^{+} + e \rightarrow R \quad \epsilon^0 = -1.2v$$
$$S^{+2} + 2e \rightarrow S \quad \epsilon^0 = 1.3v$$

Which of the following combinations will give a cell of maximum voltage.

Option 1:
P and Q

Option 2:
P and R

Option 3:
P and S

Option 4:
R and S

Correct Answer:
P and Q

Solution:
As we learned

Electrochemical series -

The standard reduction potential of a large number of electrodes has been measured using a standard hydrogen electrode as the reference electrode. These various electrodes can be arranged in increasing electrode potential.

For P standard reduction potential is maximum and for Q, SOP is max, so if P is taken as cathode and R is taken as anode, then the cell gives maximum voltage.

Hence, the answer is the option (1).

Q. 19 EMF of the cell reaction

$2\mathrm{Ag}^{+} + \mathrm{Cu} \rightarrow 2\mathrm{Ag} + \mathrm{Cu}^{+2}$ is 0.46 v . If $\mathrm{E}^0\mathrm{Cu}^{2+}/\mathrm{Cu}$ is +0.34 v , then $E^0\mathrm{Ag}^{+}/\mathrm{Ag}$ will be :-

Option 1:
0.80 v

Option 2:
0.12 v

Option 3:
0.40 v

Option 4:
1.60 v

Correct Answer:
0.80 v

Solution:
As we learned

M(s) is Solid -

[M] = 1

- wherein

$$E_{M^{n+}/M} = E^0_{M^{n+}/M} - \frac{RT}{nf}\ln\frac{1}{[M^{n+}]}$$

$$E^0\text{cell} = E^0\text{Cu}/\text{Cu}^{+2} + E^0\text{Ag}^+/\text{Ag}$$

$$0.46 = -0.34 + E^0\text{Ag}^+/\text{Ag}$$

$$\Rightarrow E^0\text{Ag}^+/\text{Ag} = 0.80$$

Hence, the answer is option (1).

Q. 20 Which of the following is a secondary battery .

Option 1:
Leclanche cell

Option 2:
Mercury cell

Option 3:
Lead storage battery

Option 4:
Both B and C

Correct Answer:
Lead storage battery

Solution:
As we learned

Lead storage battery can be used again and again so it is a secondary battery.

Hence, the answer is the option (3).

Q. 21 The reduction of acid chloride using $\mathrm{H_2/pd-BaSO_4}$ gives aldehyde, the Reaction is:-

Option 1:
Etard Reaction

Option 2:
Rosenmund Reduction

Option 3:
Kuchemovs Reaction

Option 4:
None of these

Correct Answer:
Rosenmund Reduction

Solution:
As we learned

Rosenmund's reaction -

Acid chlorides are reduced in boiling xylene using Pd / Pt along with $BeSO_4$ or quinoline is used to poison Pd / Pt to stop reduction of aldehyde further.

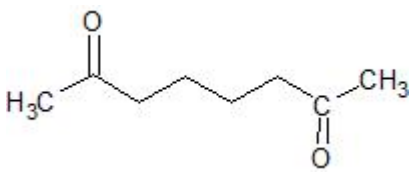
- wherein

$$\mathrm{RCOCl_2 + H_2 \rightarrow RCHO + HCl}$$

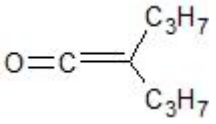
Rosenmund's Reaction:- Acid chloride reduced to aldehyde using $\mathrm{H_2/BaSO_4}$

Hence, the answer is the option (2).

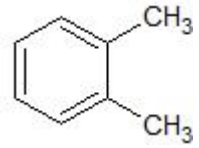
Q. 22 Identify the is alkene which undergoes ozonolysis to produce



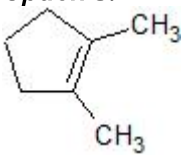
Option 1:



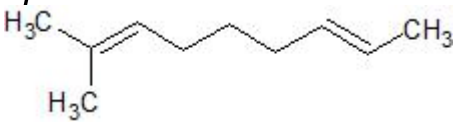
Option 2:



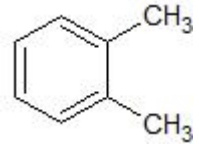
Option 3:



Option 4:



Correct Answer:



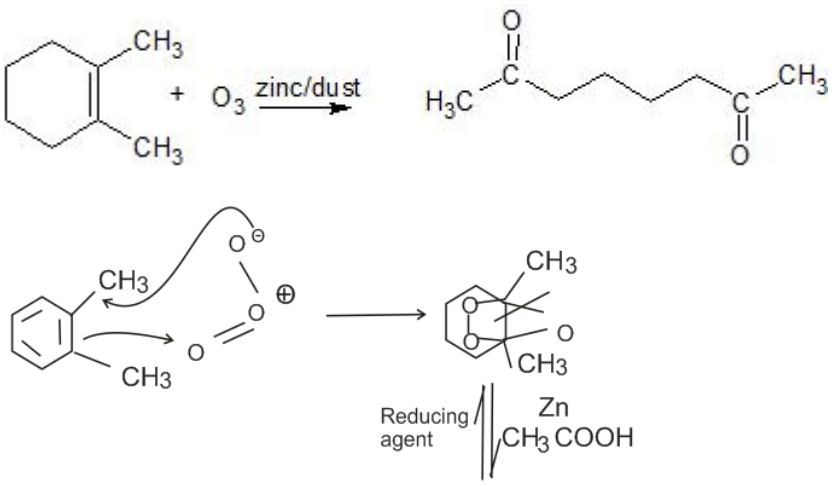
Solution:
As we learned

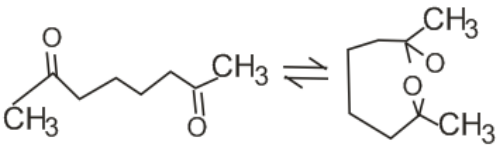
Reductive Ozonolysis of alkenes -

In the presence of Zn dust and H_2O gives aldehyde.

- wherein

$$\mathrm{RCH=CHR+O_3\rightarrow 2RCHO+H_2O_2}$$





Hence, the answer is the option (2).

Q. 23 Nitriles reduced with $SnCl_2$ in the presence of HCl, which on hydrolysis gives aldehyde, the Rxn is:

Option 1:
Stephen Reaction

Option 2:
Rosenmund Reduction

Option 3:
Etard Reaction

Option 4:
None of these

Correct Answer:
Stephen Reaction

Solution:
Stephen Reaction

$$RCN + SnCl_2 + HCl \rightarrow \underset{\downarrow}{RCH{=}NH} \\ RCHO$$

Hence, the answer is the option (1).

Q. 24 The in correct ststment about metalic solid is

Option 1:
Metals are highly mateable and ductile

Option 2:
conduct electricity in molten state

Option 3:
Metallic solid are colourless

Option 4:
both (b) and (c)

Correct Answer:
Metallic solid are colourless

Solution:
As we learn

Metallic solids -

Metallic bond, i.e., the attraction between the positively charged metal ion and mobile electron.

- wherein

Ex. iron, copper, zinc, aluminium, sodium

Metallic solids possess color.

Hence, the answer is the option (3).

Q. 25 A gas cylinder containing LPG can withstand a pressure of 16 atm. The pressure gauze of the cylinder indicates 12 atm at 300K. Due to a sudden fire in the building, the temperatures start rising. At what temperature cylinder will explode

Option 1:
400 K

Option 2:
350 K

Option 3:
450K

Option 4:
500 K

Correct Answer:
400 K

Solution:
As we learn

Given $P_2 = 16\ \text{atm}, P_1 = 12\ \text{atm}, T_1 = 300\ \text{K}, T_2 = ?$

since volume remains constant

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$
$$T_2 = \frac{16}{12} \times 300 = 400\ \text{K}$$

Hence, the answer is the option (1).

Q. 26 Which of the following is not a property of ionic solid

Option 1:
Form 3D structure

Option 2:
The ions are free to move

Option 3:
(b) and (d)

Option 4:
The electrical insulator in a solid state

Correct Answer:
The ions are free to move

Solution:
As we learn

In Ionic solids, the ionic bond is present between cation and anion. They are generally hard and brittle. But Ions in ionic solids are not free to move.

Hence, the answer is the option (2).

Q. 27 The d- electron configuration , $e^4t_2^3$ corresponds to the complex ion

Option 1:
$[\text{FeCl}_4]^{2-}$

Option 2:
$[\text{Co(Spb)}_4]$

Option 3:
$[\text{CoCl}_4]^{2-}$

Option 4:
$[Co(H_2O)_6]^{2+}$

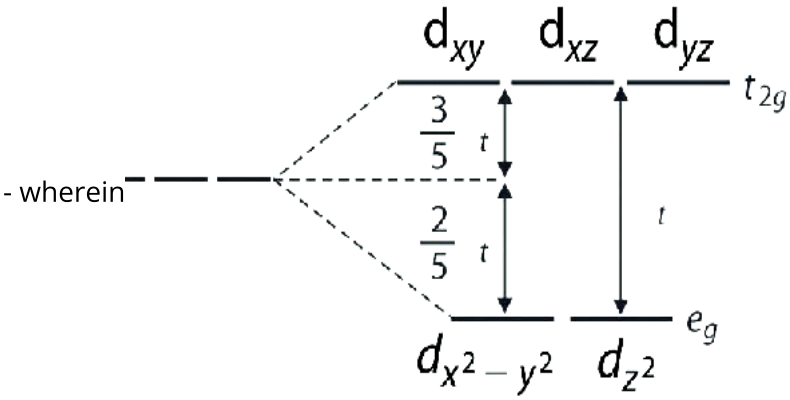
Correct Answer:
$[CoCl_4]^{2-}$

Solution:
As we have learned

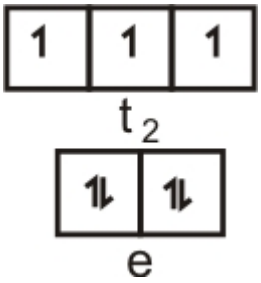
Crystal field splitting in tetrahedral complexes -

t_{2g} orbitals have more value of energies as compared to e_g

- wherein



$Co^{2+} 4sp^3d^2$(high spin)



tetrahedral splitting

Hence, the answer is the option (3).

Q. 28 Which one of the following ions has zero CFSE in the octahedral field?

Option 1:
Fe^{3+} (Low Spin)

Option 2:
Fe^{3+} (High Spin)

Option 3:
Co^{+2} (low Spin)

Option 4:
Cr^{+3} (High Spin)

Correct Answer:
Fe^{3+} (High Spin)

Solution:
As we have learned

CFSE in the octahedral complex -

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

$$\rightarrow f^{+3} \rightarrow d^5(\text{ high spin })$$

$$CFFSE = \left[-\frac{2}{5}(3) + \frac{3}{5}(2)\right] \triangle_o = 0$$

-**Hence, the answer is the option (2).**

Q. 29 Which of the following hydroxide is soluble in excess NaOH?

Option 1:
$Be(OH)_2$

Option 2:
KoH

Option 3:
$Mg(OH)_2$

Option 4:
$\mathrm{Ca(oH)_2}$

Correct Answer:
$Be(OH)_2$

Solution:
$Be(OH)_2$ is amphoteric is nature so it is soluble in excess NaoH to form $\mathrm{Be}\left(\mathrm{OH}_4^{-2}\right)$.

Hence, the correct answer is option (1).

Q. 30 Which of the following metal hydroxide has most basic nature:

Option 1:
LiOH

Option 2:
NaOH

Option 3:
KOH

Option 4:
RbOH

Correct Answer:
RbOH

Solution:
As we learn

In Alkali metal hydroxides, the basic character increases down the group as:
$\mathrm{LiOH} < \mathrm{NaOH} < \mathrm{KOH} < \mathrm{RbOH} < \mathrm{CsOH}$

Hence, the answer is the option (4).

Q. 31 An aqueous solution contains a substance which yeilds $4x10^{-3}$ mol/l ion of H_3O^{+}. If log 2=0.3010 then PH of the solution is:

Option 1:
1.5

Option 2:
2.398

Option 3:
3.0

Option 4:
3.4

Correct Answer:
2.398

Solution:
As we learnt in

The p(H) scale -

Hydronium ion concentration in molarity is more conveniently expressed on a logarithmic scale known as p(H) scale.

- wherein

The p(H) of a solution is defined as negative logarithm to base 10 of the activity of hydrogen ion

$$P(H) = -\log\left[H^{+}\right]$$

$$\left[H^{+}\right] = 4 \times 10^{-3}\mathrm{M}$$

then $pH = -\log\left(H^{+}\right)$

$$= -\log\left(4 \times 10^{-3}\right)$$
$$= 3 - 2\log 2 = 3 - 2 \times 0.301 = 2.398$$

Hence, the answer is the option (2).

Q. 32 Vant Hoff's equation giving the effect of temperature on chemical equilibrium is represented as:

Option 1:
$\frac{dlnF}{dt} = \frac{\Delta H}{RT^2}$

Option 2:
$\frac{dI_nK_p}{dt} = \frac{DHT^2}{R}$

Option 3:
$\frac{dI_nK_p}{dt} = \frac{\Delta H}{RT^2}$

Option 4:
$\frac{dI_nK_p}{dt} = \frac{RT^2}{\Delta H}$

Correct Answer:
$\frac{dI_nK_p}{dt} = \frac{\Delta H}{RT^2}$

Q. 33 Dead burnt plaster is

Option 1:
$\mathrm{CaSO_4 \cdot 2H_2O}$

Option 2:
$\mathrm{2CaSO_4 \cdot H_2O}$

Option 3:
$\mathrm{CaSO_4}$

Option 4:
$\mathrm{CaSO_4 \cdot H_2O}$

Correct Answer:
$\mathrm{CaSO_4}$

Solution:
As we learnt in

Dead burnt plastic -

Gypsum when heated above 393K, no water of crystallisation is left and anhydrous $\mathrm{CaSO_4}$ is formed

-

Plaster of Paris, the hemihydrate of Calcium Sulphate, when heated to a high temperature, loses all water of crystallization and the product is dead burnt plaster or $CaSO_4$.

Hence, the answer is the option (3).

Q. 34 The absolute configuration of D and L glyceraldehyde are respectively.

Option 1:
R, R

Option 2:
S, R

Option 3:
S, S

Option 4:
R, S

Correct Answer:
R, S

Solution:
The structures of D and L Glyceraldehyde are given below :

We assign priority as per the CIP rule. In D Glyceraldehyde, the rotation appears to be counterclockwise but the least prior group is towards us, hence the configuration is R.

In L. Glyceraldehyde, the rotation appears to be clockwise, but the least prior group is towards us, hence the configuration is S.

Hence, the answer is the option (4).

Q. 35 What is the total number of stereoisomers possible for the following compound?

CH_3-CH(Br)-CH(Br)-CH(Br)-CH_2OH

Option 1:
2

Option 2:
4

Option 3:
6

Option 4:
8

Correct Answer:
8

Solution:
CH_3-CH(Br)-CH(Br)-CH(Br)-CH_2OH

The given molecule is not symmetrical and it contains 3 chiral centres. There are two orientations possible at every chiral carbon. Hence, the total number of stereoisomers is $2^3 = 8$

Hence, the answer is the option (4).

Q. 36 More than one correct answer (36 to 40)

Q. 36 Identify the correct statement(s) :
(A) The oxidation number of Cr in CrO_5 is +6
(B) $\Delta H > \Delta U$ for the reaction $N_2O_4(g) \rightarrow 2NO_2$ (g), provided both gases behave
(C) pH of 0.1 (N) H_2SO_4 is less than that of 0.1 (N) HCl at $25^\circ C$ ideally
(D) $\left(\frac{RT}{F}\right) = 0.0591$ volt at $25^\circ C$

Q. 37 Which of the following statements about the S_N2 reaction mechanism is/are true?
(A) The rate of reaction increases with increasing nucleophilicity.
(B) The number 2 denotes a second order reaction.
(C) Tertiary butyl substrates do not follow this mechanism.
(D) The optical rotation of substrates always changes from $(+)$ to $(-)$ or from $(-)$ to $(+)$ in the products.

Q.38 Which of the following statement/statements is/are correct?
(A) Solid I_2 is freely soluble in water
(B) Solid I_2 is freely soluble in water but only in presence of excess KI
(C) Solid I_2 is freely soluble in CCl_4
(D) Solid I_2 is freely soluble in hot water

Q.39 The correct set(s) of reactions to synthesize benzoic acid starting from benzene is/are
(A) (i) Br_2/Fe
(ii) Mg / dry ether
(iii) CO_2
(iv) $H_3O^\oplus$
(B) (i) Br_2/Fe
(ii) $NH_3, 25^\circ C$
(iii) $NaNO_2$, dil. $HCl, 0^\circ$ to $5^\circ C$
(iv) $CuCN/KCN$
(v) dil. HCl, Δ
(C) (i) CH_3Cl, Anhydrous $AlCl_3$
(ii) $KMnO_4$ $|\overset{\ominus}{O}$ H, Δ (iii) $H_3\overset{\oplus}{O}$
(D) (i) CH_3COCl, Anhydrous $AlCl_3$
(ii) $Br_2, NaOH$
(iii) $H_3O^\oplus$

Q.40 Which statement(s) is/are applicable above critical temperature ?
(A) A gas cannot be liquified.
(B) Surface tension of a liquid is very high.
(C) A liq. phase cannot be distinguished from a gas phase.
(D) Density changes continuously with P or V .

More than one correct answer (66 to 75)

Q. 66 The function $\mathrm{f}: \mathbb{R} \rightarrow \mathbb{R}$ defined by $\mathrm{f}(x)=\mathrm{e}^{x}+\mathrm{e}^{-x}$ is :
(A) one-one
(B) onto
(C) bijective
(D) not bijective

Q. 67 If $a_i, b_i, c_i \in \mathbb{R}(i=1,2,3)$ and $x \in \mathbb{R}$ and $\begin{vmatrix} a_1+b_1x & a_1x+b_1 & c_1 \\ a_2+b_2x & a_2x+b_2 & c_2 \\ a_3+b_3x & a_3x+b_3 & c_3 \end{vmatrix}=0$, then
(A) $x=1$
(B) $x=-1$
(C) $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}=0$
(D) $x=2$

Q. 68 If ABC is an isosceles triangle and the coordinates of the base $B(1,3)$ and $C(-2,7)$. The coordinates of A can be
(A) $(1,6)$
(B) $\left(-\frac{1}{8}, 5\right)$
(C) $\left(\frac{5}{6}, 6\right)$
(D) $\left(-7, \frac{1}{8}\right)$

Q.69 A square with each side equal to 'a' above the x-axis origin. One of the sides passing through the origin makes an angle $\alpha\left(0<\alpha<\frac{\pi}{4}\right)$ with the positive direction of the axis. Equation of the diagonals of the square

(A) $y(\cos \alpha-\sin \alpha)=x(\sin \alpha+\cos \alpha)$
(B) $\mathrm{y}(\cos \alpha+\sin \alpha)=x(\cos \alpha-\sin \alpha)$
(C) $y(\sin \alpha+\cos \alpha)+x(\cos \alpha-\sin \alpha)=a$
(D) $\mathrm{y}(\cos \alpha-\sin \alpha)+x(\cos \alpha+\sin \alpha)=\mathrm{a}$

Q.70 Choose the correct statement :
(A) $x+\sin 2x$ is a periodic function
(B) $x+\sin 2x$ is not a periodic function
(C) $\cos(\sqrt{x}+1)$ is a periodic function
(D) $\cos(\sqrt{x}+1)$ is not a periodic function

Q.71 $\text{The points of extremum of } \int_0^{x^2} \frac{t^2-5t+4}{2+e^t}dt \text{ are}$

(A) ± 1
(B) ± 2
(C) ± 3
(D) $\pm \sqrt{2}$

Q.72

Let Γ be the curve $y=be^{-x/a} \& L$ be the straight line $\frac{x}{a}+\frac{y}{b}=1$ where $a, b \in \mathbb{R}$.

Then
(A) L touches the curve Γ at the point where the curve crosses the axis of y.
(B) L does not touch the curve at the point where the curve crosses the axis of y.
(C) Γ touches the axis of x at a point.
(D) Γ never touches the axis of x.

Q.73 The acceleration $\mathrm{fft/sec}^2$ of a particle after a time t sec starting from rest is given by $f=6-\sqrt{1.2t}$. Then the maximum velocity v and time T to attend this velocity are

(A) $\mathrm{T}=20\mathrm{sec}$
(B) $\mathrm{v}=60\mathrm{ft/sec}$
(C) $\mathrm{T}=30\mathrm{sec}$
(D) $\mathrm{v}=40\mathrm{t/sec}$

Q 74 If the quadratic equation $ax^2+bx+c=0(a>0)$ has two roots α and β such that $\alpha<-2$ and $\beta>2$, then

(A) $\mathrm{c}<0$
(B) $\mathrm{a}+\mathrm{b}+\mathrm{c}>0$
(C) a - b + c <0
(D) $a-b+c>0$

Q.75 If n is a positive integer, the value of $(2n+1)^nC_0+(2n-1)^nC_1+(2n-3)^nC_2+\ldots.+1\cdot {}^n\mathrm{C}_\mathrm{n}$ is
(A) $(n+1)2^n$
(B) 3^n
(C) $f'(2)$ where $f(x)=x^{n+1}$
(D) $(\mathrm{n}+1)2^{\mathrm{n}+1}$

Maths

Q. 1 What should be added to complex no $2+3i$ to get $1-i$

Option 1:
$-1-4i$

Option 2:
$-1+4i$

Option 3:
$1+5i$

Option 4:
$2-4i$

Correct Answer:
$-1-4i$

Solution:
As we learned

Addition of Complex Numbers -

(a+ib)+(c+id)=(a+c)+i(b+d)

$(2+3i)+(a+ib)=1-i$
$(2+a)+i(3+b)=1-i$
$2+a=1, 3+b=-1$
$a=-1, b=-4$

Hence, the correct answer is the option (4)

Q. 2 Find the difference. $z_1=2+i_{\&}z_2=-1+2i$

Option 1:
$i+3$

Option 2:
$3-i$

Option 3:
$3+3i$

Option 4:
None of these

Correct Answer:
$3-i$

Solution:
Given:

$$\begin{aligned} z_1-z_2 &= (2+i)-(-1+2i) \\ &= (2+1)+i(1-2) \\ &= 3-i \end{aligned}$$

Hence, the correct answer is the option 2

Q. 3 Write the equation of Circle with $(-1,2)$ as its centre and 2 as its radius, in argand plane.

Option 1:
$Z+1-2i=2$

Option 2:
$Z+1+2i=-2$

Option 3:
$|Z+1-2i|=2$

Option 4:
$|Z-1+2i|=2$

Correct Answer:
$|Z+1-2i|=2$

Solution:
As we learned

Equation of circle -

$|z-z_0|=r$
$z_0=$ centre of circle

$r=$ radius of circle
z lies on circle.
- wherein

Locus of z will be a circle as z is always at a fixed distance r from a fixed point z_0

$z=x+iy, z_0=x_0+iy_0$

$|Z-Z_0|=V$
$\Rightarrow |Z-(-1+2i)|=2$
$\Rightarrow |Z+1-2i|=2$

Hence, The answer is the option (3)

Q. 4 What is the $\mathrm{Im}(z)$, Where $z=z_1z_2$ and $z_1=1-i_{\&}z_2=3+ui$

Option 1:
7

Option 2:
-1

Option 3:
1

Option 4:
-7

Correct Answer:
1

Solution:
Definition of Complex Number -

$z=x+iy, x, y \in R_{\&}\mathrm{i}^2=-1$
Real part of $z=\mathrm{Re}(z)=x$ \& Imaginary part of $z=\mathrm{Im}(z)=y$
Multiplication of Complex Numbers -

$(a+ib)(c+id)=(ac-bd)+i(bc+ad)$
$z=z_1z_2=(1-i)(3+4i)$

$=7+i$

Hence, the answer is the Option (3)

Q. 5 What is/are among the following is/are 8^{th} root of unity.

Option 1:
$\cos \frac{10\pi}{8}+i \sin \frac{10\pi}{8}$

Option 2:
i

Option 3:
1

Option 4:
All of the above

Correct Answer:
All of the above

Solution:
As we learned

nth roots of unity -

$z=(1)^{\frac{1}{n}} \Rightarrow z=\cos \frac{2k\pi}{n}+i \sin \frac{2k\pi}{n}$

Where $k=0,1,2,\ldots\ldots,(n-1)$

$(1)\,)^{\frac{1}{8}}=\cos \dfrac{2k\pi}{8}+i \sin \dfrac{2k\pi}{8}$

$k=0,1,2,\cdots,7$

$\text{For } k=2; \quad \cos \dfrac{\pi}{2}+i \sin \dfrac{\pi}{2}=i$

$\text{For } k=5; \quad \cos \dfrac{10\pi}{8}+i \sin \dfrac{10\pi}{8}$

For $k=0, \quad 1$

Hence, the correct answer is the option (4)

Q. 6

Which of the following can be obtained by column transformation of $\begin{bmatrix}1 & 2 & 3\\3 & 4 & 10\\3 & 8 & 4\end{bmatrix}$

Option 1:
$\begin{bmatrix}1 & 2 & 3\\3 & 10 & 4\\3 & 4 & 8\end{bmatrix}$

Option 2:
$\begin{bmatrix}1 & 3 & 10\\3 & 8 & 4\\1 & 2 & 3\end{bmatrix}$

Option 3:
$\begin{bmatrix}1 & 3 & 3\\2 & 4 & 8\\3 & 10 & 4\end{bmatrix}$

Option 4:
$\begin{bmatrix}3 & 1 & 2\\10 & 3 & 4\\4 & 3 & 8\end{bmatrix}$

Correct Answer:
$\begin{bmatrix}3 & 1 & 2\\10 & 3 & 4\\4 & 3 & 8\end{bmatrix}$

Solution:
As we have learnt

Elementary row (column) transformation -

Interchange of any two rows (column)

- wherein

$R_i \leftrightarrow R_j \left(C_i \leftrightarrow C_j\right)$
$C_1 \rightarrow C_3 \text{ then } C_2 \rightarrow C_3$

Hence correct answer is option 4

Q. 7 Position vector of P is (where O is the origin):

Option 1:
$\overrightarrow{PO}$

Option 2:
$\overrightarrow{OP}$

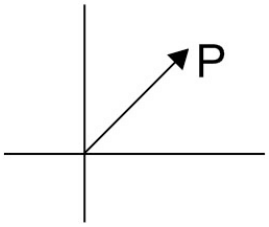
Option 3:
$-\overrightarrow{PO}$

Option 4:
$\overrightarrow{OP} - \overrightarrow{PO}$

Correct Answer:
$\overrightarrow{OP}$

Solution:

Let O be a fixed origin, then position vector of P is $\overrightarrow{OP}$



Hence, the correct answer is the option (1).

Q. 8 For $P = (1, -2, 1)$ and $Q = (2, 3, -2)$, Find $\overrightarrow{PQ}$.

Option 1:
$-\hat{i} + 2\hat{j} + 4\hat{k}$

Option 2:
$-\hat{i} - 5\hat{j} + 3\hat{k}$

Option 3:
$\hat{i} - 3\hat{j} + \hat{k}$

Option 4:
$\hat{i} + 5\hat{j} - 3\hat{k}$

Correct Answer:
$\hat{i} + 5\hat{j} - 3\hat{k}$

Solution:

As we have learnt

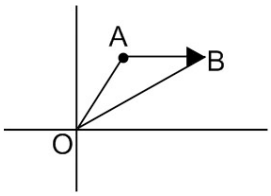
Position Vector -

If $\vec{a}$ and $\vec{b}$ are the position of vectors of two points A and B then

$\overrightarrow{AB} = \vec{b} - \vec{a}$

$\overrightarrow{AB} = P \vee \text{ of } B - P \vee \text{ of } A$

- wherein



$$\overrightarrow{PQ} = \overrightarrow{OQ} - \overrightarrow{OP} = (2\hat{i} + 3\hat{j} - 2\hat{k}) - (\hat{i} - 2\hat{j} + \hat{k})$$
$$= (\hat{i} + 5\hat{j} - 3\hat{k})$$

Hence, the correct answer is option (4).

Q. 9 A unit vector has magnitude=

Option 1:
0

Option 2:
1

Option 3:
5

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

Correct Answer:
1

Solution:
As we have learnt

Unit vector -

A vector of unit magnitude in direction of a vector $\vec{a}$ is called unit vector along $\widehat{a}$.

- wherein

It is denoted by $\widehat{a}$.

Hence, the correct answer is Option 2.

Q. 10 Vector $\vec{a}$ has unit vector, $\hat{a} =$ (where $\vec{a} = \hat{i} - 2\hat{j} + \hat{k}$)

Option 1:
$\frac{\hat{i}-2\hat{j}+\hat{k}}{2}$

Option 2:
$\hat{i} - 2\hat{j} + \hat{k}$

Option 3:
$\frac{\hat{i}-2\hat{j}+\hat{k}}{\sqrt{5}}$

Option 4:
None of these

Correct Answer:
None of these

Solution:
As we have learnt
Unit vector -

$\widehat{a}=\vec{a}/|\vec{a}|$

- wherein

$|\vec{a}|=$ magnitude of $\vec{a}$
$\hat{a}=\frac{\hat{i}-2\hat{j}+\hat{k}}{\sqrt{1+4+1}}=\frac{1}{\sqrt{6}}\hat{i}-\frac{2}{\sqrt{6}}\hat{j}+\frac{1}{\sqrt{6}}\hat{k}$

Hence, the correct answer is Option (4).

Q. 11 Which of the following vectors is/are collinear to $\vec{a}=3\hat{i}-2\hat{j}+5\hat{k}$

Option 1:
$-6\hat{i}+4\hat{j}-10\hat{k}$

Option 2:
$3\hat{i}-2\hat{j}+6\hat{k}$

Option 3:
$\hat{i}-\hat{j}+5\hat{k}$

Option 4:
None of these.

Correct Answer:
$-6\hat{i}+4\hat{j}-10\hat{k}$

Solution:
As we have learnt

Collinear Vectors - Two vectors are said to be collinear if their directed line segments are parallel disregards to their direction.

- wherein

If $\vec{a}$ and $\vec{b}$ are collinear, then $\vec{a}=K\vec{b}$ where $\mathrm{K}\in\mathrm{R}$

$-6\hat{i}+4\hat{j}-10\hat{k}=-2(\vec{a})$
Hence, the correct answers is the option (1)

Q. 12 Evaluate this

$\lim_{n\to\infty}\left(\frac{1}{n^2}+\frac{2}{n^2}+\frac{3}{n^2}+\ldots+\frac{n-1}{n^2}\right)$

Option 1:
1

Option 2:
2

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

Option 4:
None of these

Correct Answer:
$\frac{1}{2}$

Solution:
As we have learned,

Definite Integrals as the limit of a sum -

$\int_0^l f(x)dx=\lim_{x\to\infty}\sum\frac{1}{x}f\left(\frac{r}{x}\right)$

Or
$\int_a^b f(x)dx = \lim_{x\to\infty} h\sum_{r=0}^{x} f(a+rh)$
- wherein

Where $f(x)$ is a continuous function in $[O, l]$

Where $h = \frac{b-a}{x}$ And $f(x)$ is continuous in $[a, b]$

$$S_n = \frac{1}{n^2} + \frac{2}{n^2} + \frac{3}{n^2} + \ldots + \frac{n-1}{n^2}$$
$$= \sum_{r=2}^{n} \frac{r-1}{n^2} = \frac{1}{n}\sum_{r=2}^{n} \frac{r-1}{n}$$
$$\Rightarrow S = \lim_{n\to\infty} \frac{1}{n}\sum_{r=2}^{n} \frac{r}{n}$$

As $n \to \infty$
$\Rightarrow \frac{1}{n} = 0$
$= \int_0^1 x dx = \frac{1}{2}$

Hence, the correct answer is the option (3).

Q. 13 $\int \frac{3dx}{(x+4)(x^2+4)} = Aln(f(x)) + Bln(g(x)) + D\tan'(h(x)) + C$

Then A + B + D is

Option 1:
7/5

Option 2:
2/5

Option 3:
1

Option 4:
4/5

Correct Answer:
1

Solution:
As we have learned

Rule of integration by Partial fraction -

Linear and non-repeated:

$$\frac{P(x)}{Q(x)} = \frac{P(x)}{(x-\alpha_1)(x-\alpha_2)\cdots(x-\alpha_n)}$$
$$\text{Let } \frac{P(x)}{Q(x)} = \frac{A}{(x-\alpha_1)} + \frac{B}{(x-\alpha_2)} \cdots$$

Find A, B...
By comparing N^x and $P(x)$

$$8 = A\left(x^2+4\right) + (Bx+C)(X+4) \ldots . (1)$$
$x = -4$
$A = 8/20 = 2/5$
$0 = A + B \Rightarrow B = -2/5$
$8 = 4A + 4C \Rightarrow C = 2 - A = 8/5$
$$\int \frac{8}{(x+4)(x^2+4)} dx = \int \left(\frac{2\cdot 1}{5\cdot x+4} + \frac{\frac{-2}{5}x + \frac{8}{5}}{x^2+4} \right) dx$$
$$= 1/5 \int \left(\frac{2}{x+4} dx + \frac{-2x+8}{x^2+4} \right) dx$$
$$= \frac{2}{5}\int \frac{1}{x+4} dx - \frac{2}{5}\int \frac{x}{x^2+4} dx + \frac{8}{5}\int \frac{1}{x^2+4} dx$$
$A = 2/5 B = -1/5, D = 4/5$
$$A + B + D = \frac{2-4+4}{5} = 1$$

Hence, the answer is the option (3).

Q. 14 $\int \frac{dx}{(2\cos(x)+2\sin(x))^2} = \frac{1}{A\tan(x)+B} + C$ Then $A - B =$?

Option 1:
8

Option 2:
-8

Option 3:
4

Option 4:
0

Correct Answer:
0

Solution:

$$I = \int \frac{dx}{(2\cos(x)+2\sin(x))^2} = \frac{1}{4}\int \frac{dx}{(\sin(x)+\cos(x))^2}$$
$$= \frac{1}{4}\int \frac{\sec^2(x)dx}{(\tan(x)+1)^2}$$

$$\because \sin(x) = \frac{\tan(x)}{\sec(x)}$$
$$\cos(x) = \frac{1}{\sec(x)}$$
$$\sec^2(x) = \tan^2(x) + 1$$

Put $u = \tan(x)$

$$dx = \frac{1}{\sec^2(x)}du$$
$$I = -4\int \frac{1}{u^2+1}du$$

Again put $u + 1 = v$

$$du = dv$$
$$I = \frac{1}{4}\int \frac{1}{v^2}dv = -\frac{1}{4v} + C$$
$$= -\frac{1}{4(u+1)} + C$$
$$= -\frac{1}{4\tan(x)+4} + C$$

$A = -4$
$B = 4$

Hence, the answer is the option 4.

Q. 15 $\int e^{2x}\left(\frac{\sin 2x - 1}{1-\cos 2x}\right)dx = e^{ax}/af(x) + C Then \quad f'(x) =$?

Option 1:
$\cot(x)$

Option 2:
$\csc(x)$

Option 3:
$-\cot(x)$

Option 4:
$-\csc^2(x)$

Correct Answer:
$-\csc^2(x)$

Solution:
$\int e^{2x}\left(\frac{2\sin x\cos x-1}{2\sin^2 x}\right)dx$
$\int e^{2x}\left(\frac{2\sin x\cos x}{2\sin^2 x}-\frac{1}{2\sin^2 x}\right)dx$
$\int e^{2x}\left(\cot x-1/2\csc^2 x\right)dx$
$\because \int e^{2x}\left(f(x)+\frac{f'(x)}{\alpha}\right)dx=\frac{e^2x}{x}f(x)$
$f(x)=\cot x$
$f'(x)=-\csc^2 x$
so $\int e^{2x}\left(\frac{\sin 2x-1}{1-\cos 2x}dx\right)=\frac{e^{2x}}{2}\cot(x)+C$

$f(x)$=$cot(x)$

$f'(x)$= $-\csc^2(x)$

Hence, the answer is the option (4).

Q. 16 $\int \ln(a)\,(1-1/a^x)e^{ax}dx=ef(x),g(x)+C$ Then $f(x)g(x)=$?

Option 1:
a

Option 2:
1/a

Option 3:
1

Option 4:
-1

Correct Answer:
1/a

Solution:
Result for integration by parts -

$e^{f(x)}\left[g(x)f'(x)+g'(x)\right]dx=e^{f(x)}g(x)+c$
$\int e^{\tan^{-1}x}\left[\frac{x^n+1}{x^2+1}+nx^{n-1}\right]dx=e^{tan^{-1}x}\,(x^n+1)+c$
$\int\left(\ln(a)-\frac{\ln(a)}{ax}\right)e^{ax}dx=\int e^{ax}\left(a'\ln\left(a\frac{1}{ax}-\frac{\ln(a)}{xx}\right)\right)dx$
$\int e^{f(x)}dx\left(g(x)f'(x)+g'(x)dx\right)=e^{f(x)g(x)}+C$
$f(x)a^x, f(x)=a^x\ln(a)$
$g(x)=\frac{1}{a^x}g'(x)=\frac{-\ln(a)}{a^x}$
$=\frac{e^{ax}}{a^x}+C$
$f(x)*g(x)=1$

Hence, the answer is the option 2.

Q. 17 $\int e^x(x+1)dx=xf(x)+C.Thenf(0)$ is

Option 1:
e

Option 2:
2e

Option 3:
1/e

Option 4:
1

Correct Answer:
1

Solution:
Result of integration by parts -

$$\int \big(f(x)+xf'(x)\big)dx$$
$$=xf(x)+C$$
$$=\int (e^x+e^x x)dx$$
$$\int \big(f(x)+xf'(x)\big)dx=xf(x)+C$$
$$HEREf(x)=e^x andf'(x)=e^x$$
$$\int e^x(x+1)dx=xe^x+C\rightarrow f(x)=e^x$$
$$f(a)=e^a=1$$

Hence, the answer is the option 4.

Q. 18 Which of the following is true?

Option 1:
If f(x) is continuous at 1 , f(1)= 10 then there exists an interval $(1-\delta,1+\delta)$ such that $\forall$ $x\epsilon(1-\delta,1+\delta), f(x)=-5$

Option 2:
If f(x) is continuous at 1 , f(1)= 10 then there exists an interval $(1-\delta,1+\delta)$ such that $\forall$ $x\epsilon(1-\delta,1+\delta), f(x)=1$

Option 3:
If f(x) is continuous at 1 , f(1)= 10 then there exists an interval $(1-\delta,1+\delta)$ such that $\forall$ $x\epsilon(1-\delta,1+\delta), f(x)>0$

Option 4:
If f(x) is continuous at 1 , f(1)= 10 then there exists an interval $(1-\delta,1+\delta)$ such that $\forall$ $x\epsilon(1-\delta,1+\delta), f(x)<0$

Correct Answer:
If f(x) is continuous at 1 , f(1)= 10 then there exists an interval $(1-\delta,1+\delta)$ such that $\forall$ $x\epsilon(1-\delta,1+\delta), f(x)>0$

Solution:
As we have learned

Properties of continuous function -

If f is continuous at a and $f(a)\neq 0$ then there exists an open interval

($a-\delta,\ a+\delta$), such that all have the same sign as $f(a)$

If f(x) is continuous at x= a, f(a) $\neq$ zero then there exists an interval $(a-\delta,a+\delta)$ such that $\forall n\epsilon(a-\delta,a+\delta)$, f(x) has the same sign as f(a).

Hence, the answer is the option (3).

Q. 19 Let $y=x^3+x^2-x$ then the equation of the tangent at (1, 1) on the curve will be?

Option 1:
$4x-y=3$

Option 2:
$4x + y = 5$

Option 3:
$4x - y = 1$

Option 4:
$4x + 10y = 14$

Correct Answer:
$4x - y = 3$

Solution:
Equation of the tangent

To find the equation of the tangent we need either one slope + one point or two points.

$$\therefore \ (y - y_\circ) = m(x_\circ - y_\circ)$$

$$or \ (y - y_2) = \frac{y_2 - y_1}{x_2 - x_1}(x - x_2)$$

- wherein

Where $(x_\circ, y_\circ)$ is the point on the curve and M = M_T slope of the tangent.

$$\frac{dy}{dx} = 3x^2 + 2x - 1$$
$$\Rightarrow \frac{dy}{dx} \ at \ (1,1) = 3 + 2 - 1 = 4$$ = slope of tangent at (1, 1)

Therefore, using the slope form of the line we have,

$$y - 1 = 4(x - 1) \Rightarrow 4x - y = 3$$

Hence, the answer is option (1).

Q. 20 Let $y = e^x$ then the equation of the tangent at (0, 1) will be?

Option 1:
$y = 2x + 3$

Option 2:
$y = 2x + 1$

Option 3:
$y = x + 1$

Option 4:
$y - 3x = 1$

Correct Answer:
$y = x + 1$

Solution:
Equation of the tangent

To find the equation of the tangent we need either one slope + one point or two points.

$$\therefore \ (y - y_\circ) = m(x_\circ - y_\circ)$$

$$or \ (y - y_2) = \frac{y_2 - y_1}{x_2 - x_1}(x - x_2)$$

- wherein

Where $(x_\circ, y_\circ)$ is the point on the curve and M = M_T slope of the tangent

$\frac{dy}{dx} = e^x \Rightarrow \frac{dy}{dx} = e^x \Rightarrow \frac{dy}{dx}$ at (0, 1) = $= e^0 = 1 =$ slope of the tangent

Therefore, the equation of tangent = $(y - 1) = 1(x - 0) \Rightarrow y = x + 1$

Hence, the answer is option (3).

Q. 21 Length of subnormal at any point P on $y = e^{ax}$ is equal to

Option 1:
a.(abscissa of P)^2

Option 2:
a.(ordinate of P)^2

Option 3:
a.(subtangent of P)

Option 4:
None of these

Correct Answer:
a.(ordinate of P)^2

Solution:
As we know, length of subnormal = yy' at (x_0, y_0)

So for the given curve y.y' =

$$e^{ax_o} \cdot (ae^{ax_o}) = a(e^{ax_o})^2 = ay_o^2 = a(square\ of\ ordinate)$$

Hence, the answer is option (2).

Q. 22 The angle between the intersection of curves $x^3 - 3xy^2 = 4$ and $3x^2y - y^3 = 4$ is

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

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

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

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

Correct Answer:
$\frac{\pi}{-2}$

Solution:
Let P(x_1,y_1) be the point of intersection of these curves

First curve

$$x^3 - 3xy^2 = 4 \Rightarrow 3x^2 - 3[x(2y)\frac{dy}{dx} + y^2] = 0$$

$$\Rightarrow \frac{dy}{dx} = \frac{x^2 - y^2}{2xy}$$

Hence, the slope of the tangent at P(x_1,y_1) $= \frac{x_1^2 - y_1^2}{2x_1y_1}$

Second curve

$$3x^2y - y^3 = 4 \Rightarrow 3x^2\frac{dy}{dx} + 6xy - 3y^2\frac{dy}{dx} = 0$$

$$\Rightarrow \frac{dy}{dx} = -2xy/(x^2 - y^2)$$

Hence, the slope of the tangent at P(x_1,y_1) $= \frac{-2x_1y_1}{x_1^2 - y_1^2}$

Now, the product of these slopes

$$= \frac{x_1^2 - y_1^2}{2x_1y_1} \times \frac{-2x_1y_1}{x_1^2 - y_1^2} = -1$$

Hence it is an orthogonal intersection, so the angle

Hence, the answer is option (3).

Q. 23 For throwing a dice, which is a simple event?

Option 1:
$A = \{H, T\}$

Option 2:
$A = \{H\}$

Option 3:
$A = \{1, 2, 3, 4, 5, 6\}$

Option 4:
$A = \{4\}$

Correct Answer:
$A = \{4\}$

Solution:
Simple event -

An event is called a simple event if it is a singleton subset of the sample space S.

- wherein

for ex :

S = {H, T} then A = {H}

Hence, the correct answer is option (4).

Q. 24 For throwing a dice which is a compound event?

Option 1:
$A = \{2, 4, 6\}$

Option 2:
$A = \{1\}$

Option 3:
$A = \{1, 3, 5, 7\}$

Option 4:
$A = \{5\}$

Correct Answer:
$A = \{2, 4, 6\}$

Solution:
Compound event -

A subset of the sample space S which contains more than one element is called a mixed event or when two or more events occur together their Joint occurrence is called a compound event.

- wherein

for ex: s = {1, 2, 3, 4, 5, 6}

A = {2, 4, 6}

B = {1, 2, 4}

Hence, the correct answer is option (1).

Q. 25 Find the correct option for independent compound event .

Option 1:
$A = \{1, 3, 5\}, B = \{2, 4, 6\}$

Option 2:
$A = \{1, 2, 3, 4, 5, 6\}, B = \{4, 5\}$

Option 3:
$A = \{1, 2, 3\}, B = \{2, 3, 5\}$

Option 4:
None of these

Correct Answer:
$A = \{1, 3, 5\}, B = \{2, 4, 6\}$

Solution:
Independent compound events are the events in which no common element is found.

Hence, the answer is the option (1)

Q. 26 Let A be the matrix of the order 2×2 and I is the identity matrix. Then total number of solution of the matrix equation $A^2 - I = 0$ is:

Option 1:
0

Option 2:
1

Option 3:
2

Option 4:
more than 2

Correct Answer:
more than 2

Solution:
$A^2 - I = 0$
$A^2 = I$
$A^{-1}A \cdot A = A^{-1}I$
$IA = A^{-1}I$
$A = A^{-1}$

There are many such matrices which are inverse of their own.

Hence, the correct answer is the option 4.

Q. 27 If $A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$ and $A^2 - \lambda A - I_2 = 0$, then λ = ? where 0 is zero matrix and I_2 is identity matrix of order 2 .

Option 1:
-4

Option 2:
4

Option 3:
2

Option 4:
-2

Correct Answer:
4

Solution:
$A^2 - \lambda A - I_2 = 0$
$A^2 - \lambda A = I_2$

$A^{-1}A \cdot A - \lambda A \cdot A^{-1} = I_2 \cdot A^{-1}$ $A^{-1} = \frac{1}{|A|}\text{adj}\, A$

$IA - \lambda I = A^{-1}$ $A^{-1} = \frac{1}{-1}\begin{bmatrix} 3 & -2 \\ -2 & 1 \end{bmatrix}$

$\lambda = A - A^{-1}$
$\lambda = 4$
Hence, the answer is the option 2.

Q. 28 $A = \begin{bmatrix} 2 & 6 \\ 0 & 12 \end{bmatrix}, \quad B = \begin{bmatrix} 4 & 0 \\ 8 & 12 \end{bmatrix}$ Then which of the following is triangular matrix?

Option 1:
A+2B

Option 2:
A-2B

Option 3:
AB

Option 4:
None of these

Correct Answer:
None of these

Solution:
Given matrices:

$A = \begin{bmatrix} 2 & 6 \\ 0 & 12 \end{bmatrix}, \quad B = \begin{bmatrix} 4 & 0 \\ 8 & 12 \end{bmatrix}$

Evaluate A :
- A has zeros below the diagonal.
- A is an upper triangular matrix.

Evaluate B :
- B has no strict pattern of zeros either below or above the diagonal.
- B is not triangular.

Hence, the answer is the option 4.

Q. 29 What is projection of vector $2\hat{i} - \hat{j} + 3\hat{k}$ on z-axis ?

Option 1:
2

Option 2:
-1

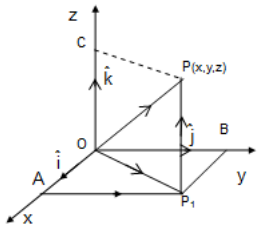
Option 3:
3

Option 4:
4

Correct Answer:
3

Solution:
As we have learnt

Projection of Vector on axis -



- wherein

OA, OB and OC are projected of OP on the x,y,z axes respectively.

Hence, the answer is the Option (3).

Q. 30 What is position vector of point P(-1,5,7) ?

Option 1:
$5\hat{i}-\hat{j}+7\hat{k}$

Option 2:
$-\hat{i}+5\hat{j}+7\hat{k}$

Option 3:
$-\hat{i}+5\hat{k}+7\hat{j}$

Option 4:
None of these

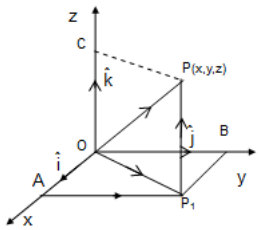
Correct Answer:
$-\hat{i}+5\hat{j}+7\hat{k}$

Solution:
As we have learnt

Position vector of a point -

$\overrightarrow{OP}=\hat{x}i+y\hat{j}+z\hat{k}$

- wherein



Hence, the correct answer is Option (2).

Q. 31 What is $|\overrightarrow{OP}|_{\text{if P is}}\ (2,-1,2\sqrt{5})$?

Option 1:
$3\sqrt{5}$

Option 2:
$\sqrt{5}$

Option 3:
4

Option 4:
5

Correct Answer:
5

Solution:
As we have learnt

Position vector of a point -

$|\overrightarrow{OP}| = \sqrt{x^2+y^2+z^2} = r$

- wherein

$|\overrightarrow{OP}| = \sqrt{4+1+20} = 5$

Hence, the correct answer is the option (4)

Q. 32 $\lim_{x\to 1} \frac{x^2+4x-5}{\sin(x^2-1)}$ is equal to:

Option 1:
0

Option 2:
1

Option 3:
2

Option 4:
3

Correct Answer:
3

Solution:
L - Hospital Rule -
In the form of $\frac{0}{0}$ and $\frac{\infty}{\infty}$ we differentiate $\frac{N^r}{D^r}$ separately.

$\Rightarrow \lim_{x\to a} \frac{f(x)}{g(x)} = \lim_{x\to a} \frac{f'(x)}{g'(x)}$

- wherein

$\lim_{x\to a} \frac{\frac{d}{dx}f(x)}{\frac{d}{dx}g(x)}$

Where $f(x)$ and $g(x) = 0$

$\lim\limits_{x\to 1} \dfrac{x^2+4x-5}{\sin(x^2-1)}$
$= \lim\limits_{x\to 1} \dfrac{2x+4}{\cos(x^2-1)\cdot 2x} \left[ByL'H \quad \text{Rule}\right]$
$= \frac{6}{1*2} = 3$

Hence, the correct answer is the option 4.

Q. 33 General Solution of the D.E $\frac{dy}{dx} = \frac{y}{x} + \left(\frac{y}{x}\right)^2$

Option 1:
$\frac{-x}{y} = \log|x| + c$

Option 2:
$\frac{x}{y} = \log|x| + c$

Option 3:
$\frac{y}{x} = \log|y| + c$

Option 4:
$\frac{y}{x} = \log|y| + c$

Correct Answer:
$\frac{-x}{y} = \log|x| + c$

Solution:
As we learnt

Homogeneous Differential Equation -

Put

$\frac{y}{x} = v$

$\frac{dy}{dx} = v + \frac{xdv}{dx}$

$\frac{dy}{dx} = \frac{y}{x} + \left(\frac{y}{x}\right)^2$

$x.v' + v = v + v^2 \Rightarrow x\frac{du}{dx} = v^2$

$\int \frac{dv}{v^2} = \int \frac{dx}{x}$

$-\frac{1}{v} = \log(x) + C \Rightarrow -\frac{x}{y} = \log(x) + C$

Hence, the correct answer is option (1).

Q. 34 If $\mathrm{f(x)} = \int \sin(a^x)\ln(1/a)a^x dx = g(x) + C$, 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:
$f(x) = \int \sin(a^x)\ln(1/a)a^x dx$
$-\int \sin(a^x)a^x \ln(a)dx$
$\text{put } a^x = t \Rightarrow \ln(a)a^x dx = dt$
$= -\sin(t)dt = \cos(t) + C$
$= \cos(a^x) + C$
$g(x) = \cos(a^x)$
$g(0) = \cos(a^0) = \cos(1)$

Hence, the answer is the option (3).

Q. 35 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

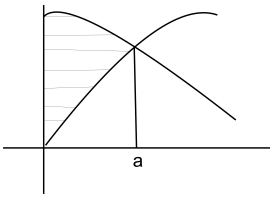
Solution:
As we have learned

Area between two curves -

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

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

- wherein



The line y = x+2

cut

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

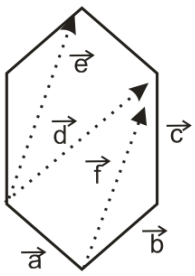
$\text{area } = 15/2 - \int_{-1}^{2} x^2 dx = \frac{9}{2}$

$k/9 = 9/2$

$k = 81/2$

Hence, the answer is Option the (1)

Q. 36 Find $\vec{a} + \vec{b} + \vec{c}$ in this regular hexagon:



Option 1:
$\vec{d}$

Option 2:
$\vec{e}$

Option 3:
$\vec{f}$

Option 4:
None of these

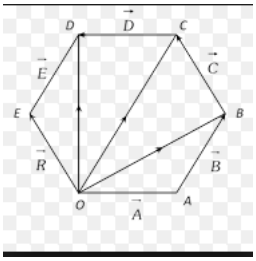
Correct Answer:
$\vec{d}$

Solution:
As we have learnt

Polygon Law -

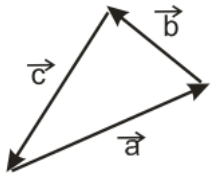
Polygon law of vector addition states that if several vectors are represented by the side of the polygon taken in order, their resultant is fully represented by the closing side of the polygon taken in the opposite order.

- wherein



Hence, the correct answer is option (1).

Q. 37 What is $\vec{a}+\vec{b}+\vec{c}$ in the adjoining figure?



Option 1:
$2\vec{a}$

Option 2:
$2\vec{b}$

Option 3:
$2\vec{c}$

Option 4:
$\overrightarrow{0}$

Correct Answer:
$\overrightarrow{0}$

Solution:
As we have learnt

Vector Addition -

If vectors $\vec{a},\vec{b}$ and $\vec{c}$ taken in order are represented by the sides of a triangle ABC , then $\vec{a}+\vec{b}+\vec{c}=\overrightarrow{0}$

Hence, the correct answer is the option (4)

-

Q. 38 A vector of magnitude 3 units in y-axis is :

Option 1:
$3\hat{i}$

Option 2:
$3\hat{j}$

Option 3:
$3\hat{k}$

Option 4:
$-3\hat{j}$

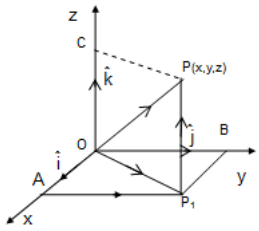
Correct Answer:
$3\hat{j}$

Solution:
As we have learnt

Regular Cartesian System -

In three dimensional co-ordinate system, unit vectors in direction of positive $\mathrm{x}, \mathrm{y}, \mathrm{z}$ axis are $\hat{i}, \hat{j}$ and $\hat{k}$ respectively.

- wherein



Hence, the answer is Option 2.

Q. 39 If $\begin{bmatrix} x+2 & y+2x \\ z-2 & 2w+4 \end{bmatrix} = \begin{bmatrix} -x-2 & 0 \\ 2 & w \end{bmatrix}$ and the value of $|x+w|+|y+z|$

Option 1:
10

Option 2:
12

Option 3:
14

Option 4:
none of the above

Correct Answer:
14

Solution:
As we have learned

Equal Matrices -

Same order and each element of one is equal to the corresponding element of the other.

$x+2=-(x+2) \Rightarrow 2x=-4 \Rightarrow x=-2$
$y=-2x=4$
$z=4$
$2w+4=w \Rightarrow w=-4$

$|x+w|+|y+z|$=$|-2-4|+|4+4|$

$=14$

Hence, the correct answer is the option (3).

Q. 40 Which of the option is incorrect . $|A| \neq 0$

Option 1:
A (adj A) = |A| In

Option 2:
adj (adj A) = $|A|^{n-2}A$

Option 3:
adj (ABC) = (adj B) (adj C) (adj A)

Option 4:
both a and b

Correct Answer:
adj (ABC) = (adj B) (adj C) (adj A)

Solution:
As we have learned

Property of adjoint of A -

$|\text{adj } A| = |A|^{n-1}$

- wherein
$\text{adj } A_{\text{denotes adjoint of } A}|A|$ and denotes determinant of A and n is the order of the matrix

adj (ABC)

= (adj C) (adj B) (adj A)

Hence, the answer is the option (3)

Q. 41 The no. value of k for which the linear equation possess a non - zero solution is

2x + ky + z= 0

kx+ 2y +2z = 0

x+y +2z = 0

Option 1:
0

Option 2:
1

Option 3:
2

Option 4:
3

Correct Answer:
2

Solution:
As we have learned
Cramer's rule for solving system of linear equations -
When $\Delta = 0$ and atleast one of Δ_1, Δ_2 and Δ_3 is non-zero, system of equations has no solution
- wherein

$a_1x + b_1y + c_1z = d_1$
$a_2x + b_2y + c_2z = d_2$
$a_3x + b_3y + c_3z = d_3$

and

$$\Delta = \begin{matrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{matrix}$$

non zero sol. means non trial sol . For non trivial sol. of the given equation

$$\begin{matrix} 2 & k & 1 \\ k & 2 & 2 \\ 1 & 1 & 2 \end{matrix} = 0 \Rightarrow 4 - 2k^2 + 2k + k - 2 = 0$$
$k = 2, -1/2$

Hence, the correct answer is Option 3.

Q. 42 If $AB = A$ and $BA = B$ then

Option 1:
$A^2B = A$

Option 2:
$ABA = A$

Option 3:
$BAB = B$

Option 4:
All of these

Correct Answer:
All of these

Solution:
$A^2B = A(A \cdot B) = A \cdot A = A^2$
$ABA = A(BA) = AB = A$
$BAB = B(AB) = BA = B$

Hence, the answer is the option (4).

Q. 43 If $[a_{ij}]_{3*3} \forall a_{ij} = a$ then

Option 1:
$|A| = 0$

Option 2:
A^{-1} does not exist

Option 3:
$A^2 = 3A$(For a $= 1$)

Option 4:
all of the above

Correct Answer:
all of the above

Solution:
$A = \begin{bmatrix} a & a & a \\ a & a & a \\ a & a & a \end{bmatrix}$
Here $|A| = 0$
so, A^{-1} doesnt exist

$A^2 = \begin{bmatrix} 3a^2 & 3a^2 & 3a^2 \\ 3a^2 & 3a^2 & 3a^2 \\ 3a^2 & 3a^2 & 3a^2 \end{bmatrix}$ for
$a = 1$
$A^2 = 3A$
Hence, the correct answer is the option (4).

Q. 44 Which of the following statement is wrong ?

Option 1:
No. of terms in xy is finite

Option 2:
No. of terms in $\frac{1}{(x+y)^7}$ is finite

Option 3:
No. of terms in $\frac{1}{\sqrt{xy}}$ is infinite

Option 4:
No. of terms in $\sqrt{x/y}$ is infinite

Correct Answer:
No. of terms in $\frac{1}{(x+y)^7}$ is finite

Solution:
As we have learned

Binomial Theorem - When Binomial Expression is raised to the power of n .

- wherein

Where n can be +ve, -ve or a fraction

$(x+y)^n$ will have finite expansion in case 'n'

is a +ve integer , elsewhere infinite expansion

Hence, the correct answers is the option (2)

Q. 45 Which of the statement is incorrect ?

Option 1:
coeff of x^7 in $(1+x)^9 = {}^9C_7$

Option 2:
coeff of x^7 in $1/(1+x)^9 = {}^5C_7$

Option 3:
coeff of x^3 in $1/(1+x) = 1$

Option 4:
none of the above

Correct Answer:
none of the above

Solution:
As we have learned

Type of Binomial Theorem -

There are two type of Binomial Theorem for +ve integral index and for -ve rational index

$$(1+x)^n = 1 + {}^n_1\mathrm{C} + {}^n_2\mathrm{C}x^2 + \ldots {}^4_4\mathrm{C}x^4$$
$$1/(1+x)^n = 1 + {}^n_1\mathrm{C}x + {}^{n+1}_2\mathrm{C} + {}^{n+2}_3\mathrm{C} + \ldots . \infty$$

Hence, the correct answers is the option (4)

Q. 46 Number of terms in expansion of $(1+x)^6 + (2+x)^7$

Option 1:
6

Option 2:
7

Option 3:
8

Option 4:
13

Correct Answer:
8

Solution:
We have:

To find number of terms in expansion of $(1+x)^6 + (2+x)^7$

$(1+x)^6 => 7$ terms having coef. of x^0 to x^6
$(2+x)^7 => 8$ terms having coeff. of x^0 to x^7
When we add 2 we will get 8 terms.

Hence, the answer is the option (3).

Q. 47 If ${}^nC_r$ is rth term of nth of pascal triangle, then ${}^3C_2 + {}^3C_3$

Option 1:
4

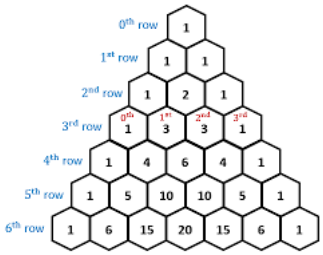
Option 2:
${}^4C_3$

Option 3:
a and b both

Option 4:
none of these

Correct Answer:
a and b both

Solution:
Pascal Triangle -



${}^3C_2 + {}^3C_3 = {}^4C_3 = 6$

Hence, the answer is the option 3.

Q. 48 Find the no of terms in $(x+1)^7(x+2)^8 + (x+3)^{14}$

Option 1:
15

Option 2:
14

Option 3:
16

Option 4:
21

Correct Answer:
16

Solution:
As we have learned

Number of terms - In the expression of $(x+a)^n$ total number of terms is $n+1$

- wherein more than 1 from n.

Number of terms in $(x+a)^4$ is $(n+1)$ number of terms in

$(x+a)^m(x+b)^n is (m+n+1)$
$(x+1)^7(x+2)^8$ is $7+8+1=16$

Hence, the answer is the option (3)

Q. 49 $(x+2)^7 = {}^7C_0 \times 2^7 + {}^7C_1 \times 2^6 x + {}^7C_2 \times 2^5 x^2 + {}^7C_3 \times 2^4 x^3 + {}^7C_4 \times 2^3 x^4 + \ {}^7C_5 \times 2^2 x^5 + {}^7C_6 \times 2 x^6 + {}^7C_7 \times x^7$

Binomial coefficient of x^5 is

Option 1:
${}^7C_5$

Option 2:
${}^7C_5 \times 2^2$

Option 3:
2^7

Option 4:
none of these

Correct Answer:
${}^7C_5$

Solution:
As we have learned

Binomial Coefficients in Binomial Expansion -

In the expansion of $(x+a)^n$, Binomial Coefficients are ${}^nc_r$
- wherein
${}^nc_r$ is +ve.
$\frac{n!}{r!(n-r)!}$

Binomial coeff of any term in this expansion $= {}^nC_r$

${}^7C_5$

Hence, the answer is the option (1).

Q. 50 If $\sin A = 3/5$, where $0 < A < 90$. Then the value of $\sin(2A)$?

Option 1:
-24/25

Option 2:
7/25

Option 3:
24/25

Option 4:
none of these

Correct Answer:
24/25

Solution:
As we have learned

Trigonometric Identities -

$\sin^2\theta + \cos^2\theta = 1$
$1 + \tan^2\theta = \sec^2\theta$
$1 + \cot^2\theta = \operatorname{cosec}^2\theta$

- wherein

They are true for all real values of θ
we have

$\sin A = 3/5$
$\cos^2 A = 1 - \sin^2 A = 1 - 3/5 * 3/5 = 1 - 9/25 = 16/25$
$\cos A = +4/5$
$\sin(2a) = 2\sin A \cos A = 2 * 3/5 * 4/5 = 24/25$

Hence, the correct answer is option (3).

Q. 51 No. of solution of the equation

$$\cos 2\theta + 2\sin^2\theta = 0$$

Option 1:
3

Option 2:
2

Option 3:
1

Option 4:
none

Correct Answer:
none

Solution:
As we have learned

Double Angle Formula -

$$\sin 2\alpha = 2\sin\alpha\cos\alpha$$
$$\cos 2\alpha = \cos^2\alpha - \sin^2\alpha$$
$$= 2\cos^2\alpha - 1$$
$$= 1 - 2\sin^2\alpha$$
$$\tan 2\alpha = \frac{2\tan\alpha}{1-\tan^2\alpha}$$

- wherein

These are formulae for double angles.

$$1 - 2\sin^2 1\theta + 2\sin^2\theta = 0$$
$$1 = 0$$

no solution

Hence, the correct answer is option (4).

Q. 52 $\cos^{-1}x = \tan^{-1}x$, then $\cos^2\theta =$?

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

Option 2:
$\sqrt{5}+2$

Option 3:
$\frac{\sqrt{5}+1}{2}$

Option 4:
none

Correct Answer:
$\frac{\sqrt{5}-1}{2}$

Solution:
$$x = \cos\theta = \tan\theta \Rightarrow \cos^2\theta = \sin\theta$$
$$1 - \sin^2\theta = \sin\theta \Rightarrow \sin^2\theta + \sin\theta - 1 = 0$$
$$\sin\theta = \frac{1+\sqrt{5}}{2}$$
$$\text{now, } 1 - \cos^2\theta + \sin\theta - 1 = 0$$
$$\cos^2\theta = \frac{\sqrt{5}-1}{2}$$
Hence, the correct answer is the option (1).

Q. 53 Let f (x) = $\tan^{-1} x + \cot^{-1} x,\ then\ \pi/2\ is\ equal\ to$

Option 1:
f (-1/ 2)

Option 2:
$f(k^2 + 2k - 4)$

Option 3:
f ($1/k^2$)

Option 4:
all of the above

Correct Answer:
all of the above

Solution:
When $x \in R$

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

Hence, the correct answer is option (4).

Q. 54 An aeroplane flying at constant speed parallel to the horizontal ground, 2 Km above, is observed at an elevation of 60 from a point on the ground. After 10 sec elevation is 30 from the same point. Speed of the plane is

Option 1:
$400/\sqrt{3}$

Option 2:
$\sqrt{3} * 400$

Option 3:
800

Option 4:
none of these

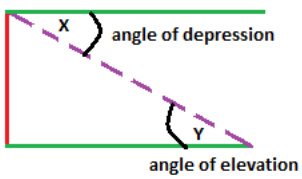
Correct Answer:
$400/\sqrt{3}$

Solution:
As we have learned

The angle of Elevation -

If an object is above the horizontal line from the eye, we have to raise our head to view the object.

- wherein



$\tan 60^\circ = 2000/x = \sqrt{3}$
$x = 2000/\sqrt{3}\ \text{m}$
$\tan 30^\circ = 1/\sqrt{3} = 2000/y \Rightarrow y = 2000\sqrt{3}$
$\text{speed} = \text{dist.}/\text{time} = y - x/\text{ time} = \frac{2000(\sqrt{3} - 1/\sqrt{3})}{10}$
$= 400/\sqrt{3}\ \text{m/s}$

Hence, the correct answer is option (1).

Q. 55 Two finite set have m and n two element . The total no. of subset of first set is 48 more than the total no. of subset of second set .Then (m,n) are

Option 1:
6,4

Option 2:
8,4

Option 3:
4,6

Option 4:
8,6

Correct Answer:
6,4

Solution:
As we have learned
Number of sub set of a set -

If a set has n elements, then it has 2^n sub set. given

$$2^m - 2^n = 48$$
$$2^n m\left(2^{m-n} - 14\right) = 2^4 * 3$$
$$2^n = 2^4 \text{ and } 2^{m-n} - 1 = 3$$
$$n = 4 \text{ and } 2^{m-n} = 4 = 2^2$$
$$m - n = 2$$
$$m = 6$$

Hence, the correct answer is Option (1).

Q. 56 The measure of dispersion is

Option 1:
Mean deviation

Option 2:
S.D

Option 3:
Quartile dispersion

Option 4:
All of These

Correct Answer:
All of These

Solution:
As we learnt in

DISPERSION -

Dispersion means scatteredness, Dispersion measures the degree of scatteredness of the variable about its central value.

Measure of dispersion is

Mean deviation.

Quartile dispersion.

Standard deviation.

Hence, the answer is Option (4).

Q. 57 The S.D of 5 scores 2,3,4,5 is

Option 1:
1

Option 2:
2

Option 3:
$\sqrt{2}$

Option 4:
$\sqrt{3}$

Correct Answer:
$\sqrt{2}$

Solution:
Step 1: Calculate the mean $(\bar{x})$: $\bar{x} = \frac{\text{Sum of all data points}}{\text{Number of data points}} = \frac{2+3+4+5}{4} = \frac{14}{4} = 3.5$

Step 2: Find the squared deviations from the mean:

For each data point x_i, compute $(x_i - \bar{x})^2$: -

For $x_1 = 2 : (2 - 3.5)^2 = (-1.5)^2 = 2.25$ -

For $x_2 = 3 : (3 - 3.5)^2 = (-0.5)^2 = 0.25$ -

For $x_3 = 4 : (4 - 3.5)^2 = (0.5)^2 = 0.25$ -

For $x_4 = 5 : (5 - 3.5)^2 = (1.5)^2 = 2.25$

Step 3: Compute the variance: $$\text{Variance } = \frac{\text{Sum of squared deviations}}{\text{Number of data points}}$$
$$\text{Variance } = \frac{2.25 + 0.25 + 0.25 + 2.25}{4} = \frac{5}{4} = 1.25$$

Step 4: Compute the standard deviation:

$\text{SD} = \sqrt{\text{Variance }} = \sqrt{1.25} = 1.118 \text{ (approximately)}.$

Final Answer:

1.12
Hence, the answer is the option 3.

Q. 58 The variance of the data 2, 4, 6,8, 10 is.

Option 1:
6

Option 2:
7

Option 3:
8

Option 4:
None of These

Correct Answer:
8

Solution:

$V = \frac{1}{n}\sum x_i^2 - (\bar{x})^2$

$\text{where } \bar{x} = \frac{2+4+6+8+10}{5}$

$\Rightarrow \frac{30}{5} = 6$

$\therefore \frac{1}{5}(100+64+36+16+4) - 36$

$= \frac{1}{5}(220) - 36$

$= 44 - 36 = 8$

Hence, the answer is the option (3).

Q. 59 If the standard deviation of 0,1,2, 3.....9 in K, the standard deviation of 10,11,12,13.....19 is

Option 1:
K

Option 2:
$K + 10$

Option 3:
$K + \sqrt{10}$

Option 4:
10 K

Correct Answer:
K

Solution:
As we learnt in

Standard Deviation -

In case of discrete frequency distribution

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

Since, $\sigma^2 = \frac{\sum (x_i - \bar{x})^2}{n}$ and each data increases by $\lambda(\lambda = 10)$ then there will be no change in standard deviation because $(x_i - \bar{x})$ will be same.

So, new standard deviation is K.

Hence, the correct answer is the option (1)

Q. 60 Which of the following LP problems has an optimal solution?

Note: In all cases $x_1 \geq 0, x_2 \geq 0$

Option 1:
$\text{Min } -2x_1 + x_2$ subject to $x_2 \leq 2$

Option 2:
min $-2x_1 + x_2$ subject to $x_1 + x_2 \geq 5, 2x_1 + x_2 \geq 7$

Option 3:
$Max\ 2x_1 + x_2$ subject to $x_1 - x_2 \leq 2$

Option 4:
None of these

Correct Answer:
min $-2x_1 + x_2$ subject to $x_1 + x_2 \geq 5, 2x_1 + x_2 \geq 7$

Solution:
for max or min optimal solution

two linear equations must be taken

for x_1 and x_2

Hence, the answer is the option (2).

Q. 61 Two models of a product - Regular (x) and Delux (y) are produced by a company. A linear programming model is used to determine the production schedule. The formulation is as follows:

Maximize profit: $50x + 60y$
Subject to : $8x + 10y \leq 800$ (labour laws)
$x + y \leq 120$ (total units demanded)
$4x + 5y \leq 500$ (raw materials)
All variables ≥ 0
The optimal solution is $x = 100, y = 0$
How many units of labour hours must be used to produce this number of units?

Option 1:
400

Option 2:
200

Option 3:
500

Option 4:
None of the above

Correct Answer:
None of the above

Solution:
Given:

$z = 50x + 60y$
$8x + 10y \leq 800$
$x + y \leq 120$
$4x + 5y \leq 500$
$\text{at } x = 100, y = 0$

$\Rightarrow 800 \text{ units of the labour hours.}$
Hence, the answer is the option (4).

Q. 62 Consider the following linear programming problem
Maximize $5x + 6y$
Subject to $4x + 2y \leq 420, \quad 1x + 2y \leq 120$
all variables ≥ 0
which of the following points (x, y) is feasible?

Option 1:
(50,40)

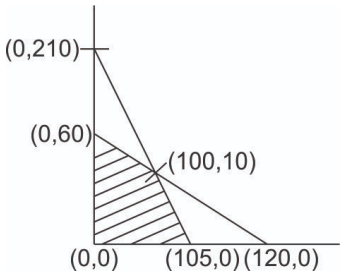
Option 2:
(30,50)

Option 3:
(60,30)

Option 4:
(90,20)

Correct Answer:
(60,30)

Solution:
Given:



$Z = 5x + 6y$
$4x + 2y \leq 420$
$x + 2y \leq 120$
$x = 60$
$y = 30$ is feasible.

Hence, the answer is the option (3).

Q. 63 If, $\frac{\log_2 x}{4} = \frac{\log_2 y}{6} = \frac{\log_2 z}{3k}$ and $x^3y^2z = 1$, then $k =$

Option 1:
-8

Option 2:
4

Option 3:
-3

Option 4:
-1

Correct Answer:
-8

Solution:
$\frac{\log_2 x}{4} = \frac{\log_2 y}{6} = \frac{\log_2 z}{3k} = \lambda$
Now $\log_2 x = 4\lambda$

$\log_2 y = 6\lambda$
$\log_2 z = (3k)\lambda$
$\log x^3y^2z = 3\log_2 x + 2\log_2 y + \log_2 z = 12\lambda + 12\lambda + 3k\lambda = 3\lambda(8 + k) = 0$
Thus k=-8

Hence, the correct answer is the option (1)

Q. 64 If the roots of the equation $bx^2 + cx + a = 0$ be imaginary, then for all real values of x , the expression $3b^2x^2 + 6bcx + 2c^2$ is

Option 1:
Greater than 4ab

Option 2:
Less than 4ab

Option 3:
Greater than -4ab

Option 4:
Less than -4ab

Correct Answer:
Greater than -4ab

Solution:
As we learnt in

Condition for Real and distinct roots of Quadratic Equation -

$D = b^2 - 4ac > 0$

- wherein

$ax^2+bx+c=0$

is the quadratic equation
and
Complex Roots with non - zero Imaginary part -

$D=b^2-4ac<0$

- wherein

$ax^2+bx+c=0$

is the quadratic equation

$bx^2+cx+a=0$

if roots are imaginary, then

$c^2-4ab<0------(1)$

Expression is $3b^2x^2+6bcx+2c^2=y$

$\text{Thus } 3b^2x^2+6bcx+\left(2c^2-y\right)=0$
For real value of x, we have

$$(6bc)^2-4\left(3b^2\right)\left(2c^2-y\right)\geq 0$$
$$3c^2-2c^2+y\geq 0$$
$$c^2+y\geq 0$$
$$=>y\geq -c^2------(2)$$

Comparing (1) \& (2)

$y>-4ab$

Hence, the correct answer is the option (3)