

Jupiter Academy

Subjects : Physics , Chemistry ,
Maths , English , Aptitude

VITEEE SAMPLE PAPER 03

(Solutions)

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Total Marks : 488

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Physics - Section A (MCQ)

1. When a wave traverses a medium the displacement of a particle located at x at a time t is given by $y = a \sin(bt - cx)$. Where a, b and c are constants of the wave. Which of the following is a quantity with dimensions?

A) $\frac{y}{a}$ B) bt C) cx **D) $\frac{b}{c}$**

Solution : (Correct Answer: D)

Here, $y = a \sin(bt - cx)$

Comparing this equation with general wave equation

$$y = a \sin \left(\frac{2\pi t}{T} - \frac{2\pi x}{\lambda} \right)$$

we get $b = \frac{2\pi}{T}, c = \frac{2\pi}{\lambda}$

(a) Dimensions of $\frac{y}{a} = \frac{[L]}{[L]} = \text{Dimensionless}$

(b) Dimensions of $bt = \frac{2\pi}{T} \cdot t = \frac{[T]}{[T]}$
= Dimensionless

(c) Dimensions of $cx = \frac{2\pi}{\lambda} \cdot x = \frac{[L]}{[L]}$
= Dimensionless

(d) Dimensions of $\frac{b}{c} = \frac{\frac{2\pi}{T}}{\frac{2\pi}{\lambda}} = \frac{\lambda}{T} = [LT^{-1}]$

2. Two bodies of same mass are projected with the same velocity at an angle 30° and 60° respectively. The ratio of their horizontal ranges will be

A) 1 : 1 B) 1 : 2 C) 1 : 3 D) $2 : \sqrt{2}$

Solution : (Correct Answer: A)

Horizontal range is same when angle of projection is θ or $(90^\circ - \theta)$.

3. Two particles A and B, move with constant velocities $\vec{v}_1$ and $\vec{v}_2$. At the initial moment their position vectors are $\vec{r}_1$ and $\vec{r}_2$ respectively. The condition for particles A and B for their collision is

A) $\vec{r}_1 \cdot \vec{v}_1 = \vec{r}_2 \cdot \vec{v}_2$

B) $\vec{r}_1 \times \vec{v}_1 = \vec{r}_2 \times \vec{v}_2$

C) $\vec{r}_1 - \vec{r}_2 = \vec{v}_1 - \vec{v}_2$

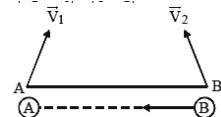
D) $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$

Solution : (Correct Answer: D)

For collision $\vec{V}_{B/A}$ should be along

$\overline{B \rightarrow A} (\vec{r}_{A/B})$

$$\text{So, } \frac{\vec{V}_2 - \vec{V}_1}{|\vec{V}_2 - \vec{V}_1|} = \frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|}$$



4. Two persons A and B are located in X - Y plane at the points (0,0) and (0,10) respectively. (The distances are measured in MKS unit). At a time $t = 0$, they start moving simultaneously with velocities $\vec{v}_a = 2\hat{j}ms^{-1}$ and $\vec{v}_b = 2\hat{i}ms^{-1}$ respectively. The time after which A and B are at their closest distance is

A) 2.5 s B) 4 s C) 1 s D) $\frac{10}{\sqrt{2}}$ s

Solution : (Correct Answer: A)

Let after the time (t) the position of A is $(0, v_A t)$ and position of B = $(v_B t, 10)$. Distance between them

$$y = \sqrt{(0 - v_B t)^2 + (v_A t - 10)^2} \text{ or } y^2 = (2t)^2 + (2t - 10)^2 \text{ or } y^2 = l = 4t^2 + 4t^2 + 100 - 40t$$

$\Rightarrow l = 8t^2 + 100 - 40t$ Now, $\frac{dl}{dt} = (16t - 40) = 0$
or

$$t = \frac{40}{16} = 2.5 \text{ s} \quad \therefore \frac{d^2 l}{dt^2} = 16 = (+ve)$$

So, l will be minimum.

5. If μ_s, μ_k and μ_r are coefficients of static friction, sliding friction and rolling friction, then

A) $\mu_s < \mu_k < \mu_r$

B) $\mu_k < \mu_r < \mu_s$

C) $\mu_r < \mu_k < \mu_s$

D) $\mu_r = \mu_k = \mu_s$

Solution : (Correct Answer: C)

$\mu_s > \mu_k > \mu_r$

6. If the potential energy of a gas molecule is $U = \frac{M}{r^6} - \frac{N}{r^{12}}$, M and N being positive constants, then the potential energy at equilibrium must be

A) zero

B) $NM^2/4$

C) $MN^2/4$

D) $M^2/4N$

Solution : (Correct Answer: D)

Given, $U = \frac{M}{r^6} - \frac{N}{r^{12}}$

$$\therefore F = -\frac{dU}{dr} = -\frac{d}{dr} \left(\frac{M}{r^6} - \frac{N}{r^{12}} \right)$$

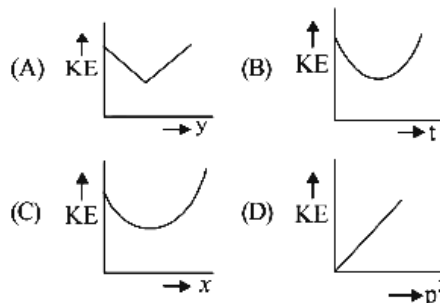
$$= - \left(\frac{-6M}{r^7} + \frac{12N}{r^{13}} \right) = \left(\frac{6M}{r^7} - \frac{12N}{r^{13}} \right)$$

For equilibrium position, $F = 0$

$$\therefore \frac{6M}{r^7} = \frac{12N}{r^{13}} \text{ or } r^6 = \frac{2N}{M}$$

$$\text{Hence, } U = \frac{M}{(2N/M)} - \frac{N}{(2N/M)^2} = \frac{M^2}{4N}$$

7. A particle is projected up from a point at an angle θ with the horizontal direction. At any time t , if p is the linear momentum, y is the vertical displacement, x is horizontal displacement, the graph among the following which does not represent the variation of kinetic energy KE of the particle is



A) graph(A)

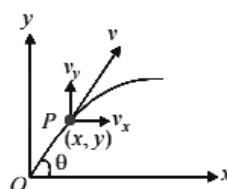
B) graph(B)

C) graph(C)

D) graph(D)

Solution : (Correct Answer: A)

Momentum, $p = m \cdot v \Rightarrow v = \left(\frac{p}{m} \right)$



Kinetic energy, KE

$$= \frac{1}{2}mv^2 = \frac{1}{2}m \left(\frac{p^2}{m^2} \right) = \frac{1}{2m}p^2$$

$$\text{or, } KE \propto p^2 \quad (\because \frac{1}{2m} = \text{constant})$$

Hence, the graph between KE and p^2 will be linear.

Now, kinetic energy $KE = \frac{1}{2}mv^2$

The velocity component at point P,

$v_y = (u \sin \theta - gt)$ and $v_x = u \cos \theta$
Resultant velocity at point P

$$\vec{v} = v_y \hat{j} + v_x \hat{i}$$

$$= (u \sin \theta - gt) \hat{j} + u \cos \theta \hat{i}$$

$$|\vec{v}| = \sqrt{(u \cos \theta)^2 + (u \sin \theta - gt)^2}$$

$$= \sqrt{u^2 \cos^2 \theta + u^2 \sin^2 \theta + g^2 t^2 - 2ugt \sin \theta}$$

$$\therefore \text{KE} = \frac{1}{2} m (u^2 + g^2 t^2 - 2ugt \sin \theta) \text{ ii/}$$

i. e., $\text{KE} \propto t^2$

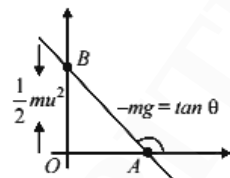
Hence, graph will be parabolic intercept on y-axis.
Hence, the graph between KE and t . Now, in case of height

$$\text{KE} = \frac{1}{2} m (v^2) \text{ and } v^2 = (u^2 - 2gy)$$

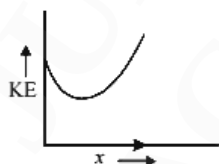
$$\therefore \text{KE} = \frac{1}{2} m (u^2 - 2gy)$$

$$\text{KE} = -mgy + \frac{1}{2} mu^2$$

Intercept on y-axis = $\frac{1}{2} mu^2$



$$\text{Now, KE} = \frac{1}{2} mv^2$$



$$\text{KE} = \frac{1}{2} m \left(\frac{x}{t} \right)^2$$

i.e., $\text{KE} \propto x^2$. Thus graph between KE and x will be parabolic.

8. A body of mass 5 m initially at rest explodes into 3 fragments with mass ratio 3 : 1 : 1. Two of fragments each of mass 'm' are found to move with a speed of 60 m/s in mutually perpendicular directions. The velocity of third fragment is

A) $10\sqrt{2}$ B) $20\sqrt{2}$ C) $20\sqrt{3}$ D) $60\sqrt{2}$

Solution : (Correct Answer: B)

Using principle of conservation of linear momentum,

$$3m \times v = \sqrt{(m \times 60)^2 + (m \times 60)^2}$$

$$= m \times 60\sqrt{2}$$

$$\Rightarrow v = 20\sqrt{2} \text{ m/s}$$

9. Two masses m_a and m_b moving with velocities v_a and v_b in opposite direction collide elastically and after the collision m_a and m_b move with velocities V_b and V_a respectively. Then the ratio m_a/m_b is

A) $\frac{V_a - V_b}{V_a + V_b}$ B) $\frac{m_a + m_b}{m_a}$

C) 1 D) $\frac{1}{2}$

Solution : (Correct Answer: C)

As velocities are exchanged on perfectly elastic collision, therefore masses of two objects must be

$$= (u \sin \theta - gt) \hat{j} + u \cos \theta \hat{i}$$

$$\therefore \frac{m_a}{m_b} = 1 \text{ or } m_a = m_b$$

10. A wheel of radius 0.4 m can rotate freely about its axis as shown in the figure. A string is wrapped over its rim and a mass of 4 kg is hung. An angular acceleration of 8 rad s^{-2} is produced in it due to the torque. Then, moment of inertia of the wheel is ($g = 10 \text{ ms}^{-2}$)

A) $2 \text{ kg} \cdot \text{m}^2$ B) $1 \text{ kg} \cdot \text{m}^2$
C) $4 \text{ kg} \cdot \text{m}^2$ D) $8 \text{ kg} \cdot \text{m}^2$

Solution : (Correct Answer: A)

Given, $r = 0.4 \text{ m}$,

$\alpha = 8 \text{ rad s}^{-1}$,

$m = 4 \text{ kg}$, $I = ?$

Torque, $\tau = I\alpha$

$mgr = I \cdot \alpha$

$$4 \times 10 \times 0.4 = I \times 8 \text{ or } I = \frac{16}{8} = 2 \text{ kg} \cdot \text{m}^2$$

11. A sphere rolls down on an inclined plane of inclination θ . What is the acceleration as the sphere reaches the bottom?

A) $\frac{5}{7} g \sin \theta$ B) $\frac{3}{5} g \sin \theta$
C) $\frac{2}{7} g \sin \theta$ D) $\frac{2}{5} g \sin \theta$

Solution : (Correct Answer: A)

$$a = \frac{g \sin \theta}{1 + \frac{k^2}{R^2}} = \frac{g \sin \theta}{1 + \frac{2}{5}} = \frac{5}{7} g \sin \theta$$

12. Two particles of equal mass m go round a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is

A) $\frac{1}{2} \sqrt{\frac{Gm}{R}}$ B) $\sqrt{\frac{4Gm}{R}}$
C) $\sqrt{\frac{Gm}{2R}}$ D) $\frac{1}{2R} \sqrt{\frac{1}{Gm}}$

Solution : (Correct Answer: A)

From given condition

$$\frac{Gmm}{(2R)^2} = \frac{mv^2}{R}, v = \frac{Gm}{4R} = \frac{1}{2} \sqrt{\frac{Gm}{R}}$$

13. The length of elastic string, obeying Hooke's law is ℓ_1 metres when the tension 4 N and ℓ_2 metres when the tension is 5 N. The length in metres when the tension is 9 N is –

A) $5\ell_1 - 4\ell_2$
B) $5\ell_2 - 4\ell_1$
C) $9\ell_1 - 8\ell_2$
D) $9\ell_2 - 8\ell_1$

Solution : (Correct Answer: B)

Let ℓ_0 be the unstretched length and ℓ_3 be the length under a tension of 9 N. Then

$$Y = \frac{4\ell_0}{A(\ell_1 - \ell_0)} = \frac{5\ell_0}{A(\ell_2 - \ell_0)}$$

$$= \frac{9\ell_0}{A(\ell_3 - \ell_0)}$$

These give

$$\frac{4}{\ell_1 - \ell_0} = \frac{5}{\ell_2 - \ell_0} \Rightarrow \ell_0 = 5\ell_1 - 4\ell_2$$

$$\text{Further, } \frac{4}{\ell_1 - \ell_0} = \frac{9}{\ell_2 - \ell_0}$$

Substituting the value of ℓ_0 and solving, we get $\ell_3 = 5\ell_2 - 4\ell_1$

14. A long glass capillary tube is dipped in water. It is known that water wets glass. The water level rises by h in the tube. The tube is now pushed down so that only a length $h/2$ is outside the water surface. The angle of contact at the water surface at the upper end of the tube will be

- A) $\tan^{-1} 2$ B) 60°
C) 30° D) 15°

Solution : (Correct Answer: B)

Here, $h = \frac{2s \cos 0^\circ}{r\rho g} = \frac{2s}{r\rho g}$

According to question,

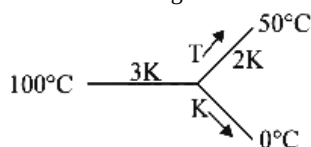
$$\frac{h}{2} = \frac{2s \cos \theta'}{r\rho g}$$

Dividing eq. (ii) by (i) we get,

$$\frac{1}{2} = \cos \theta'$$

$$\text{or } \theta' = 60^\circ$$

15. Three rods of same dimensional have thermal conductivity 3 K, 2 K and K. They are arranged as shown in the figure below



Then, the temperature of the junction in steady state is

- A) $\frac{200}{3}^\circ\text{C}$ B) $\frac{100}{3}^\circ\text{C}$
C) 75°C D) $\frac{50}{3}^\circ\text{C}$

Solution : (Correct Answer: A)

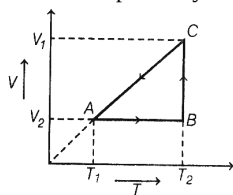
From figure, $H = H_1 + H_2$

$$\Rightarrow \frac{3KA(100-T)}{l} = \frac{2KA(T-50)}{l} + \frac{KA(T-0)}{l}$$

$$\Rightarrow 300 - 3T = 2T - 100 + T \Rightarrow 6T = 400$$

$$\Rightarrow T = \frac{200}{3}^\circ\text{C}$$

16. A cyclic process for 1 mole of an ideal is shown in the $V-T$ diagram. The work done in AB , BC and CA respectively is



- A) $0, RT_2 \ln \left| \frac{V_1}{V_2} \right|, R(T_2 - T_1)$
B) $R(T_1 - T_2), 0, RT_1 \ln \left| \frac{V_1}{V_2} \right|$
C) $0, RT_2 \ln \left| \frac{V_1}{V_2} \right|, R(T_1 - T_2)$
D) $0, RT_2 \ln \left| \frac{V_2}{V_1} \right|, R(T_2 - T_1)$

Solution : (Correct Answer: C)

Process AB is isochoric, hence $W_{AB} = 0$

Process BC is isothermal, hence

$$W_{BC} = nRT_2 \ln \left(\frac{V_1}{V_2} \right)$$

$$\text{or } W_{BC} = RT_2 \ln \left(\frac{V_1}{V_2} \right)$$

Process CA is isobaric (as, $V \propto T$)

$$\therefore W_{CA} = p(V_f - V_i) = nR(T_f - T_i)$$

$$= R(T_1 - T_2)$$

17. If $\bar{v}$, v_{rms} and v_p represent the mean speed, root mean square and most probable speed of the molecules in an ideal monoatomic gas at temperature T and if m is mass of the molecule, then

- A) $v_p < \bar{v} < v_{\text{rms}}$

- B) no molecule can have a speed greater than

$$\sqrt{2}v_{\text{rms}}$$

- C) no molecule can have a speed less than $v_p/\sqrt{2}$

- D) None of the above

Solution : (Correct Answer: A)

$$\text{Mean speed, } \bar{v} = \sqrt{\frac{8kT}{\pi m}} = 0.92v_{\text{rms}}$$

$$\text{rms speed, } v_{\text{rms}} = \sqrt{\frac{3kT}{m}}$$

$$\text{Most probable speed } v_p$$

$$= \sqrt{\frac{2kT}{m}} = 0.816v_{\text{rms}}$$

$$\text{i.e., } v_p < \bar{v} < v_{\text{rms}}$$

18. If the differential equation for a simple harmonic motion is $\frac{d^2y}{dt^2} + 2y = 0$, the time-period of the motion is

- A) $\pi\sqrt{2}\text{sec}$ B) $\frac{\sqrt{2}s}{\pi}\text{sec}$
C) $\frac{\pi}{\sqrt{2}}\text{sec}$ D) $2\pi\text{sec}$

Solution : (Correct Answer: A)

The differential equation of simple harmonic motion is

$$\frac{d^2y}{dt^2} + 2y = 0 \text{ or } \frac{d^2y}{dt^2} = -2y \dots (i)$$

Standard equation of simple harmonic motion is

$$\frac{d^2y}{dt^2} = -\omega^2 y \dots (ii)$$

Comparing eq. (i) and (ii), $\omega^2 = 2$ or $\omega = \sqrt{2}$

As we know, $\omega = \frac{2\pi}{T}$

$$\therefore \text{Time period, } T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{2}} = \pi\sqrt{2}\text{sec}$$

19. In space charge limited region, the plate current in a diode is 10 mA for plate voltage 150 V. If the plate voltage is increased to 600 V, then the plate current will be

- A) 10 mA B) 40 mA
C) 80 mA D) 160 mA

Solution : (Correct Answer: C)

In space charge limited region, the plate current is given by Child's law $i_p = KV_p^{3/2}$. Thus,

$$\frac{i_{p2}}{i_{p1}} = \left(\frac{V_{p2}}{V_{p1}} \right)^{3/2} = \left(\frac{600}{150} \right)^{3/2} = (4)^{3/2} = 8$$

$$\text{or, } i_{p2} = i_{p1} \times 8 = 10 \times 8 \text{ mA} = 80 \text{ mA} \dots (i)$$

20. Two identical light sources S_1 and S_2 emit light of same wavelength λ . These light rays will exhibit interference if

- A) their phase differences remain constant
B) their phases are distributed randomly
C) their light intensities remain constant
D) their light intensities change randomly

Solution : (Correct Answer: A)

For interference phase difference must be constant.

21. The capacity of a capacitor is $4 \times 10^{-6} \text{ F}$ and its potential is 100 V. The energy released on discharging it fully will be

- A) 0.02 J B) 0.04 J
C) 0.025 J D) 0.05 J

Solution : (Correct Answer: A)

Energy released on discharge of capacitor

$$U = \frac{1}{2} CV^2$$

$$= \frac{1}{2} \times 4 \times 10^{-6} \times (100)^2 = 0.02 \text{ J}$$

22. The transmission of high frequencies in a coaxial cable is determined by

A) $\frac{1}{(LC)^{1/2}}$ where L and C are inductance and capacitance
 B) $(LC)^2$
 C) the impedance L alone
 D) the dielectric and skin effect

Solution : (Correct Answer: D)

A coaxial cable consists of a conducting wire surrounded by a dielectric space, over which there is a sleeve of coppermesh covered with a shield of PVC insulation. The power transmission is regulated by dielectric. At high frequencies energy loss due to mesh is significant (called skin effect).

23. Two bar magnets A and B are placed one over the other and are allowed to vibrate in a vibration magnetometer. They make 20 oscillations per minute when the similar poles of A and B are on the same side, while they make 15 oscillations per minute when their opposite poles lie on the same side. If M_A and M_B are the magnetic moments of A and B and if $M_A > M_B$, the ratio of M_A and M_B is

A) 4 : 3 B) 25 : 7
 C) 7 : 5 D) 25 : 16

Solution : (Correct Answer: B)

Ratio of magnetic moments

$$\frac{M_A}{M_B} = \frac{T_d^2 + T_s^2}{T_d^2 - T_s^2} = \frac{v_s^2 + v_d^2}{v_s^2 - v_d^2}$$

$$= \frac{\left(\frac{1}{20}\right)^2 + \left(\frac{1}{15}\right)^2}{\left(\frac{1}{15}\right)^2 - \left(\frac{1}{20}\right)^2} = \frac{400 + 225}{400 - 225}$$

$$M_A : M_B = 25 : 7$$

24. A wire of length l is bent into a circular loop of radius R and carries a current I . The magnetic field at the centre of the loop is B. The same wire is now bent into a double loop of equal radii. If both loops carry the same current I and it is in the same direction, the magnetic field at the centre of the double loop will be

A) Zero B) 2 B C) 4 B D) 8 B

Solution : (Correct Answer: C)

No Solution

25. In CuSO_4 solution when electric current equal to 2.5 faraday is passed, the gm equivalent deposited on the cathode is

A) 1 B) 1.5 C) 2 D) 2.5

Solution : (Correct Answer: A)

1 faraday deposited 1 g equivalent

26. In nature, the electric charge of any system is always equal to

A) half integral multiple of the least amount of charge
 B) zero
 C) square of the least amount of charge
 D) integral multiple of the least amount of charge

Solution : (Correct Answer: D)

According to quantization of charge, the charge of any system is an integral multiple of the charge of electron which is the least amount of charge on any system.

27. The electric field of a plane electromagnetic wave in free space travelling along x-direction is given by : $E_z = 60 \sin(kx + \omega t) \text{ V/m}$.

The magnetic field component will be given as :

Here c represents the speed of light in free space.

A) $B_z = \frac{60}{c} \sin(kz + \omega t) \text{ T}$
 B) $B_z = \frac{60}{c} \sin(kx + \omega t) \text{ T}$
 C) $B_y = \frac{60}{c} \sin(ky + \omega t) \text{ T}$
 D) $B_y = \frac{60}{c} \sin(kx + \omega t) \text{ T}$

Solution : (Correct Answer: D)

Given $E_z = 60 \sin(kx + \omega t) \text{ V/m}$. The magnetic field component must be perpendicular to E_z and x .

Also $B_0 = \frac{E_0}{c} = \frac{60}{c}$. Thus

$B_y = \frac{60}{c} \sin(kx + \omega t)$.

28. A fish, looking up through the water, sees the outside world contained in a circular horizon. If the refractive index of water is $4/3$ and the fish is 12 cm below the surface of water, the radius of the circle in centimetre is

A) $\frac{12 \times 3}{\sqrt{5}}$ B) $12 \times 3 \times \sqrt{5}$
 C) $\frac{12 \times 3}{\sqrt{7}}$ D) $12 \times 3 \times \sqrt{7}$

Solution : (Correct Answer: C)

No Solution

29. When a plastic thin film of refractive index 1.45 is placed in the path of one of the interfering waves then the central fringe is displaced through width of five fringes. The thickness of the film, if the wavelength of light is $5890 \text{ \AA}$, will be

A) $6.544 \times 10^{-4} \text{ cm}$ B) $6.544 \times 10^{-4} \text{ m}$
 C) $6.54 \times 10^{-4} \text{ cm}$ D) $6.5 \times 10^{-4} \text{ cm}$

Solution : (Correct Answer: A)

$$X_0 = \frac{\beta}{\lambda} (\mu - 1) t \Rightarrow 5\beta = \frac{\beta(0.45)t}{5890 \times 10^{-10}}$$

$$\therefore t = \frac{5 \times 5890 \times 10^{-10}}{0.45} = 6.544 \times 10^{-4} \text{ cm}$$

30. A metallic surface ejects electrons. When exposed to green light of intensity I but no photoelectrons are emitted, when exposed to yellow light of intensity I. It is possible to eject electron from the same surface by

A) yellow light of same intensity which is more than I
 B) green light of any intensity
 C) red light of any intensity
 D) None of the above

Solution : (Correct Answer: A)

$$\lambda_{\text{red}} > \lambda_{\text{violet}}$$

As wavelength λ less than that of yellow colour and hence can initiate photoelectric effect irrespective of intensity.

31. The ratio of minimum wavelengths of Balmer and Paschen series of hydrogen atom will be

A) 1 : 4 B) 4 : 9 C) 9 : 4 D) 4 : 1

Solution : (Correct Answer: B)

Minimum wavelength for Balmer series,

$$\frac{1}{\lambda_{\min B}} = R \left(\frac{1}{2^2} - \frac{1}{\infty^2} \right)$$

$$\frac{1}{\lambda_{\min B}} = \frac{R}{4} \text{ or } \lambda_{\min B} = \frac{4}{R} \dots (i)$$

Similarly for Paschen series,

$$\frac{1}{\lambda_{\min P}} = R \left(\frac{1}{3^2} - \frac{1}{\infty^2} \right)$$

$$\frac{1}{\lambda_{\min P}} = \frac{R}{9} \text{ or } \lambda_{\min P} = \frac{9}{R} \dots (ii)$$

From Eqs. (i) and (ii), we get

$$\frac{\lambda_{\min B}}{\lambda_{\min P}} = \frac{4}{9} = 4 : 9$$

32. The radius of nucleus is

- A) proportional to its mass number
 B) inversely proportional to its mass number
 C) proportional to the cube root of its mass number
 D) not related to its mass number

Solution : (Correct Answer: C)

Radius of nucleus is given by $R \propto A^{1/3}$

$R = R_0 A^{1/3}$, where A = mass number

33. The amplification factor of a triode is 50. If the grid potential is decreased by 0.20 V. What increase, in plate potential will keep the plate current unchanged?

- A) 5 V B) 10 V C) 0.2 V D) 50 V

Solution : (Correct Answer: B)

Amplification factor of a triode, $\mu = \frac{p}{\Delta V_g} \Rightarrow \Delta V_p$
 $= -\mu \times \Delta V_g = -50(-20) = 10 \text{ V}$

34. The fundamental radio antenna is a metal rod which has a length equal to

- A) λ in free space at the frequency of operation
 B) $\frac{\lambda}{2}$ in free space at the frequency of operation
 C) $\frac{\lambda}{4}$ in free space at the frequency of operation
 D) $\frac{3\lambda}{4}$ in free space at the frequency of operation

Solution : (Correct Answer: C)

The common antenna is a straight conductor of length $l = \frac{\lambda}{4}$ held vertically with its lower end touching the ground.

35. Ratio of powers of a convex and concave lens is $\frac{3}{2}$ and their equivalent focal length (when lenses are kept in contact) is 30 cm. Focal lengths of lenses are

- A) 75 cm, -50 cm B) 10 cm, -15 cm
 C) 15 cm, -10 cm D) 50 cm, -75 cm

Solution : (Correct Answer: B)

$\left| \frac{P_1}{P_2} \right| = \frac{3}{2}$ So, $\frac{f_2}{f_1} = \frac{-3}{2}$

or $f_2 = \frac{-3}{2} f_1$

Now, $\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2}$ gives,

$\frac{1}{30} = \frac{1}{f_1} - \frac{2}{3f_1}$

$\Rightarrow f_1 = 10 \text{ cm}$

Hence, $f_2 = \frac{-3}{2} \times f_1 = \frac{-3}{2} \times 10$

$= -15 \text{ cm}$

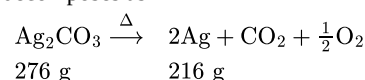
Chemistry - Section A (MCQ.)

36. 2.76 g of silver carbonate on being strongly heated yields a residue weighing

- A) 3.54 g B) 3.0 g
 C) 1.36 g D) 2.16 g

Solution : (Correct Answer: D)

Silver carbonate on being strongly heated decomposes as



As 276 g of Ag_2CO_3 gives = 216 g of Ag Hence, 2.76 g of Ag_2CO_3 will give

$$= \frac{2.76 \times 216}{276} = 2.16 \text{ g}$$

37. Which has the maximum number of molecules among the following?

- A) 44 g CO_2 B) 48 g O_3
 C) 8 g H_2 D) 64 g SO_2

Solution : (Correct Answer: C)

44 g $\text{CO}_2 = 1 \text{ mol CO}_2 = N_A$ molecules of CO_2

48 g $\text{O}_3 = 1 \text{ mol O}_3 = N_A$ molecules of O_3

8 g $\text{H}_2 = 4 \text{ mol H}_2 = 4 \times N_A$ molecules of H_2

64 g $\text{SO}_2 = 1 \text{ mol SO}_2 = N_A$ molecules of SO_2 $N_A = 6.023 \times 10^{23}$

38. The number of radial nodes in 3s and 2p respectively are

- A) 2 and 0 B) 1 and 2
 C) 0 and 2 D) 2 and 1

Solution : (Correct Answer: A)

Number of radial nodes = $n - l - 1$

For 3s, radial nodes = $3 - 0 - 1 = 2$

For 2p, radial nodes = $2 - 1 - 1 = 0$

Hence, the number of radial nodes are 2, and 0 respectively.

39. The position of both, an electron and a helium atom is known within 1.0 nm. Further the momentum of the electron is known within $5.0 \times 10^{-26} \text{ kg ms}^{-1}$. The minimum uncertainty in the measurement of the momentum of the helium atom is

- A) 50 kg ms^{-1} B) 80 kg ms^{-1}
 C) 8.0 $\times 10^{-26} \text{ kg ms}^{-1}$ D) 5.0 $\times 10^{-26} \text{ kg ms}^{-1}$

Solution : (Correct Answer: D)

By Heisenberg uncertainty Principle

$\Delta x \times \Delta p = \frac{h}{4\pi}$ (which is constant)

As Δx for electron and helium atom is same thus momentum of electron and helium will also be same therefore the momentum of helium atom is equal to $5 \times 10^{-26} \text{ kg. m. s}^{-1}$.

40. Calculate the energy needed to convert three moles of sodium atoms in the gaseous state to sodium ions. The ionization energy of sodium is 495 kJ mol^{-1} —

- A) 1485 kJ B) 495 kJ C) 148.5 kJ D) None

Solution : (Correct Answer: A)

Energy needed to convert 1 mole of sodium (g) to sodium ions = 495 kJ

$\therefore$ Energy needed to convert 3 moles of Na(g) to Na^+ ions = $495 \times 3 = 1485 \text{ kJ}$

41. Which is a planar molecule?

- A) XeO_4 B) XeF_4 C) XeOF_4 D) $\text{XeO}_2 \text{ F}_2$

Solution : (Correct Answer: B)

XeF_4 is planar

42. $\text{NH}_4\text{Cl(s)}$ is heated in a test tube. Vapours are brought in contact with red litmus paper, which changes it to blue and then to red. It is because of

- A) formation of NH_4OH and HCl
 B) formation of NH_3 and HCl
 C) greater diffusion of NH_3 than HCl
 D) greater diffusion of HCl than NH_3

Solution : (Correct Answer: C)

$\text{NH}_4\text{Cl(s)} \xrightarrow{\Delta} \text{NH}_3 \uparrow + \text{HCl} \uparrow$ Graham's law of diffusion says, lighter gas will diffuse most rapidly. Therefore, NH_3 will be (mol. wt. = 17) diffused rapidly than HCl . (mol. wt. = 36.5).

43. The values of ΔH and ΔS for the reaction, C (graphite) + $\text{CO}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$ are 170 kJ and 170 JK^{-1} , respectively. This reaction will be spontaneous at

- A) 910 K B) 1110 K C) 510 K D) 710 K

Solution : (Correct Answer: B)

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

At equilibrium, $\Delta G = 0$

$$\Rightarrow 0 = (170 \times 10^3 \text{ J}) - T (170 \text{ JK}^{-1})$$

$$\Rightarrow T = 1000 \text{ K}$$

For spontaneity, ΔG is -ve, which is possible only if $T > 1000 \text{ K}$.

44. For the reaction



$$(K_c = 1.8 \times 10^{-6} \text{ at } 184^\circ\text{C}) (R = 0.0831 \text{ kJ}/(\text{mol.K}))$$

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

- A) Whether K_p is greater than, less than or equal to K_c depends upon the total gas pressure
 B) $K_p = K_c$
 C) K_p is less than K_c
 D) K_p is greater than K_c

Solution : (Correct Answer: D)

For the reaction:-



Given $K_c = 1.8 \times 10^{-6}$ at 184°C R

$$= 0.00831 \text{ kJ}/\text{mol.K}$$

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

$$\Delta n_g = 3 - 2 = 1$$

$$K_p = 1.8 \times 10^{-6} \times 0.00831 \times 457$$

$$= 6.836 \times 10^{-6}$$

Hence it is clear that $K_p > K_c$

45. 20ml of 0.1M acetic acid is mixed with 50 mL of potassium acetate. K_a of acetic acid = 1.8×10^{-5} at 27°C . Calculate concentration of potassium acetate if pH of the mixture is 4.8.

- A) 0.1M B) 0.04M C) 0.4M D) 0.02M

Solution : (Correct Answer: A)

Let the concentration of potassium acetate is x .

According to Henderson's equation,

$$\text{pH} = \text{p}K_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$

$$4.8 = -\log(1.8 \times 10^{-5}) + \log \frac{x \times 50}{20 \times 0.1M}$$

$$4.8 = 4.74 + \log 25x$$

$$\text{or } \log 25x = 0.06$$

$$25x = 1.148$$

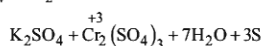
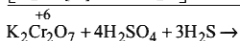
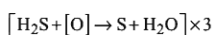
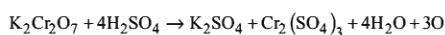
$$\therefore x = 0.045M$$

46. Acidified potassium dichromate is treated with hydrogen sulphide. In the reaction, the oxidation number of chromium

- A) Increases from +3 to +6
 B) Decreases from +6 to +3
 C) Remains unchanged
 D) Decreases from +6 to +2

Solution : (Correct Answer: B)

Decreases from +6 to +3.



47. The correct order of the thermal stability of hydrogen halides (H - X) is

- A) $\text{HI} > \text{HCl} < \text{HF} > \text{HBr}$
 B) $\text{HCl} < \text{HF} > \text{HBr} < \text{HI}$
 C) $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$
 D) $\text{HI} < \text{HBr} > \text{HCl} < \text{HF}$

Solution : (Correct Answer: C)

The H - X bond strength decreases from HF to HI. i.e. $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$. Thus HF is most stable

while HI is least stable. The decreasing stability of the hydrogen halide is also reflected in the values of dissociation energy of the H - X bond

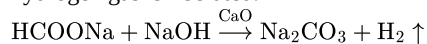
H - F	H - Cl	H - Br	H - I
135 kcal/mol ⁻¹	103 kcal/mol ⁻¹	87 kcal/mol ⁻¹	71 kcal/mol ⁻¹

48. The gas evolved on heating alkali formate with soda-lime is

- A) CO
 B) CO₂
 C) Hydrogen
 D) water vapor

Solution : (Correct Answer: C)

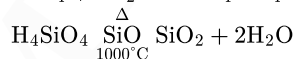
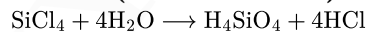
Alkali formate i.e. HCOONa with soda-lime i.e. NaOH + CaO will react to give Na₂CO₃ and hydrogen gas is liberated.



49. SiCl₄ on hydrolysis forms 'X' and HCl. Compound 'X' loses water at 1000°C and gives 'Y'. Compounds 'X' and 'Y' respectively are

- A) H₂SiCl₆, SiO₂ B) H₄SiO₄, Si
 C) SiO₂, Si D) H₄SiO₄, SiO₂

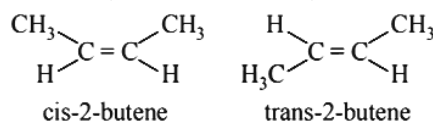
Solution : (Correct Answer: D)



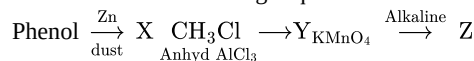
50. Which one of the following show stereoisomerism?

- A) 2-Butene B) 3-Methyl but-1-ene
 C) 2-Methyl butene, D) Butanol

Solution : (Correct Answer: A)

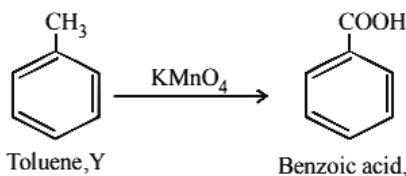
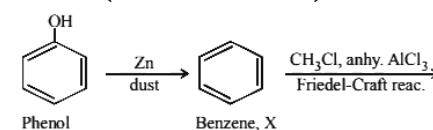


51. What is Z in the following sequence of reactions?



- A) Benzene B) Toluene
 C) Benzaldehyde D) Benzoic acid

Solution : (Correct Answer: C)



52. How many lattice points belong to a face centered cubic unit cell?

- A) 1 B) 2 C) 4 D) 3

Solution : (Correct Answer: C)

In face centred cubic lattice, the atoms are present at eight corners of faces and one each at 6 faces.

$$\therefore \text{Lattice points belonging to face centred cubic unit cell} = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$$

53. If the elevation in boiling point of a solution of 10 g of solute (mol.wt = 100) in 100 g of water is ΔT_b , the ebullioscopic constant of water is

- A) 10 B) 100T_b

C) ΔT_b D) $\frac{\Delta T_b}{10}$

Solution : (Correct Answer: C)

We know that, $\Delta T_b = \frac{1000 \times K_b \times w}{W \times M}$

$$M = \frac{1000 \times K_b \times w}{W \times \Delta T_b}$$

$$\Delta T_b = \frac{1000 \times K_b \times 10}{100 \times 100}$$

$$\Delta T_b = K_b$$

54. How long (in hours) must a current of 5.0 amperes be maintained to electroplate 60 g of calcium from molten CaCl_2 ?

A) 27 hours B) 8.3 hours
C) 11 hours D) 16 hours

Solution : (Correct Answer: D)

$$\text{Eq. mass of } \text{Ca}^{++} = \frac{\text{Mol. mass}}{2} = \frac{40}{2} = 20$$

$$Z = \frac{\text{Eq. mass of water}}{96500} = \frac{20}{96500}$$

$$\text{Given } w = 60 \text{ g, } i = 5 \text{ amp}$$

$$w = zit$$

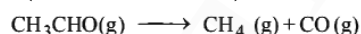
$$\text{or } 60 = \frac{20}{96500} \times 5 \times t$$

$$\therefore t = \frac{96500 \times 60}{20 \times 5} = 57900 \text{ sec} = 16 \text{ h}$$

55. The half life of the first order reaction $\text{CH}_3\text{CHO(g)} \rightarrow \text{CH}_4\text{(g)} + \text{CO(g)}$
If initial pressure of $\text{CH}_3\text{CHO(g)}$ is 80 mmHg and the total pressure at the end of 20 minutes is 120 mmHg

A) 80 min B) 120 min C) 20 min D) 40 min

Solution : (Correct Answer: C)



$$\text{When } t = 0 \quad p^0 \quad 0 \quad 0$$

$$\text{When } t = t \quad p^0 - p \quad p \quad p$$

$$\therefore p^0 - p + p + p = 120 \text{ mmHg}$$

$$\text{or, } p^0 + p = 120 \text{ mmHg;}$$

$$p = 120 - 80 = 40 \text{ mmHg}$$

$$k = \frac{1}{t} \ln \frac{p^0}{p^0 - p} = \frac{1}{20} \ln \frac{80}{80 - 40} = \frac{1}{20} \ln 2$$

$$\text{Again, } t_{1/2} = \frac{\ln 2}{k}$$

$$\therefore t_{1/2} = \frac{\ln 2}{\frac{1}{20} \ln 2} \times 20 = 20 \text{ min}$$

56. Peptisation involves

A) precipitation of colloidal particles
B) disintegration of colloidal aggregates
C) evaporation of dispersion medium
D) impact of molecules of the dispersion medium on the colloidal particles

Solution : (Correct Answer: B)

Peptisation is the process in which freshly prepared precipitate disintegrates into colloidal solution.

57. Purest form of iron is

A) pig iron B) wrought iron
C) cast iron D) steel

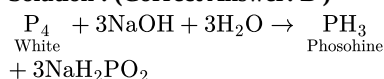
Solution : (Correct Answer: B)

The purest form of iron is wrought or malleable.

58. Phosphine is generally prepared in the laboratory:

A) By heating phosphorus in a current of hydrogen
B) By heating white phosphorus with an aqueous solution of caustic potash
C) By decomposition of P_2H_4 at 110°C
D) By heating red phosphorus with an aqueous solution of caustic soda

Solution : (Correct Answer: B)



59. In which of the following pairs both the ions are coloured in aqueous solutions ?

A) Sc^{3+} , Ti^{3+} B) Sc^{3+} , Co^{2+}
C) Ni^{2+} , Cu^+ D) Ni^{2+} , Ti^{3+}

Solution : (Correct Answer: D)

Sc^{3+} (Z = 18) : $1s^2, 2s^2p^6, 3s^2p^6d^0, 4s^0$; no unpaired electron.

Cu^+ (Z = 28) : $1s^2, 2s^2p^6, 3s^2p^6d^{10}, 4s^0$; no unpaired electron.

Ni^{2+} (Z = 26) : $1s^2, 2s^2p^6, 3s^2p^6d^8, 4s^0$

unpaired electrons are present.

Ti^{3+} (Z = 19) : $1s^2, 2s^2p^6, 3s^2p^6d^1, 4s^0$;

unpaired electron is present

Co^{2+} (Z = 25) : $1s^2, 2s^2p^6, 3s^2p^6d^7, 4s^0$;

unpaired electrons are present

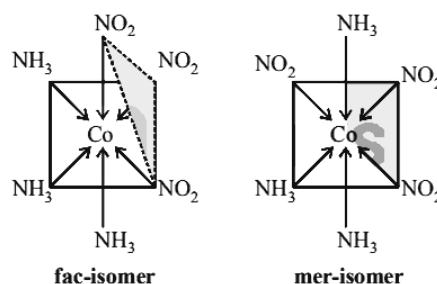
So from the given options the only correct combination is Ni^{2+} and Ti^{3+} .

60. Which of the following complex will show fac & mer isomerism?

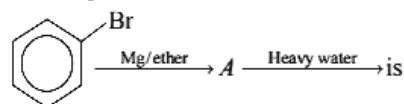
A) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$
B) $[\text{CoCl}_2(\text{en})_2]^+$
C) $[(\text{Co}(\text{NH}_3)\text{Cl}(\text{en})_2)]^{2+}$
D) $[\text{Co}(\text{NH}_3)_2\text{Cl}_2(\text{en})]^+$

Solution : (Correct Answer: A)

Complexes of the type MA_3B_3 exist in two geometrical forms which are named as facial (fac-) and meridional (mer-isomers). $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$ may be represented in fac- and mer-isomeric forms as follows.

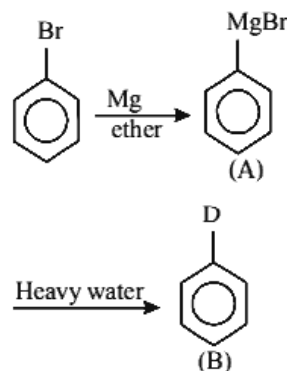


61. The final product obtained in the reaction,



A) B) C) D)

Solution : (Correct Answer: B)



62. Which of the following gives red colour in Victor Meyer's test?

A) n-propyl alcohol B) Isopropyl alcohol
C) tert-butyl alcohol D) sec-butyl alcohol

Solution : (Correct Answer: A)

In Victor Meyer's test, Red colour is given by primary alcohols (1°) (alcohols having CH_2OH). The structures of the given Alcohols are

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
n-propyl alcohol (1°)
 (b) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
iso-propyl alcohol (2°)
 (c) $\text{CH}_3\text{C}(\text{OH})(\text{CH}_3)_2$
tert-butyl alcohol (3°)
 (d) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
sec-butyl alcohol (2°)

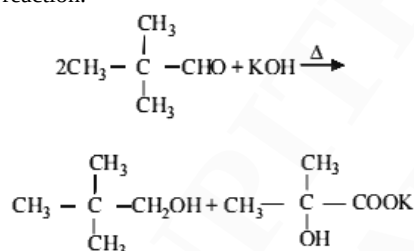
Hence, *n*-propyl alcohol is a 1° alcohol and gives red colour in Victor-Meyer's test.

63. Which of the following will give Cannizzaro reaction?

- A) CH_3CHO B) CH_3COCH_3
 C) $(\text{CH}_3)_3\text{C}-\text{CHO}$ D) $\text{CH}_3\text{CH}_2\text{CHO}$

Solution : (Correct Answer: C)

Aldehydes which have no α -H atom give Cannizzaro's reaction, $(\text{CH}_3)_3\text{C}-\text{CHO}$ does not contain α -H atom, hence it will give Cannizzaro reaction.

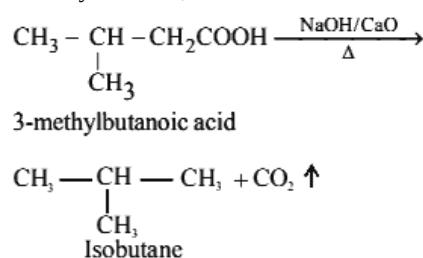


64. Which of the following reactions is used to prepare isobutane?

- A) Wurtz reaction of $\text{C}_2\text{H}_5\text{Br}$
 B) Hydrolysis of *n*-butylmagnesium iodide
 C) Reduction of propanol with red phosphorus and HI
 D) Decarboxylation of 3-methylbutanoic acid

Solution : (Correct Answer: D)

3-methylbutanoic acid gives isobutane on decarboxylation i.e.,



While Wurtz reaction of $\text{C}_2\text{H}_5\text{Br}$ gives *n*-butane and hydrolysis of *n*-butyl magnesium bromide gives *n*-butane but reduction of propanol with HI/P gives propane.

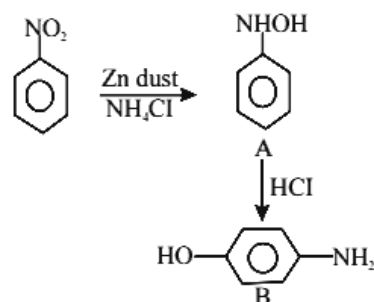
65. $\text{C}_6\text{H}_5-\text{NO}_2 \xrightarrow[\text{NH}_4\text{Cl}]{\text{Zn dust}} \text{A} \xrightarrow[\text{conc. HCl}]{\text{cold}} \text{B}$

A and B respectively are

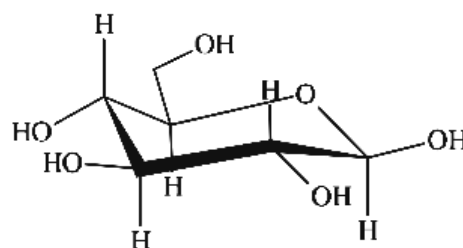
- A) $\text{C}_6\text{H}_5-\text{NHOH}$, $\text{HO}-\text{C}_6\text{H}_4-\text{NH}_2$ B) $\text{C}_6\text{H}_5-\text{NH}-\text{NH}-\text{C}_6\text{H}_5$
 $\text{H}_2\text{N}-\text{C}_6\text{H}_4-\text{C}_6\text{H}_4-\text{NH}_2$

- C) $\text{C}_6\text{H}_5-\text{N}(\text{O})=\text{N}-\text{C}_6\text{H}_5$ D) None of the above
 $\text{C}_6\text{H}_5-\text{N}(\text{O})=\text{N}-\text{C}_6\text{H}_4-\text{NH}_2$

Solution : (Correct Answer: A)

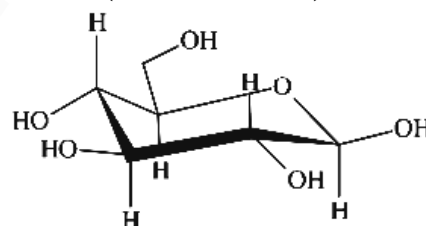


66. The following carbohydrate is



- A) a ketohexose
 B) an aldohexose
 C) an α -furanose
 D) an α -pyranose

Solution : (Correct Answer: B)



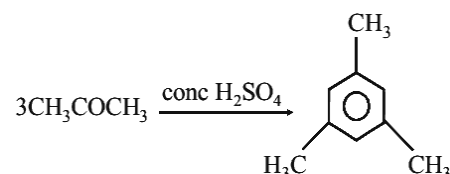
It is a β -pyranose hence it is an aldohexose.

67. Which of these undergo polymerisation?

- A) CH_3OH B) $\text{C}_2\text{H}_5\text{OH}$
 C) CH_3CHO D) none of these

Solution : (Correct Answer: C)

Acetone on polymerisation give mesitylene



3 molecules of acetaldehyde produce paraldehyde $(\text{CH}_3\text{CHO})_3$ and 4 molecules of it produce metaldehyde $(\text{CH}_3\text{CHO})_4$.

68. Glycerine is used as a preservative for fruits and eatables because

- A) it makes them sweet
 B) it acts as an insecticide
 C) it keeps the food moist
 D) all of the above

Solution : (Correct Answer: C)

Glycerine is used as a preservative because it keeps the fruitmoist.

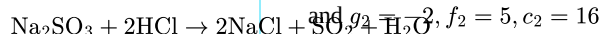
69. Compound A and B are treated with dil. HCl separately. The gases liberated are Y and Z respectively. Y turns acidified dichromate paper green while Z turns lead acetate paper black. The compound A and B are respectively.

- A) Na_2CO_3 and NaCl
 B) Na_2SO_3 and Na_2S
 C) Na_2S and Na_2SO_3
 D) Na_2SO_3 and Na_2SO_4

Solution : (Correct Answer: B)

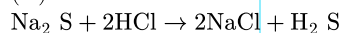
Gas (Y) SO_2 which can be obtained from Na_2SO_3 (A) and gas (Z) is H_2S which can be obtained from Na_2S (B).

This can be easily understood by the following reactions.

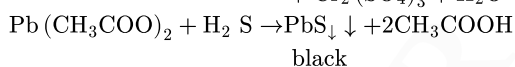
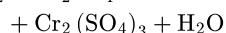
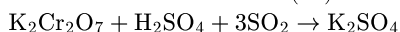


(A)

(Y)



(B)



black

70. Which of the following does not give a white precipitate with sodium bisulphide?

- A) Acetone B) Formaldehyde
 C) Benzophenone D) Acetaldehyde

Solution : (Correct Answer: C)

Sodium bisulphite reacts with aldehydes and simple methyl ketones to form white crystalline adducts.

Benzophenone is a hindered ketone (diphenyl), so it does not react appreciably with NaHSO_3 .

Maths - Section A (MCQ)

71. Dual of $(x + y) \cdot (x + 1) = x + x \cdot y + y$ is

- A) $(x \cdot y) + (x \cdot 0) = x \cdot (x + y) \cdot y$
 B) $(x + y) + (x, 1) = x \cdot (x + y) \cdot y$
 C) $(x \cdot y)(x \cdot 0) = x \cdot (x + y) \cdot y$
 D) None of the above

Solution : (Correct Answer: A)

$$(x + y) \cdot (x + 1) = x + x \cdot y + y$$

Replace 'by' 't', '+by' '1' by '0', we

$$\text{get } (x \cdot y) + (x \cdot 0) = x \cdot (x + y) \cdot y$$

72. If one root of the equation $(l - m)x^2 + lx + 1 = 0$ is double of the other and if l is real then the greatest value of m is ($l \neq m$) :

- A) $\frac{1}{3}$ B) $\frac{8}{9}$ C) $\frac{9}{8}$ D) 3

Solution : (Correct Answer: C)

Let the roots of the equation be α and 2α , then

$$\alpha + 2\alpha = \frac{l}{m-l} \text{ and } \alpha \cdot 2\alpha = \frac{1}{l-m}$$

$$\Rightarrow \alpha = \frac{l}{3(m-l)} \text{ and } \alpha^2 = \frac{1}{2(l-m)}$$

Eliminating α , we get

$$\frac{l^2}{9(m-l)^2} = \frac{1}{2(l-m)} \Rightarrow 2l^2 - 9l + 9m = 0$$

$$\text{Since } l \text{ is real, so } (-9)^2 - 4 \cdot 2 \cdot 9m \geq 0$$

$$\Rightarrow m \leq \frac{9}{8}$$

73. If two circles $2x^2 + 2y^2 - 3x + 6y + k = 0$ and $x^2 + y^2 - 4x + 10y + 16 = 0$ cut orthogonally, then the value of k is

- A) 41 B) 14 C) 4 D) 1

Solution : (Correct Answer: C)

The given two circles are

$$2x^2 + 2y^2 - 3x + 6y + k = 0 \dots (i)$$

$$\Rightarrow x^2 + y^2 - \frac{3}{2}x + 3y + \frac{k}{2} = 0 \dots (ii)$$

Since, general equation of circle is

$$x^2 + y^2 + 2gx + 2fy + c = 0 \dots (iii)$$

Therefore, comparing eqs. (i) and (ii) with eq. (iii), we get

$$g_1 = -\frac{3}{4}, f_1 = \frac{3}{2}, c_1 = \frac{k}{2}$$

$$\text{and } g_2 = -2, f_2 = 5, c_2 = 16$$

Both the circles cut orthogonally,

$$\therefore 2(g_1g_2 + f_1f_2) = c_1 + c_2$$

$$\Rightarrow 2\left(\frac{3}{2} + \frac{15}{2}\right) = \frac{k}{2} + 16$$

$$\Rightarrow 18 = \frac{k}{2} + 16 \Rightarrow \frac{k}{2} = 2 \Rightarrow k = 4$$

74. Amplitude of $\frac{1+\sqrt{3}i}{\sqrt{3}+1}$ is :

- A) $\frac{\pi}{6}$ B) $\frac{\pi}{4}$ C) $\frac{\pi}{3}$ D) $\frac{\pi}{2}$

Solution : (Correct Answer: C)

Let $r(\cos \theta + i \sin \theta)$

$$= \frac{1+i\sqrt{3}}{\sqrt{3}+1} = \frac{1}{\sqrt{3}+1} + i \frac{\sqrt{3}}{\sqrt{3}+1}$$

$$\Rightarrow r \cos \theta = \frac{1}{\sqrt{3}+1}; r \sin \theta = \frac{\sqrt{3}}{\sqrt{3}+1}$$

75. If $x + iy = (1 - i\sqrt{3})^{100}$, then find (x, y) .

- A) $(2^{99}, 2^{99}\sqrt{3})$
 B) $(2^{99}, -2^{99}\sqrt{3})$
 C) $(-2^{99}, 2^{99}\sqrt{3})$
 D) None of these

Solution : (Correct Answer: C)

$$\therefore \text{ROR}^{-1} = \{(3, 3), (3, 5), (5, 3), (5, 5)\}$$

$$(1 - i\sqrt{3})^{100} = 2^{100} \left(-\frac{1}{2} + \frac{i\sqrt{3}}{2}\right)^{100} = 2^{100} \omega^{100}$$

$$= 2^{100} \omega = 2^{100} \left(-\frac{1}{2} + \frac{\sqrt{3}i}{2}\right) = -2^{99} + 2^{99}\sqrt{3}i$$

$$\text{Now, } x + iy = (1 - i\sqrt{3})^{100}$$

$$= -2^{99} + 2^{99}\sqrt{3}i$$

$$\Rightarrow x = -2^{99}, y = 2^{99}\sqrt{3}$$

$$\therefore (x, y) = (-2^{99}, 2^{99}\sqrt{3})$$

76. There are 5 letters and 5 different envelopes. The number of ways in which all the letters can be put in wrong envelope, is

- A) 119 B) 44 C) 59 D) 40

Solution : (Correct Answer: B)

Required numbers

$$= 5! \left[1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \frac{1}{5!}\right] = 44$$

Note that if $r(0 \leq r \leq n)$ objects occupy the original places and none of the remaining $(n - r)$ objects occupies its original places then the number of such arrangements

$$= {}^nC_r \cdot (n - r)!$$

$$\left[1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \dots + (-1)^{n-2} \frac{1}{(n-r)!}\right]$$

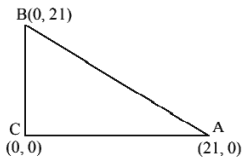
77. The number of integral points (integral point means both the coordinates should be integer) exactly in the interior of the triangle with vertices $(0, 0)$, $(0, 21)$ and $(21, 0)$ is

A) 133 B) 190 C) 233 D) 105

Solution : (Correct Answer: B)

$$x + y = 21$$

The number of integral solutions to the equations are $x + y < 21$, i.e., $x < 21 - y$



$$\begin{aligned} \therefore \text{Number of integral coordinates} &= 19 + 18 + \dots \\ &+ 1 \\ &= \frac{19(19+1)}{2} = \frac{19 \times 20}{2} = 190 \end{aligned}$$

78. If $\Delta(r) = \begin{vmatrix} r & r^3 \\ 1 & n(n+1) \end{vmatrix}$, then $\sum_{r=1}^n \Delta(r)$ is equal to

A) $\sum_{r=1}^n r^2$ B) $\sum_{r=1}^n r^3$
C) $\sum_{r=1}^n r$ D) $\sum_{r=1}^n r^4$

Solution : (Correct Answer: B)

$$\begin{aligned} \Delta(r) &= \begin{vmatrix} r & r^3 \\ 1 & n(n+1) \end{vmatrix} \\ \Rightarrow \sum_{r=1}^n \Delta(r) &= \begin{vmatrix} \sum_{r=1}^n r & \sum_{r=1}^n r^3 \\ 1 & n(n+1) \end{vmatrix} \\ &= \begin{vmatrix} \frac{n(n+1)}{2} & \frac{[n(n+1)]^2}{4} \\ 1 & n(n+1) \end{vmatrix} \\ &= \frac{[n(n+1)]^2}{4} - \frac{[n(n+1)]^2}{4} \\ &= \frac{[n(n+1)]^2}{4} = \sum_{r=1}^n r^3 \end{aligned}$$

79. Let a, b and c be in AP and $|a| < 1$, $|b| < 1$, $|c| < 1$.

$$x = 1 + a + a^2 + \dots \text{ to } \infty$$

$$y = 1 + b + b^2 + \dots \text{ to } \infty$$

$$z = 1 + c + c^2 + \dots \text{ to } \infty, \text{ then } x, y \text{ and } z \text{ are in}$$

A) AP B) GP
C) HP D) None of these

Solution : (Correct Answer: C)

$$x = 1 + a + a^2 + \dots \infty = \frac{1}{1-a}$$

$$y = 1 + b + b^2 + \dots \infty = \frac{1}{1-b}$$

$$\text{and } z = 1 + c + c^2 + \dots \infty = \frac{1}{1-c}$$

Since, a, b and c are in AP.

$$\Rightarrow 1-a, 1-b \text{ and } 1-c \text{ are also in AP}$$

$$\Rightarrow \frac{1}{1-a}, \frac{1}{1-b} \text{ and } \frac{1}{1-c} \text{ are in HP.}$$

$\therefore x, y$ and z are in HP.

Note that if the common ratio of a GP is not less than 1, then we do not determine the sum of an infinite GP that series.

80. If $A(-2, 1)$, $B(2, 3)$ and $C(-2, -4)$ are three points. Then, the angle between BA and BC is

A) $\tan^{-1}\left(\frac{2}{3}\right)$
B) $\tan^{-1}\left(\frac{3}{2}\right)$
C) $\tan^{-1}\left(\frac{1}{3}\right)$
D) $\tan^{-1}\left(\frac{1}{2}\right)$

Solution : (Correct Answer: A)

$A(-2, 1)$, $B(2, 3)$ and $C(-2, -4)$ are three given points.

Slope of the line BA

$$m_1 = \frac{1-3}{-2-2} = \frac{1}{2}$$

$$\left(\text{Using slope formula, } m = \frac{y_2 - y_1}{x_2 - x_1} \right)$$

Slope of the line BC

$$m_2 = \frac{-4-3}{-2-2} = \frac{7}{4}$$

Now, angle between AB and BC is given by

$$\begin{aligned} \tan \theta &= \left| \frac{m_1 - m_2}{1 + m_1 m_2} \right| = \left| \frac{\frac{1}{2} - \frac{7}{4}}{1 + \frac{1}{2} \cdot \frac{7}{4}} \right| \\ \Rightarrow \tan \theta &= \left| -\frac{10}{15} \right| \Rightarrow \tan \theta = \left| -\frac{2}{3} \right| \\ \Rightarrow \theta &= \tan^{-1} \left| -\frac{2}{3} \right| \Rightarrow \theta = \tan^{-1} \left(\frac{2}{3} \right) \\ [\because |-x| &= x] \end{aligned}$$

81. A steam boat is moving at velocity V when steam is shut off. Given that the retardation at any subsequent time is equal to the magnitude of the velocity at that time. The velocity v in time t after steam is shut off is

A) $v = Vt$ B) $v = Vt - V$
C) $v = Ve^t$ D) $V = Ve^{-t}$

Solution : (Correct Answer: D)

The retardation at time $t = -\frac{dv}{dt}$. Hence, the differential equation is

$$-\frac{dv}{dt} = v \Rightarrow \frac{dv}{v} = -dt \dots (i)$$

Integrating, we get $\log v = -t + c \dots (ii)$

$$\text{When } t = 0, v = V \Rightarrow C = \log V$$

The equation (ii) becomes $\log v = -t + \log V$

$$\Rightarrow \log \frac{v}{V} = -t \Rightarrow \frac{v}{V} = e^{-t} \Rightarrow v = Ve^{-t}$$

82. If $12 \cot^2 \theta - 31 \operatorname{cosec} \theta + 32 = 0$, then the value of $\sin \theta$ is

A) $\frac{3}{5}$ or $\frac{1}{5}$ B) $\frac{2}{3}$ or $\frac{-2}{3}$
C) $\frac{4}{5}$ or $\frac{3}{4}$ D) $(d) \pm \frac{1}{2}$

Solution : (Correct Answer: C)

$$12 \cot^2 \theta - 31 \operatorname{cosec} \theta + 32 = 0$$

$$\Rightarrow 12 (\operatorname{cosec}^2 \theta - 1) - 31 \operatorname{cosec} \theta + 32 = 0$$

$$\Rightarrow 12 \operatorname{cosec}^2 \theta - 31 \operatorname{cosec} \theta + 20 = 0$$

$$\Rightarrow 12 \operatorname{cosec}^2 \theta - 16 \operatorname{cosec} \theta - 15 \operatorname{cosec} \theta + 20 = 0$$

$$\Rightarrow (4 \operatorname{cosec} \theta - 5)(3 \operatorname{cosec} \theta - 4) = 0$$

$$\Rightarrow \operatorname{cosec} \theta = \frac{5}{4}, \frac{4}{3} \therefore \sin \theta = \frac{4}{5}, \frac{3}{4}$$

83. If $3 \cos x \neq 2 \sin x$, then the general solution of $\sin^2 x - \cos 2x = 2 - \sin 2x$ is

A) $n\pi + (-1)^n \frac{\pi}{2}, n \in \mathbb{Z}$ B) $\frac{n\pi}{2}, n \in \mathbb{Z}$
C) $(4n \pm 1) \frac{\pi}{2}, n \in \mathbb{Z}$ D) $(2n - 1)\pi, n \in \mathbb{Z}$

Solution : (Correct Answer: C)

$$\sin^2 x - \cos 2x = 2 - \sin 2x$$

$$\Rightarrow 1 - \cos^2 x - (2 \cos^2 x - 1) = 2 - 2 \sin x \cos x$$

$$\Rightarrow -3 \cos^2 x + 2 \sin x \cos x = 0$$

$$\Rightarrow \cos x (2 \sin x - 3 \cos x) = 0$$

$$\Rightarrow \cos x = 0, (\because 2 \sin x - 3 \cos x \neq 0)$$

$$\Rightarrow x = 2n\pi \pm \frac{\pi}{2}$$

$$\Rightarrow x = (4n \pm 1) \frac{\pi}{2}, n \in \mathbb{Z}$$

$$\Rightarrow x = 2n\pi \pm \frac{\pi}{2}$$

$$\Rightarrow x = (4n \pm 1) \frac{\pi}{2}, n \in \mathbb{Z}$$

84. If $(-4, 5)$ is one vertex and $7x - y + 8 = 0$ is one diagonal of a square, then the equation of second diagonal is

- A) $x + 3y = 21$ B) $2x - 3y = 7$
 C) $x + 7y = 31$ D) $2x + 3y = 21$

Solution : (Correct Answer: C)

One vertex of square is $(-4, 5)$ and equation of one diagonal is $7x - y + 8 = 0$

Diagonal of a square are perpendicular and bisect each other

Let the equation of the other diagonal be $y = mx + c$ where m is the slope of the line and c is the y -intercept.

Since this line passes through $(-4, 5)$

$$\therefore 5 = -4m + c$$

Since this line is at right angle to the line

$7x - y + 8 = 0$ or $y = 7x + 8$, having slope $= 7$,

$$\therefore 7 \times m = -1 \text{ or } m = -\frac{1}{7}$$

Putting this value of m in equation (i) we get

$$5 = -4 \times \left(-\frac{1}{7}\right) + c$$

$$\text{or } 5 = \frac{4}{7} + c \quad \text{or } c = 5 - \frac{4}{7} = \frac{31}{7}$$

Hence equation of the other diagonal is

$$y = -\frac{1}{7}x + \frac{31}{7} \text{ or } 7y = -x + 31$$

$$\text{or } x + 7y - 31 = 0 \text{ or } x + 7y = 31.$$

85. The angle between the tangents at those points on the curve $x = t^2 + 1$ and $y = t^2 - t - 6$ where it meets x -axis is

- A) $\pm \tan^{-1} \left(\frac{4}{29}\right)$
 B) $\pm \tan^{-1} \left(\frac{5}{49}\right)$
 C) $\pm \tan^{-1} \left(\frac{10}{49}\right)$
 D) $\pm \tan^{-1} \left(\frac{8}{29}\right)$

Solution : (Correct Answer: C)

Equation of the given curve in parametric form,

$$x = t^2 + 1 \text{ and } y = t^2 - t - 6$$

Y -coordinate of the point, where the given curve meets X -axis is 0.

$$\text{When } y = 0, \text{ then } t^2 - t - 6 = 0$$

$$\Rightarrow t^2 - 3t + 2t - 6 = 0$$

$$\Rightarrow t(t - 3) + 2(t - 3) = 0$$

$$\Rightarrow (t - 3)(t + 2) = 0$$

$$\Rightarrow t = 3 \text{ or } -2$$

when $t = 3$, then $x = 10$

when $t = -2$, then $x = 5$

Hence, the points where the curve meets the X -axis are $(10, 0)$ and $(5, 0)$.

$$\text{Now, } \frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{2t-1}{2t}$$

Slope of the tangent at point $(10, 0)$

$$m_1 = \left[\frac{dy}{dx}\right]_{x=10} = \left[\frac{dy}{dx}\right]_{t=3} = \frac{5}{6}$$

Slope of the tangent at point $(5, 0)$,

$$m_2 = \left[\frac{dy}{dx}\right]_{x=5} = \left[\frac{dy}{dx}\right]_{t=-2} = \frac{-5}{-4} = \frac{5}{4}$$

If θ be the angle between two tangents, then

$$\tan \theta = \left| \frac{m_2 - m_1}{1 + m_1 m_2} \right| = \left| \frac{\frac{5}{4} - \frac{5}{6}}{1 + \frac{5}{6} \cdot \frac{5}{4}} \right|$$

$$= \left| \frac{\frac{15-10}{12}}{\frac{24+25}{24}} \right| = \left| \frac{\frac{5}{12}}{\frac{49}{24}} \right| = \left| \frac{10}{49} \right|$$

$$\Rightarrow \tan \theta = \pm \frac{10}{49}$$

$$\therefore \theta = \tan^{-1} \left(\pm \frac{10}{49}\right) = \pm \tan^{-1} \left(\frac{10}{49}\right)$$

86. Two common tangents to the circle $x^2 + y^2 = 2a^2$ and parabola $y^2 = 8ax$ are

- A) $x = \pm(y + 2a)$ B) $y = \pm(x + 2a)$
 C) $x = \pm(y + a)$ D) $y = \pm(x + a)$

Solution : (Correct Answer: B)

Any tangent to the parabola $y^2 = 8ax$ is

$$y = mx + \frac{2a}{m} \dots (i)$$

If (i) is a tangent to the circle, $x^2 + y^2 = 2a^2$ then,

$$\sqrt{2}a = \pm \frac{2a}{m\sqrt{m^2 + 1}}$$

$$\Rightarrow m^2(1 + m^2) = 2 \Rightarrow (m^2 + 2)(m^2 - 1) = 0; \Rightarrow m = \pm 1.$$

So from (i), $y = \pm(x + 2a)$.

87. The equation of the tangent to the parabola $y^2 = 6x$ at the point whose ordinate is 6, is

- A) $x + 2y + 6 = 0$ B) $2x - y + 6 = 0$
 C) $x - 2y + 6 = 0$ D) $x - y + 6 = 0$

Solution : (Correct Answer: C)

Let x_1 be the abscissa of the point whose ordinate is 6.

Since the point $(x_1, 6)$ lies on $y^2 = 6x$,

$$\therefore 36 = 6x_1 \text{ or } x_1 = 6$$

$\therefore$ The point is $(6, 6)$

Equation of tangent at $(6, 6)$ is

$$y \cdot 6 = 2 \cdot \frac{3}{2}(x + 6) \quad (\because yy_1 = 2a(x + x_1))$$

$$\text{or } x - 2y + 6 = 0$$

88. The eccentricity of the ellipse whose major axis is three times the minor axis is:

- A) $\frac{\sqrt{2}}{3}$ B) $\frac{\sqrt{3}}{2}$
 C) $\frac{2\sqrt{2}}{3}$ D) $\frac{2}{\sqrt{3}}$

Solution : (Correct Answer: C)

Let a be the major axis and b , the minor axis of the ellipse, then $3 \text{ minor axis} = \text{major axis} \Rightarrow 3b = a$
 Eccentricity is given by :

$$b^2 = a^2(1 - e^2)$$

$$\Rightarrow b^2 = 9b^2(1 - e^2)$$

$$\Rightarrow \frac{1}{9} = (1 - e^2) \Rightarrow e^2 = \frac{8}{9} \Rightarrow e = \frac{2\sqrt{2}}{3}$$

89. The differential equation of the system of all circles of radius r in the XY plane is

- A) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = r^2 \left(\frac{d^2y}{dx^2}\right)^2$
 B) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = r^2 \left(\frac{d^2y}{dx^2}\right)^3$
 C) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = r^2 \left(\frac{d^2y}{dx^2}\right)^2$
 D) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = r^2 \left(\frac{d^2y}{dx^2}\right)^3$

Solution : (Correct Answer: C)

The equation of the family of circles of radius r is $(x - a)^2 + (y - b)^2 = r^2 \dots (1)$

Where a & b are arbitrary constants.

Since equation (1) contains two arbitrary constants, we differentiate it two times w.r.t. x & the differential equation will be of second order.

Differentiating (1) w.r.t. x , we get

$$2(x - a) + 2(y - b) \frac{dy}{dx} = 0$$

$$\Rightarrow (x - a) + (y - b) \frac{dy}{dx} = 0 \dots (2)$$

Differentiating (2) w.r.t. x , we get

$$1 + (y-b) \frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 = 0 \dots (3)$$

$$\Rightarrow (y-b) = -\frac{1 + \left(\frac{dy}{dx}\right)^2}{\frac{d^2y}{dx^2}} \dots (4)$$

On putting the value of $(y-b)$ in equation (2), we get

$$x-a = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right] \frac{dy}{dx}}{\frac{d^2y}{dx^2}} \dots (5)$$

Substituting the values of $(x-a)$ & $(x-b)$ in (1), we get

$$\begin{aligned} & \left[1 + \left(\frac{dy}{dx}\right)^2\right]^2 \left(\frac{dy}{dx}\right)^2 \\ & \left(\frac{d^2y}{dx^2}\right)^2 + \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^2}{\left(\frac{d^2y}{dx^2}\right)^2} = r^2 \\ & \Rightarrow \left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = r^2 \left(\frac{d^2y}{dx^2}\right)^2 \end{aligned}$$

90. Evaluate $\lim_{x \rightarrow 2} \frac{\sqrt{(x+7)} - 3\sqrt{(2x-3)}}{\sqrt[3]{(x+6)} - 2\sqrt[3]{(3x-5)}}$.

- A) $\frac{17}{9}$ B) $\frac{17}{18}$ C) $\frac{34}{23}$ D) $\frac{26}{7}$

Solution : (Correct Answer: C)

We have

$$L = \lim_{x \rightarrow 2} \frac{\sqrt{(x+7)} - 3\sqrt{(2x-3)}}{\sqrt[3]{(x+6)} - 2\sqrt[3]{(3x-5)}} \left(\frac{0}{0} \text{ form} \right)$$

Let $x-2 = t$ such that when $x \rightarrow 2, t \rightarrow 0$. Then

$$\begin{aligned} L &= \lim_{t \rightarrow 0} \frac{(t+9)^{\frac{1}{2}} - 3(2t+1)^{\frac{1}{2}}}{(t+8)^{\frac{1}{3}} - 2(3t+1)^{\frac{1}{3}}} \left(\frac{0}{0} \text{ form} \right) \\ &= \frac{3}{2} \lim_{t \rightarrow 0} \frac{(1+\frac{t}{9})^{\frac{1}{2}} - (2t+1)^{\frac{1}{2}}}{(1+\frac{t}{8})^{\frac{1}{3}} - (3t+1)^{\frac{1}{3}}} \left(\frac{0}{0} \text{ form} \right) \\ &= \frac{3}{2} \lim_{t \rightarrow 0} \frac{\frac{1}{2} - (2t)^{\frac{1}{2}} - \frac{(3t)^{\frac{1}{3}}}{3}}{\frac{1}{3} - \frac{(3t)^{\frac{1}{3}}}{3}} = \frac{3}{2} \cdot \frac{1}{\frac{18}{2}} - 1 = \frac{1}{24} - 1 = -\frac{23}{24} \end{aligned}$$

91. If $p \Rightarrow (\sim p \vee q)$ is false, the truth value of p and q are respectively

- A) F, T B) F, F C) T, F D) T, T

Solution : (Correct Answer: C)

$p \Rightarrow (\sim p \vee q)$ is false means p is true and $\sim p \vee q$ is false.

$\Rightarrow p$ is true and both $\sim p$ and q are false.

$\Rightarrow p$ is true and q is false.

92. The value of the sum $\sum_{n=1}^{13} (i^n + i^{n+1})$ where $i = \sqrt{-1}$ equals

- A) i B) $i-1$ C) $-i$ D) 0

Solution : (Correct Answer: B)

$$\begin{aligned} \sum_{n=1}^{13} (i^n + i^{n+1}) &= \sum_{n=1}^{13} i^n + \sum_{n=1}^{13} i^{n+1} \\ &= i \left(\frac{1-i^{13}}{1-i} \right) + i^2 \left(\frac{1-i^{13}}{1-i} \right) \\ &= i \left(\frac{1-i}{1-i} \right) - \left(\frac{1-i}{1-i} \right) = i - 1 \end{aligned}$$

93. If the roots of $z^3 + iz^2 + 2i = 0$ represent the vertices of a $\triangle ABC$ in the Argand plane, then the area of the triangle is

- A) $\frac{3\sqrt{7}}{2}$ B) $\frac{3\sqrt{7}}{4}$ C) 2 D) None

Solution : (Correct Answer: C)

$$z^3 + iz^2 + 2i = (z-i)(z^2 + 2iz - 2) = 0$$

$$\Rightarrow z = i, 1-i, -1-i$$

Let $A = (0, 1), B = (1, -1), C = (-1, -1),$

$$\therefore \triangle ABC = \frac{1}{2} \begin{vmatrix} 0 & 1 & 1 \\ 1 & -1 & 1 \\ -1 & -1 & 1 \end{vmatrix}$$

$$= \frac{1}{2} |-2-2| = 2$$

94. The relation R defined on the set $A = \{1, 2, 3, 4, 5\}$ by $R = \{(x, y) : |x^2 - y^2| < 16\}$ is given by

- A) $\{(1, 1), (2, 1), (3, 1), (4, 1), (2, 3)\}$
B) $\{(2, 2), (3, 2), (4, 2), (2, 4)\}$
C) $\{(3, 3), (4, 3), (5, 4), (3, 4)\}$
D) None of these

Solution : (Correct Answer: D)

We have $R = \{(x, y) : |x^2 - y^2| < 16\}$

$$\text{Let } x = 1, |x^2 - y^2| < 16 \Rightarrow |1 - y^2| < 16$$

$$\Rightarrow |y^2 - 1| < 16 \Rightarrow y = 1, 2, 3, 4$$

$$\text{Let } x = 2, |x^2 - y^2| < 16 \Rightarrow |4 - y^2| < 16$$

$$\Rightarrow |y^2 - 4| < 16 \Rightarrow y = 1, 2, 3, 4$$

$$\text{Let } x = 3, |x^2 - y^2| < 16 \Rightarrow |9 - y^2| < 16$$

$$\Rightarrow |y^2 - 9| < 16 \Rightarrow y = 1, 2, 3, 4$$

$$\text{Let } x = 4, |x^2 - y^2| < 16 \Rightarrow |16 - y^2| < 16$$

$$\Rightarrow |y^2 - 16| < 16 \Rightarrow y = 1, 2, 3, 4, 5$$

$$\text{Let } x = 5, |x^2 - y^2| < 16 \Rightarrow |25 - y^2| < 16$$

$$\Rightarrow |y^2 - 25| < 16 \Rightarrow y = 4, 5$$

$$\therefore R = \{(1, 1), (1, 2), (1, 3), (1, 4), (2, 1), (2, 2), (2, 3), (2, 4), (3, 1), (3, 2), (3, 3), (3, 4), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (5, 4), (5, 5)\}$$

95. If the matrix $A = \begin{bmatrix} 1 & 3 & 1 \\ -1 & 2 & -3 \\ 0 & 1 & 2 \end{bmatrix}$ then

$\text{adj}(\text{adj } A)$ is equal to

A) $\begin{bmatrix} 12 & 36 & 12 \\ -12 & 24 & -36 \\ 0 & 12 & 24 \end{bmatrix}$

B) $\begin{bmatrix} 12 & 26 & -12 \\ 24 & 36 & -36 \\ 0 & 12 & -24 \end{bmatrix}$

C) $\begin{bmatrix} 12 & -12 & 36 \\ 24 & -24 & -36 \\ 0 & 12 & 24 \end{bmatrix}$

- D) None of these

Solution : (Correct Answer: A)

$$A = \begin{bmatrix} 1 & 3 & 1 \\ -1 & 2 & -3 \\ 0 & 1 & 2 \end{bmatrix}$$

$$\Rightarrow |A| = 1(4+3) - 3(-2+0) + 1(-1-0)$$

$$= 7 + 6 - 1 = 12$$

$$\text{So, } \text{adj}(\text{adj } A) = |A|^{n-2} = A$$

$$= (12)^{3-2} A = 12 A$$

$$= 12 \begin{bmatrix} 1 & 3 & 1 \\ -1 & 2 & -3 \\ 0 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 12 & 36 & 12 \\ -12 & 24 & -36 \\ 0 & 12 & 24 \end{bmatrix}$$

96. The distance between the line $\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda(\hat{i} - \hat{j} + 4\hat{k})$ and the plane $\vec{r} \cdot (\hat{i} + 5\hat{j} + \hat{k}) = 5$, is

- A) $\frac{10}{3}$ B) $\frac{10}{\sqrt{3}}$
C) $\frac{10}{3\sqrt{3}}$ D) $\frac{10}{9}$

Solution : (Correct Answer: C)

The given line is

$$\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda(\hat{i} - \hat{j} + 4\hat{k})$$

On comparing it with $\vec{r} = \vec{a} + t\vec{b}$, we get

$$\vec{a} = 2\hat{i} - 2\hat{j} + 3\hat{k}, \quad \vec{b} = \hat{i} - \hat{j} + 4\hat{k}$$

Also, the plane is

$$\vec{r} \cdot (\hat{i} + 5\hat{j} + \hat{k}) = 5$$

On comparing it with $\vec{r} \cdot \vec{n} = d$, we get $\vec{n} = \hat{i} + 5\hat{j} + \hat{k}$ and $d = 5$

$$\text{Since, } \vec{b} \cdot \vec{n} = (\hat{i} - \hat{j} + 4\hat{k}) \cdot (\hat{i} + 5\hat{j} + \hat{k})$$

$$= 1 - 5 + 4 = 0$$

$\therefore$ Given line is parallel to the given plane. Now, distance between the line and the plane is given by required distance

$$\begin{aligned} &= \frac{|\vec{a} \cdot \vec{n} - d|}{|\vec{n}|} \\ &= \frac{|(2\hat{i} - 2\hat{j} + 3\hat{k}) \cdot (\hat{i} + 5\hat{j} + \hat{k}) - 5|}{\sqrt{1+25+1}} \\ &= \frac{|2-10+3-5|}{\sqrt{27}} = \frac{10}{3\sqrt{3}} \end{aligned}$$

97. The Value of

$$\sin^{-1} \left\{ \cot \left(\sin^{-1} \sqrt{\frac{2-\sqrt{3}}{4}} + \cos^{-1} \frac{\sqrt{12}}{4} + \sec^{-1} \sqrt{2} \right) \right\}$$

is

- A) 5 B) 6 C) 0 D) 10

Solution : (Correct Answer: C)

$$\begin{aligned} &\sin^{-1} \left\{ \cot \left(\sin^{-1} \sqrt{\frac{2-\sqrt{3}}{4}} + \cos^{-1} \frac{\sqrt{12}}{4} + \sec^{-1} \sqrt{2} \right) \right\} \\ &= \sin^{-1} \left\{ \cot \left(\sin^{-1} \sqrt{\frac{4-2\sqrt{3}}{8}} + \cos^{-1} \left(\frac{\sqrt{3}}{2} \right) + \sec^{-1} (\sqrt{2}) \right) \right\} \\ &= \sin^{-1} \left\{ \cot \left(\sin^{-1} \sqrt{\frac{(\sqrt{3}-1)^2}{8}} + \frac{\pi}{6} + \frac{\pi}{4} \right) \right\} \\ &= \sin^{-1} \left\{ \cot \left(\sin^{-1} \left(\frac{\sqrt{3}-1}{2\sqrt{2}} \right) + \frac{\pi}{6} + \frac{\pi}{4} \right) \right\} \\ \therefore \sin^{-1} \left(\frac{\sqrt{3}-1}{2\sqrt{2}} \right) &= \frac{\pi}{12} \\ &= \sin^{-1} \left\{ \cot \left(\frac{\pi}{12} + \frac{\pi}{6} + \frac{\pi}{4} \right) \right\} \\ &= \sin^{-1} \left\{ \cot \left(\frac{\pi + 2\pi + 3\pi}{12} \right) \right\} \\ &= \sin^{-1} \left\{ \cot \left(\frac{\pi}{2} \right) \right\} \\ &= \sin^{-1}(0) = 0 \end{aligned}$$

98. If $\frac{|x+3|+x}{x+2} > 1$, then $x \in$

- A) $(-5, -2)$ B) $(-1, \infty)$
C) $(-5, -2) \cup (-1, \infty)$ D) None of these

Solution : (Correct Answer: C)

$$\text{We have } \frac{|x+3|+x}{x+2} > 1$$

$$\Rightarrow \frac{|x+3|+x}{x+2} - 1 > 0 \Rightarrow \frac{|x+3|-2}{x+2} > 0$$

Now, two cases arise :

Case I : When $x+3 \geq 0$, i.e. $x \geq -3$. Then,

$$\frac{|x+3|-2}{x+2} > 0 \Rightarrow \frac{x+3-2}{x+2} > 0$$

$$\Rightarrow \frac{x+1}{x+2} > 0$$

$$\Rightarrow \{(x+1) > 0 \text{ and } x+2 > 0\}$$

$$\text{or } \{(x+1) < 0 \text{ and } x+2 < 0\}$$

$$\Rightarrow \{x > -1 \text{ and } x > -2\}$$

$$\text{or } \{x < -1 \text{ and } x < -2\}$$

$$\Rightarrow x > -1 \text{ or } x < -2$$

$$\Rightarrow x \in (-1, \infty) \text{ or } x \in (-\infty, -2)$$

$$\Rightarrow x \in (-3, -2) \cup (-1, \infty) \text{ [Since } x \geq -3]$$

Case II : When $x+3 < 0$, i.e. $x < -3$

$$\frac{|x+3|-2}{x+2} > 0 \Rightarrow \frac{-x-3-2}{x+2} > 0$$

$$\Rightarrow \frac{-(x+5)}{x+2} > 0 \Rightarrow \frac{x+5}{x+2} < 0$$

$$\Rightarrow (x+5) < 0 \text{ and } x+2 > 0 \text{ or } (x+5) > 0$$

$$\text{and } x+2 < 0$$

$$\Rightarrow (x < -5 \text{ and } x > -2) \text{ or } (x > -5 \text{ and } x < -2)$$

it is not possible.

$$\Rightarrow x \in (-5, -2)$$

Combining (i) and (ii), the required solution is $x \in (-5, -2) \cup (-1, \infty)$.

99. If $f(x) = (1+x)^{2/x}$ for $x \neq 0$ and $f(0) = e^2$ is

- A) left continuous only at $x = 0$
B) right continuous only at $x = 0$
C) continuous at $x = 0$
D) discontinuous at $x = 0$

Solution : (Correct Answer: C)

$$\lim_{x \rightarrow 0} f(x) = \lim_{x \rightarrow 0} [(1+x)^{1/x}]^2 = e^2 = f(0)$$

$$100. x = \cos^{-1} \left(\frac{1}{\sqrt{1+t^2}} \right),$$

$$y = \sin^{-1} \left(\frac{t}{\sqrt{1+t^2}} \right) \Rightarrow \frac{dy}{dx} \text{ is equal to}$$

- A) 0 B) $\tan t$ C) 1 D) $\sin t \cos t$

Solution : (Correct Answer: C)

$$\text{We have, } x = \cos^{-1} \left(\frac{1}{\sqrt{1+t^2}} \right)$$

$$\text{and } y = \sin^{-1} \left(\frac{t}{\sqrt{1+t^2}} \right)$$

$$\Rightarrow x = \tan^{-1} t \text{ and } y = \tan^{-1} t$$

$$\therefore y = x \Rightarrow \frac{dy}{dx} = 1$$

101. The value of c in Rolle's Theorem for the function

$$f(x) = e^x \sin x, x \in [0, \pi] \text{ is}$$

- A) $\frac{\pi}{6}$ B) $\frac{\pi}{4}$ C) $\frac{\pi}{2}$ D) $\frac{3\pi}{4}$

Solution : (Correct Answer: D)

Since Rolle's theorem is satisfied

$$\therefore f'(c) = 0 \Rightarrow e^c \sin c + \cos c = 0$$

$$\Rightarrow e^c \{\sin c + \cos c\} = 0$$

$$\therefore \sin c + \cos c = 0 \quad (\because e^c \neq 0)$$

$$\Rightarrow \tan c = -1 \Rightarrow c = \tan^{-1}(-1) = \pi - \frac{\pi}{4} = \frac{3\pi}{4}$$

102. The value of the integral $\int_0^{\frac{\pi}{2}} \sqrt{\cos \theta} \sin^3 \theta d\theta$ is

- A) $\frac{8}{21}$
C) $\frac{2}{7}$

- B) $\frac{21}{8}$
D) none of these.

Solution : (Correct Answer: A)

$$I = \int_0^{\frac{\pi}{2}} \sqrt{\cos \theta} \sin^3 \theta d\theta$$

$$= \int_0^{\frac{\pi}{2}} \sqrt{\cos \theta} \cdot \sin^2 \theta \cdot \sin \theta d\theta$$

Put $\cos \theta = t \Rightarrow \sin \theta d\theta = -dt$ [Note that power of $\sin \theta$ is odd] also, when

$\theta = 0, t = 1$, When $\theta = \frac{\pi}{2}, t = 0$

$$\therefore I = \int_1^0 \sqrt{t} (1 - t^2) \cdot (-dt) = \int_0^1 (t^{\frac{1}{2}} - t^{\frac{5}{2}}) dt$$

$$= \left[\frac{2}{3} t^{\frac{3}{2}} - \frac{2}{7} t^{\frac{7}{2}} \right]_0^1 = \frac{2}{3} - \frac{2}{7} = \frac{8}{21}$$

103. $\int \frac{1}{x^2(x^4+1)^{3/4}} dx$ is equal to

- A) $(1 + \frac{1}{x^4})^{1/4} + C$
 B) $(x^4 + 1)^{1/4} + C$
 C) $(1 - \frac{1}{x^4})^{1/4} + C$
D) $-(1 + \frac{1}{x^4})^{1/4} + C$

Solution : (Correct Answer: D)

$$\int \frac{dx}{x^2(x^4+1)^{3/4}} = \int \frac{dx}{x^5(1+\frac{1}{x^4})^{3/4}}$$

$$\text{Put } 1 + \frac{1}{x^4} = t \Rightarrow -\frac{4}{x^5} dx = dt$$

So, integral is

$$I = -\frac{1}{4} \int \frac{dt}{t^{3/4}} = -t^{\frac{1}{4}} + c = -\left(1 + \frac{1}{x^4}\right)^{1/4} + c$$

104. The area (in square unit) of the triangle formed by $x + y + 1 = 0$ and the pair of straight lines $x^2 - 3xy + 2y^2 = 0$ is

- A) $\frac{7}{12}$ B) $\frac{5}{12}$ **C) $\frac{1}{12}$** D) $\frac{1}{6}$

Solution : (Correct Answer: C)

$$x^2 - 2xy - xy + 2y^2 = 0$$

$$\Rightarrow (x - 2y)(x - y) = 0 \dots (i)$$

$$\Rightarrow x = 2y, x = y \dots (ii)$$

Also, $x + y + 1 = 0$ On solving Eqs. (i) and (ii), we get

$$A\left(-\frac{2}{3}, -\frac{1}{3}\right), B\left(-\frac{1}{2}, -\frac{1}{2}\right), C(0, 0)$$

$$\therefore \text{Area of } \triangle ABC = \frac{1}{2} \begin{vmatrix} -\frac{2}{3} & -\frac{1}{3} & 1 \\ 1 & -\frac{1}{2} & 1 \\ 0 & 0 & 1 \end{vmatrix}$$

$$= \frac{1}{2} \left[\frac{1}{3} - \frac{1}{6}\right] = \frac{1}{2} \left[\frac{1}{6}\right] = \frac{1}{12}$$

105. The solution of the differential equation

$$(1 + y^2) + (x - e^{\tan^{-1} y}) \frac{dy}{dx} = 0$$

- A) $(x - 2) = ke^{-\tan^{-1} y}$
B) $2xe^{\tan^{-1} y} = e^{2 \tan^{-1} y} + k$
 C) $xe^{\tan^{-1} y} = \tan^{-1} y + k$
 D) $xe^{2 \tan^{-1} y} = e^{\tan^{-1} y} + k$

Solution : (Correct Answer: B)

$$1 + y^2 + (x - e^{\tan^{-1} y}) \frac{dy}{dx} = 0$$

$$\Rightarrow (1 + y^2) dx = (e^{\tan^{-1} y} - x) dy$$

$$\Rightarrow \frac{dx}{dy} = \frac{e^{\tan^{-1} y} - x}{1 + y^2}$$

$$\Rightarrow \frac{dx}{dy} + \frac{1}{1 + y^2} \cdot x = \frac{e^{\tan^{-1} y}}{1 + y^2}$$

Which is the linear differential equation of the form $\frac{dx}{dy} + Rx = S$, where R and S are functions of y or constant (s)

$$\therefore \text{I.F.} = \int \frac{1}{1 + y^2} \cdot dy = e^{\tan^{-1} y}$$

Hence required solution is

$$x \cdot (\text{I.F.}) = \int \frac{e^{\tan^{-1} y}}{1 + y^2} (1 + y^2) dy$$

$$\Rightarrow x \cdot e^{\tan^{-1} y} = \int \frac{e^{\tan^{-1} y}}{1 + y^2} (e^{\tan^{-1} y}) dy$$

$$\Rightarrow x \cdot e^{\tan^{-1} y} = \int \frac{e^{2 \tan^{-1} y}}{1 + y^2} dy$$

Put $t = \tan^{-1} y$

$$\therefore \frac{dt}{dy} = \frac{1}{1 + y^2} \Rightarrow dt = \frac{1}{1 + y^2} \cdot dy$$

$$\therefore \int \frac{e^{2 \tan^{-1} y}}{1 + y^2} dy = \int e^{2t} \cdot dt = \frac{e^{2t}}{2} + K$$

Hence equation (1) becomes,

$$xe^{\tan^{-1} y} = \frac{1}{2} e^{2t} + K$$

$$\Rightarrow xe^{\tan^{-1} y} = \frac{1}{2} e^{2 \tan^{-1} y} + K$$

$$\Rightarrow 2xe^{\tan^{-1} y} = e^{2 \tan^{-1} y} + K$$

106. A unit vector perpendicular to the plane formed by the points $(1, 0, 1)$, $(0, 2, 2)$ and $(3, 3, 0)$ is

- A) $\frac{1}{5\sqrt{3}}(5\hat{i} - \hat{j} - 7\hat{k})$
B) $\frac{1}{5\sqrt{3}}(5\hat{i} - \hat{j} + 7\hat{k})$
 C) $\frac{1}{5\sqrt{3}}(5\hat{i} + \hat{j} + 7\hat{k})$
 D) None of these

Solution : (Correct Answer: B)

Let $A(1, 0, 1)$, $B(0, 2, 2)$ and $C(3, 3, 0)$ be the given points, then

$$\overrightarrow{AB} = -\hat{i} + 2\hat{j} + \hat{k}, \overrightarrow{BC} = 3\hat{i} + \hat{j} - 2\hat{k}$$

$$\overrightarrow{AB} \times \overrightarrow{BC} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & 2 & 1 \\ 3 & 1 & -2 \end{vmatrix} = -5\hat{i} + \hat{j} - 7\hat{k}$$

$\therefore$ unit vector $\perp$ to the plane: ABC

$$= \pm \frac{1}{5\sqrt{3}}(-5\hat{i} + \hat{j} - 7\hat{k})$$

107. The value of 'a' for which the lines $\frac{x-2}{1} = \frac{y-9}{2}$ $= \frac{z-13}{3}$ and $\frac{x-a}{-1} = \frac{y-7}{2} = \frac{z+2}{-3}$ intersect, is

- A) -5 B) -2 C) 5 **D) -3**

Solution : (Correct Answer: D)

Let the two lines be

$$\frac{x-\alpha_1}{l_1} = \frac{y-\beta_1}{m_1} = \frac{z-\gamma_1}{n_1} \dots (i)$$

and

$$\frac{x-\alpha_2}{l_2} = \frac{y-\beta_2}{m_2} = \frac{z-\gamma_2}{n_2} \dots (ii)$$

These lines will be coplaner, if

$$\begin{vmatrix} \alpha_2 - \alpha_1 & \beta_2 - \beta_1 & \gamma_2 - \gamma_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} = 0$$

Therefore, from the given lines,

$$\begin{vmatrix} 2 - a & 9 - 7 & 13 + 2 \\ 1 & 2 & 3 \\ -1 & 2 & -3 \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} 2 - a & 2 & 15 \\ 1 & 2 & 3 \\ -1 & 2 & -3 \end{vmatrix} = 0$$

$$\Rightarrow (2 - a)(-6 - 6) - 2(-3 + 3) + 15(2 + 2) = 0$$

$$\Rightarrow -24 + 12a + 60 = 0 \Rightarrow 12a = -36$$

$$\Rightarrow a = -3$$

108. Consider the objective function $Z = 40x + 50y$.

The minimum number of constraints that are required to maximize Z are,

- A) 4 B) 2 **C) 3** D) 1

Solution : (Correct Answer: C)

Two constraints are $x \geq 0, y \geq 0$ and the third one will be of the type $ax + by \leq c$

109. In a hurdle race, a player has to cross 10 hurdles. The probability that he will clear each hurdle is $\frac{5}{6}$. Then, the probability that he will knock down fewer than 2 hurdles is

- A) $\frac{5^9}{2 \times 6^9}$ B) $\frac{5^{10}}{2 \times 6^{10}}$
C) $\frac{5^9}{2 \times 6^{10}}$ D) $\frac{5^{10}}{2 \times 6^9}$

Solution : (Correct Answer: D)

It is a case of Bernoulli trials, where success is not crossing a hurdle successfully. Here, $n = 10$.

$$p = P(\text{success}) = 1 - \frac{5}{6} = \frac{1}{6} \Rightarrow q = \frac{5}{6}$$

let X be the random variable that represents the number of times the player will knock down the hurdle.

Clearly, X has a binomial distribution with $n = 10$ and $p = \frac{1}{6}$

$$\therefore P(X = r) = {}^nC_r q^{n-r} \cdot p^r \\ = {}^{10}C_r \left(\frac{1}{6}\right)^r \left(\frac{5}{6}\right)^{10-r}$$

P (player knocking down less than 2 hurdles)

$$= P(X < 2) = P(X = 0) + P(X = 1)$$

$$= {}^{10}C_0 \left(\frac{1}{6}\right)^0 \left(\frac{5}{6}\right)^{10-0} + {}^{10}C_1 \left(\frac{1}{6}\right)^1 \left(\frac{5}{6}\right)^9 \\ = \left(\frac{5}{6}\right)^9 \left(\frac{5}{6} + \frac{10}{6}\right) = \frac{5^{10}}{2 \times 6^9}$$

110. If a and b are two complex numbers, then the sum of $(n + 1)$ terms of the series $ac_0 - (a + d)c_1 + (a + 2d)c_2 - (a + 3d)c_3 + \dots$ is

- A) $\frac{a}{2^n}$ B) na
C) 0 D) None of these

Solution : (Correct Answer: C)

We have

$$ac_0 - (a + d)c_1 + (a + 2d)c_2 - (a + 3d)c_3 + \dots \dots$$

up to $(n + 1)$ terms

$$= a(c_0 - c_1 + c_2 - c_3 + \dots \dots \dots + (-1)^n c_n) + d(-c_1 + 2c_2 - 3c_3 + \dots + (-1)^n (nc_n))$$

We know that

$$(1 - x)^n = c_0 - c_1 x + c_2 x^2 - \dots \dots \dots + (-1)^n \cdot c_n x^n \dots (i)$$

Differentiating w.r.t. x we get

$$-n(1 - x)^{n-1} = -c_1 + 2c_2 x - \dots \dots \dots + (-1)^n \cdot c_n n x^{n-1} \dots (ii)$$

Putting $x = 1$ in Eqs. (i) and (ii), we get

$$c_0 - c_1 + c_2 - \dots \dots + (-1)^n c_n = 0$$

$$\text{and } -c_1 + 2c_2 - \dots \dots \dots + (-1)^n c_n = 0$$

Thus

$$ac_0 - (a + d)c_1 + (a + 2d)c_2 - (a + 3d)c_3 + \dots \dots \dots$$

$$\text{up to } (n + 1) \text{ terms} = a \cdot 0 + d \cdot 0 = 0$$

English - Section A (MCQ.)

111. Fill in the blank with most suitable word. I _____ for forty minutes to see the doctor before my name was announced.

- A) am B) were C) had D) have
waiting waiting been been
waiting waiting

Solution : (Correct Answer: C)

The correct answer is Option C: had been waiting.

Here's why:

The sentence structure suggests an action that started in the past and continued up until another point in the past. This calls for the past perfect continuous tense. had been waiting indicates that:

The action of waiting began in the past.

It continued for a duration of time (forty minutes).

It ended at a specific point in the past (when the name was announced).

The other options don't fit grammatically:

am waiting (present continuous) – Used for an action happening right now.

were waiting (past continuous) – Used for an action happening in the past without specifying if it was completed.

have been waiting (present perfect continuous) –

Used for an action that started in the past and has continued up to the present.

112. Read the following lines carefully and answer the questions that follow.

I am dotted silver threads dropped from heaven
By the gods. Nature then takes me, to adorn Her fields and valleys.

I am beautiful pearls, plucked from the Crown of Ishtar by the daughter of Dawn To embellish the gardens.

The rain calls itself the 'dotted silver threads' as

- A) the shimmering ties Earth with decorates
drops fall heaven shimmering the fields
one after and water
the other Earth

Solution : (Correct Answer: A)

Here's the breakdown of the poem and the correct answer:

Understanding the Metaphor

The poem uses a metaphor to describe the rain. The lines "I am dotted silver threads" mean the rain sees itself as individual drops that look like silver threads falling from the sky.

Why the Rain Calls Itself 'Dotted Silver Threads'

Option A (the shimmering drops fall one after the other): This is the most direct reason given in the poem. It focuses on the visual appearance of rain falling as individual drops in a sequence.

Option B (it ties heaven and Earth): This is a more symbolic interpretation. While true, it's not the reason the rain *calls itself* dotted silver threads. Option C (it dots the Earth with shimmering water): This describes the effect of rain, not the reason for the self-description.

Option D (it decorates the fields): While the rain does decorate the fields, this isn't why it refers to itself as dotted silver threads.

The Correct Answer

The most accurate answer is Option A. The poem directly emphasizes the visual appearance of the rain falling in a series of drops, comparing them to silver threads.

113. Read the following lines carefully and answer the questions that follow.

I am dotted silver threads dropped from heaven
By the gods. Nature then takes me, to adorn Her fields and valleys.

I am beautiful pearls, plucked from the Crown of Ishtar by the daughter of Dawn To embellish the gardens.

What is 'T' in the above lines?

- A) The poet B) The rain C) The nature D) The heaven

Solution : (Correct Answer: B)

The 'T' in the given lines from a poem is described using vivid imagery that links it to natural and divine elements. The 'T' is depicted as "dotted silver threads dropped from heaven by the gods" and "beautiful

pearls, plucked from the Crown of Ishtar by the daughter of Dawn." These descriptions symbolically represent raindrops, seen as precious and beautiful gifts from the divine, adorning and enriching the natural world. The references to "heaven", "gods", and "Crown of Ishtar" highlight a connection to divine or celestial origins, while "to adorn Her fields and valleys" and "to embellish the gardens" point to the nourishing and beautifying effect on nature. Therefore, the 'I' is identified as the rain. Hence, the correct option is:

Option B: The rain

114. Select the antonym for the word 'Dishevelled'

A) Untidy B) Cluttered C) Ordered D) Unkempt

Solution : (Correct Answer: C)

The word 'Dishevelled' refers to someone or something that looks untidy, messy, or scruffy. It implies a lack of tidiness or neatness. Given this, to find its antonym, we're looking for a word that means the opposite - essentially, something that denotes order, neatness, or being well-kept. Let's analyze the options:

Option A: Untidy - This is essentially a synonym of 'Dishevelled', as both imply a lack of neatness.

Option B: Cluttered - Similar to 'Untidy' and 'Dishevelled', 'Cluttered' also indicates a mess or lack of order.

Option C: Ordered - This suggests that everything is in its proper place, indicating neatness and organization, which is the opposite of 'Dishevelled'.

Option D: Unkempt - Like 'Untidy' and 'Dishevelled', 'Unkempt' refers to a lack of neatness and order. Therefore, the correct antonym for 'Dishevelled' is Option C: Ordered.

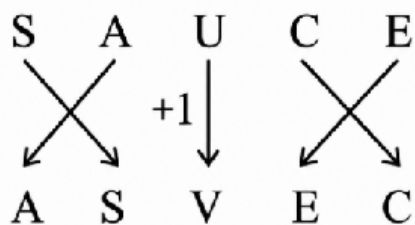
Aptitude - Section A (MCQ.)

115. In a code language, 'SAUCE' is written as 'ASVEC'. How will 'MEANT' be written as in that language?

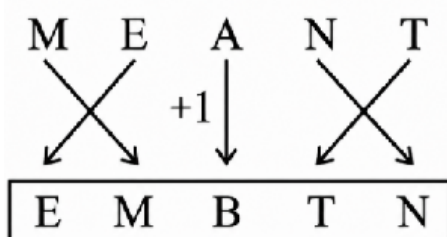
A) EMANT B) MEBTN C) EMBTND D) EMCTN

Solution : (Correct Answer: C)

As,



Similarly,



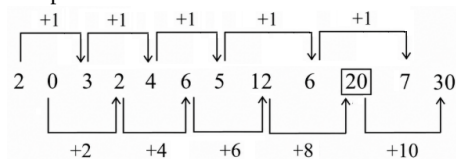
116. From the given options, choose the correct one that will replace the question mark(?) in the following series.

2, 0, 3, 2, 4, 6, 5, 12, 6, ?, 7, 30

A) 6 B) 20 C) 7 D) 16

Solution : (Correct Answer: B)

The pattern of the series is as follows.



Hence, 20 will replace the question mark.

117. Read the given statements and conclusions carefully. Assuming that the information given in the statements is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements

1. Few gentlemen are rich.
2. Few gentlemen are not fools.
3. Everyone is either a fool or rich.

Conclusions

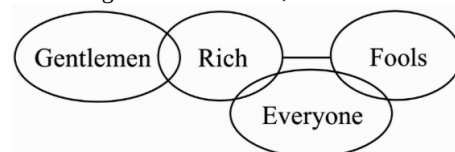
- I. No gentleman is rich.
- II. Few gentlemen being fools is a possibility.
- III. No one is both a fool and rich.

A) Only B) All C) Only D) Only

Conclusion conclusions Conclusion Conclusion
III follows follow I follows II follows

Solution : (Correct Answer: D)

According to the statements,



Conclusions I. (X) II. (✓) III. (X)

So, only Conclusion II follows.

118. The questions given below consist of a question followed by two statements labelled as I and II. We have to decide whether these statements give enough information required to answer the question or not.

Six persons A, B, C, D, E and F are sitting in a row. A and F are sitting at two extreme ends of the row. B is to the immediate right of A and D is 2nd left of F. What is the position of E with respect to A?

I. E is to the right of A.

II. E is to the left of C.

A) if B) if C) if D) if
Statement Statement Statements Statements
I, alone is II, alone I and II I and II
sufficient is together together
to answer sufficient are needed are not
the to answer to answer the
question the question question
question question question

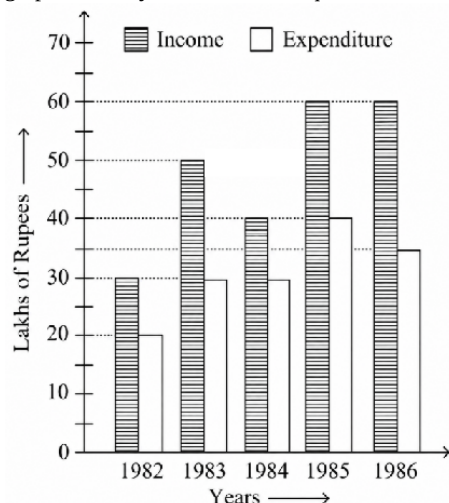
Solution : (Correct Answer: B)

On the basis of the statements given in the question, we can arrange the persons in a row in the following way

A B C or E D C or E F
1 2 3 4 5 6

Positions of C and E can be either 3rd or 5th.
From the Statement I, we get that E is to the right of A and hence, position of E can either be 3rd or 5th.
Therefore, Statement I alone is not sufficient to answer the question.
Statement II fixed the positions of C at 5th and E at 3rd place, respectively. Therefore, we get our answer from Statement II.

119. Following bar graph shows the income and expenditure (in ₹ lakhs) of a company. Read the graph carefully and answer the questions.



What is the average income of the company over the years?

- A) ₹ 24 lakhs B) ₹ 36 lakhs C) ₹ 48 lakhs D) ₹ 52 lakhs

Solution : (Correct Answer: C)

Average income of the company over the years
 $= \frac{30+50+40+60+60}{5}$ lakhs $= \frac{240}{5}$ lakhs ₹ = 48 lakhs

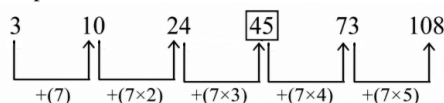
120. Select the number from among the given options that can replace the question mark (?) in the following series.

3, 10, 24, ?, 73, 108

- A) 37 B) 45 C) 52 D) 32

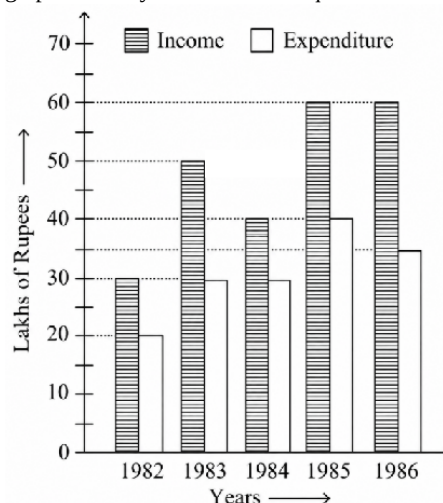
Solution : (Correct Answer: B)

the pattern of the series is follows,



Hence, '45' can replace the question mark.

121. Following bar graph shows the income and expenditure (in ₹ lakhs) of a company. Read the graph carefully and answer the questions.



Which of the following pairs of years, shows the equal expenditure of the company?

- A) 1983, 1985 B) 1985, 1986 C) 1983, 1984 D) 1982, 1983

Solution : (Correct Answer: C)

From the bar graph, it is clear that in 1983 and 1984 the expenditure of the company is same.

122. The questions given below consist of a question followed by two statements labelled as I and II. We have to decide whether these statements give enough information required to answer the question or not.

How is P related to R?

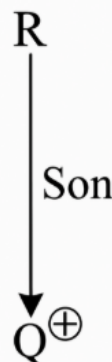
I. Q is the son of R.

II. Q is the brother of P.

- | | | | |
|---|--|--|--|
| A) if Statement I, alone is sufficient to answer the question | B) if Statement II, alone is sufficient to answer the question | C) if Statements I and II together are needed to answer the question | D) if Statements I and II together are not sufficient to answer the question |
|---|--|--|--|

Solution : (Correct Answer: D)

From Statement I,



From Statement II,



Now, from both Statements,

Here, P is either the son or daughter of R. So, we cannot find the exact relation of P to R. Hence, Statements I and II together are not sufficient to

answer the question.

