CAREER POINT

# JEE Main Online Exam 2026

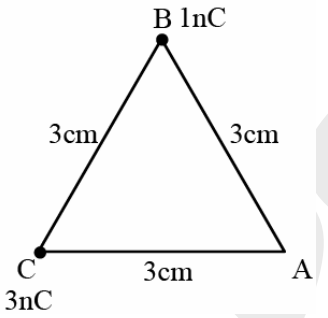
## Memory Based

## Questions & Solution

### 28th January 2026 | Morning

## PHYSICS

**1.** Find work done in bringing charge $q = 3nC$ from infinity to point A as shown in the figure :




(1) $11\times10^{-7}$ J (2) $36\times10^{-7}$ J (3) $12\times10^{-7}$ J (4) $13\times10^{-7}$ J

**Ans.** **[2]**

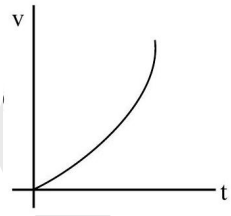
**Sol.** $W = \frac{Kqq_B}{r_{AB}} + \frac{Kqq_C}{r_{AC}}$

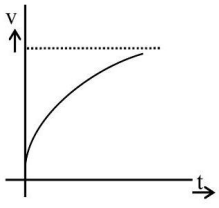
$= \frac{9\times10^9\times3\times10^{-9}}{3\times10^{-2}}[1+3]\times10^{-9}$

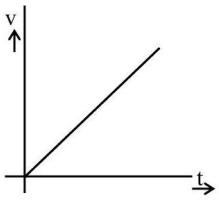
$W = 9\times4\times10^{-7}$

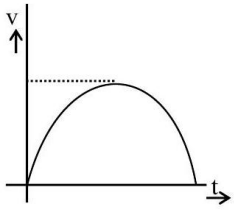
$W = 36\times10^{-7}$ J

**2.** A particle is falling under gravity. Air resistance on particle is $F = -kv$. Find correct option :

(1) 


(2) 


(3) 


(4) 


**Ans.** **[2]**

**Sol.** $a = g - \frac{kv}{m}$

$\frac{dv}{dt} = g - \frac{kv}{m} = \frac{gm - kv}{m}$

$\int_0^v \frac{dv}{gm - kv} = \int_0^v \frac{1}{m} t$

$$\left[-\frac{\ell n(gm-kv)}{k}\right]_0^v=\frac{1}{m}t$$

$$[-\ell n(gm-kv)]_0^v=\frac{k}{m}t$$

$$\ell n\left[\frac{gm}{gm-kv}\right]=\frac{k}{m}t$$

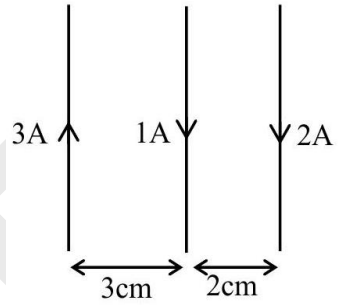
$$\ell n\left[\frac{gm-kv}{gm}\right]=\frac{-k}{m}t$$

$$\ell n\left[1-\frac{kv}{gm}\right]=\frac{-k}{m}t$$

$$\frac{kv}{gm}=\left(1-e^{-\frac{k}{m}t}\right)$$

$$v=\frac{gm}{k}\left(1-e^{-\frac{k}{m}t}\right)$$

**3.** Three very long parallel wires carrying current as shown. Find the force acting at 15 cm length of middle wire :




(1) 1μ N (2) 6μ N (3) 7μ N (4) 5μ N

**Ans.** **[2]**

**Sol.** Force per unit length on middle wire :

$$\text{F-net}=\frac{\mu_0(1)(2)}{2\pi\times2\times10^{-2}}+\frac{\mu_0(1)(3)}{2\pi\times3\times10^{-2}}$$

$$=\frac{\mu_0}{2\pi\times10^{-2}}(1+1)$$

$$=\frac{4\pi\times10^{-7}}{2\pi\times10^{-2}}\times2$$

$$=4\times10^{-5}\ \text{N/m}$$

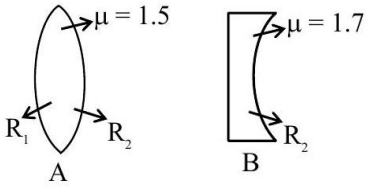
For 15 cm length $F=4\times10^{-5}\times15\times10^{-2}$ N

$$=60\times10^{-7}\ \text{N}$$

$$=6\times10^{-6}\ \text{N}$$

$$=6\mu\ \text{N}$$

**4.** Two lenses one biconvex and other plano concave have same magnitude of power. The refractive indices of their materials are 1.5 and 1.7 respectively. If the radii of curvature of the lenses are as shown. find the ratio: $\frac{R_1}{R_2}$ :




(1) $\frac{5}{2}$ (2) $\frac{5}{3}$ (3) $\frac{5}{4}$ (4) $\frac{5}{5}$

**Ans.** **[1]**

**Sol.** $$\frac{1}{f_A}=(\mu_A-1)\left[\frac{1}{R_1}-\frac{1}{(-R_2)}\right]$$

$$\frac{1}{f_B}=(\mu_B-1)\left[\frac{1}{\infty}-\frac{1}{R_2}\right]$$

$$|P_A|=|P_B| \Rightarrow 0.5\left(\frac{1}{R_1}+\frac{1}{R_2}\right)=\frac{0.7}{R_2}$$

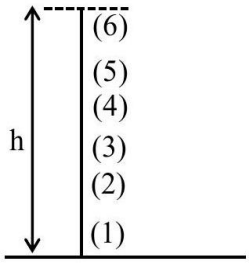
$$\Rightarrow \frac{0.5}{R_1}=\frac{0.2}{R_2} \quad \Rightarrow \frac{R_1}{R_2}=\frac{5}{2}$$

**5.** Balls are dropped at regular intervals from height 5 m. If the first ball touches the ground when $6^{th}$ ball is about to be dropped, find the height of $4^{th}$ ball above the ground at the same instant :

(1) 4.1 m (2) 4.2 m (3) 4.3 m (4) 4.4 m

**Ans.** **[2]**

**Sol.** time taken by $1^{st}$ ball to touch ground.




$$t=\sqrt{\frac{2h}{g}}=\sqrt{\frac{2\times 5}{10}}=1\ s$$

Let $1^{st}$ ball is dropped at $t=0$ then, $6^{th}$ ball will be dropped at $t=1$ s

$t=0 \rightarrow 1^{st}$ ball

$t=0.2 \rightarrow 2^{nd}$ ball

$t=0.4 \rightarrow 3^{rd}$ ball

$t=0.6 \rightarrow 4^{th}$ ball

$t=0.8 \rightarrow 5^{th}$ ball

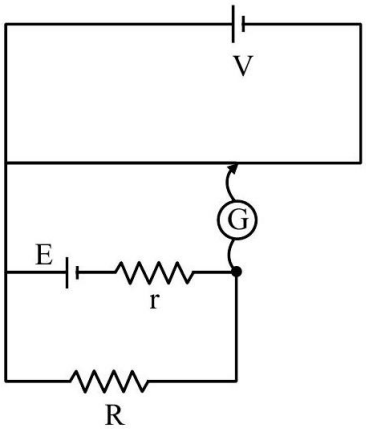
$t=1 \rightarrow 6^{th}$ ball

So, height dropped by $4^{th}$ ball : $h = \frac{1}{2} g(0.4)^2$

$= \frac{1}{2} \times 10 \times 0.16 = 0.8$ m

So, height above ground $= 5 - 0.8 = 4.2$ m

**6.** For the given circuit, if $R = 12\Omega$, balancing length is 180 cm . When value of R is $4\Omega$, then balancing length is 120 cm . Find internal resistance of cell E .




(1) $2\Omega$ (2) $5\Omega$ (3) $4\Omega$ (4) $1\Omega$

**Ans.** **[3]**

**Sol.** Let potential gradient of potentiometer wire be $\lambda$ .

$\therefore$ In $1^{st}$ case

$12i_1 = 180\lambda = E - i_1 r \Rightarrow E - 15\lambda r = 180\lambda$ … (1)

In $2^{nd}$ case

$4i_2 = 120\lambda = E - i_2 r \Rightarrow E - 30\lambda r = 120\lambda$ … (2)

From (1) and (2)

$r = 4\Omega$

**7.** An atom ${}^{8}_{3}X$ is bombarded with electrons, neutrons and protons and in 10 sec , 10 electrons, 10 protons and 9 neutrons are absorbed. If final surface area is x% of initial area, find x : – :

(1) 250% (2) 350% (3) 225% (4) 900%

**Ans.** **(3)**

**Sol.** $R = R_0 A^{1/3}$

$\therefore R_{initial} = R_0 8^{1/3} = 2R_0$

$R_{final} = R_0 27^{1/3} = 3R_0$

Initial surface area $= 4\pi(2R_0)^2$

Final surface area $= 4\pi(3R_0)^2$

Final area $= 225\%$ of initial area.

**8.** Find the ratio of de-Broglie wavelengths of deuteron having energy E and $\alpha$ -particle having energy 2E :

**Ans.** **[2]**

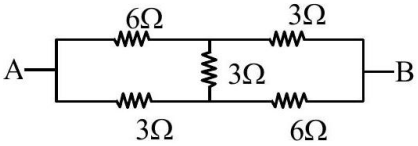
**Sol.** $\lambda = \dfrac{h}{\sqrt{2mKE}}$

$$\frac{\lambda_D}{\lambda_\alpha} = \sqrt{\frac{m_\alpha}{m_D}\left(\frac{KE_\alpha}{KE_D}\right)}$$

$$= \sqrt{\left(\frac{4}{2}\right)\left(\frac{2E}{E}\right)}$$

$$\frac{\lambda_D}{\lambda_\alpha} = 2$$

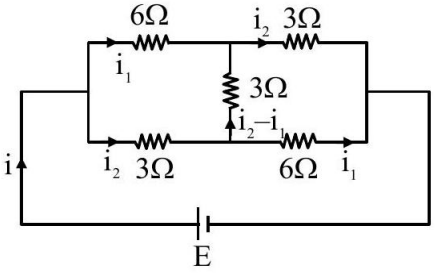
**9.** If equivalent resistance between points A and B is $\dfrac{X}{5}$ (in $\Omega$ ), then find value of X :




(1) 20 (2) 25 (3) 21 (4) 30

**Ans.** **[3]**

**Sol.**




$-3i_2 - 6i_1 + E = 0 \quad \ldots (1)$

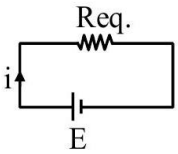
$3(i_2 - i_1) - 6i_1 + 3i_2 = 0 \quad \ldots (2)$

$6i_2 - 9i_1 = 0 \Rightarrow i_2 = \dfrac{3}{2}i_1$

From (1) $+3\left(\dfrac{3}{2}i_1\right) + 6i_1 = E$

$i_1 = \dfrac{2E}{21}, i_2 = E/7$

$\dfrac{5E}{21} = i = i_1 + i_2$




$i = \dfrac{E}{Req.} \Rightarrow Req. = \dfrac{21}{5} = \dfrac{X}{5}$

Value of X is 21.

**10.** A circular coil of radius R carries current such that magnetic field at its centre is $16\mu$ T . Find the magnetic field on the axis at a distance of $\sqrt{3}R$ from the centre of coil.

(1) $2\mu$ T (2) $4\mu$ T (3) $3\mu$ T (4) $5\mu$ T

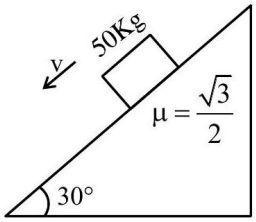
**Ans.** **[1]**

**Sol.** Given, $\frac{\mu_0 I}{2R} = 16\mu$ T … (1)

Then, $\frac{\mu_0 IR^2}{2\left[R^2 + (\sqrt{3}R)^2\right]^{3/2}} = B$ … (2)

Now, $\frac{B}{16} = \frac{R^2/\left(2\times 8R^3\right)}{1/2R} \Rightarrow B = 2\mu$ T

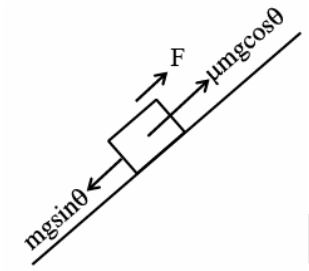
**11.** Find external force F so that block can move on inclined plane with constant velocity.




(1) 125 N (2) 120 N (3) 145 N (4) 115 N

**Ans.** **[1]**

**Sol.**




$mg\sin\theta = F + \mu mg\cos\theta$

$F = mg\sin\theta - \mu mg\cos\theta$

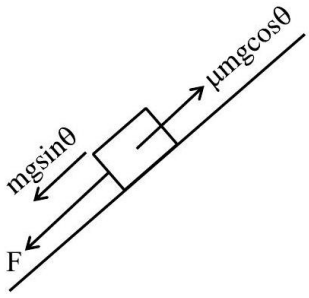
$= 500[\sin 30° - \mu\cos 30°]$

$= 500\left[\frac{1}{2} - \frac{\sqrt{3}}{2}\cdot\frac{\sqrt{3}}{2}\right] = 500\left[\frac{1}{2} - \frac{3}{4}\right]$

$F = 500\left[-\frac{1}{4}\right]$

$F = -125$N

$F = 125$ N




$\therefore$

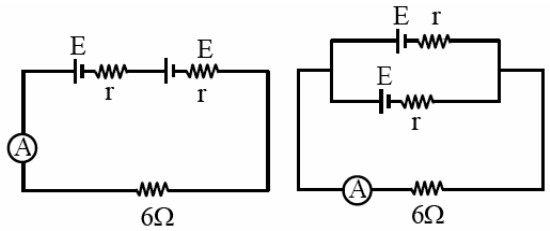
**12.** A particle moves according to the equation $x = A\sin(\omega t)$. The potential energy is maximum at time $t = \frac{T}{2\beta}$, where $T$ is the time period of particle. Find the minimum value of $\beta$ :

**Ans.** **[2]**

**Sol.** For SHM starting from mean, PE is maximum after T/4 time.

$\therefore 2\beta = 4 \Rightarrow \beta = 2$

**13.** Figure shows two combinations of real cells with $6\Omega$ internal resistance. If reading of ammeters are same in both cases, find the value of ' r '.




(1) $6\Omega$ (2) $5\Omega$ (3) $8\Omega$ (4) $12\Omega$

**Ans.** **[1]**

**Sol.** In1 $^{st}$ case, $i = \frac{2E}{6+2r}$

In $2^{nd}$ case, $i = \frac{E}{6+\frac{r}{2}}$

$\therefore \frac{2E}{6+2r} = \frac{E}{6+r/2}$

$\Rightarrow \frac{1}{3+r} = \frac{2}{12+r}$

$\Rightarrow 12 + r = 6 + 2r$

$\Rightarrow r = 6\Omega$

**14.** Focal length of a convex lens in air is $f = 18$ cm. It is immersed in a liquid of refractive index $4/3$. If change in focal length of lens is $\Delta f = nf$, Find n . [Given refractive index of lens is 1.5] :

**Ans.** **[3]**

**Sol.** For lens in air,

$\frac{1}{f} = \left(\frac{\mu_L}{1} - 1\right)\left[\frac{1}{R_1} - \frac{1}{R_2}\right] = \frac{1}{18}$

$\therefore \frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{18} \times 2 = \frac{1}{9}$

In liquid,

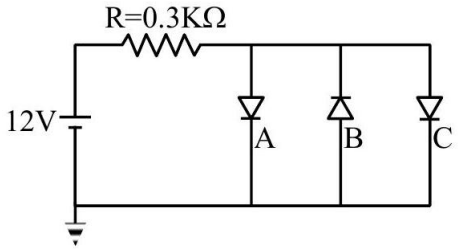
$\frac{1}{f'} = \left(\frac{\mu_L}{\mu_S} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \left(\frac{1.5 \times 3}{4} - 1\right)\left(\frac{1}{9}\right) = \frac{1}{8} \times \frac{1}{9}$

$\therefore f' = 72$ cm

$\therefore \Delta f = (72 - 18)\text{cm} = 54 \text{ cm} = 3 \times 18 \text{ cm}$

$\therefore n = 3$

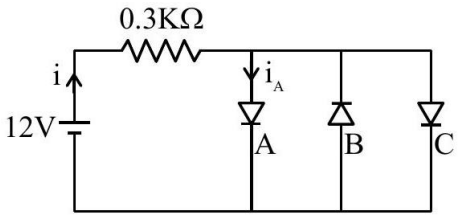
**15.** Three silicon diodes connected parallel to each other as shown. Forward voltage of diode is 0.7 V . Find current through diode A :




(1) $\frac{113}{3}$ mA (2) $\frac{113}{6}$ mA (3) $\frac{113}{9}$ mA (4) $\frac{226}{3}$ mA

**Ans.** **[2]**

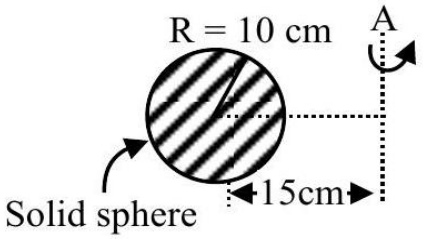
**Sol.**




$$i = \frac{12-0.7}{0.3\times10^3} \Rightarrow i = \frac{113}{3} \text{ mA}$$

$$i_A = \frac{i}{2} = \frac{113}{6} \text{ mA}$$ (Option B is correct)

**16.** As shown in the figure, radius of gyration about the axis shown in $\sqrt{n}$cm for a solid sphere. Find ' n '.




**Ans.** **[265]**

**Sol.** $I_A = Icm + md^2$

$$= \frac{2}{5}mR^2 + md^2$$

$$mk^2 = I_A = m\left[\frac{2}{5}(10)^2 + (15)^2\right]$$

$$k^2 = \left[\frac{2}{5}\times100 + 225\right]$$

$$k^2 = [40 + 225]$$

$$k = \sqrt{265} \text{ cm}$$

$$n = 265$$

**17.** If nothing is kept between jaws, zero of Vernier scale lies right of 0 cm of main scale and $4^{th}$ line of Vernier scale matches perfectly with any line of main scale. An object is kept between jaws and zero of Vernier scale crosses $15^{th}$ division of main scale and $5^{th}$ division of Vernier scale exactly matches with any line of main scale. (Least count = 0.1 mm and 1MSD = 1 mm ). Find dimension of object :

(1) 15.1 mm (2) 15.5 mm (3) 15.4 mm (4) 15.9 mm

**Ans.** **[1]**

**Sol.** Reading = MSR + VSR × LC - Zero error

$= 15 \text{ mm} + 5 \times 0.1 \text{ mm} - 4 \times 0.1 \text{ mm}$

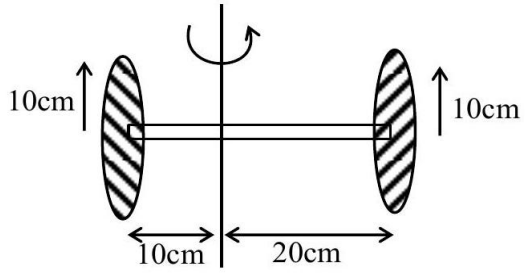
$= 15 \text{ mm} + 0.5 \text{ mm} - 0.4 \text{ mm}$

Reading $= 15.1$ mm

Dimension $= 15.1$ mm

Note : Vernier scale has positive zero error.

**18.** In the system of two discs and a rod of mass 600 g each, a torque of magnitude $43 \times 10^5$ dyne-cm is applied along the axis of rotation as shown in figure. Find the approx angular acceleration about given axis




(1) $11 \text{rad/s}^2$ (2) $100 \text{rad/s}^2$ (3) $27 \text{rad/s}^2$ (4) $22 \text{rad/s}^2$

**Ans.** **[1]**

**Sol.** $\tau = I_{sys}\alpha$

$\tau = (I_{disc1} + I_{disc2} + I_{rod})\alpha$

$$\tau = \left(\left(\frac{MR^2}{4} + Md_1^2\right) + \left(\frac{MR^2}{4} + Md_2^2\right) + \left(\frac{MR^2}{12} + Md_3^2\right)\right)\alpha$$

$$43 \times 10^5 \times 10^{-7} = \left(\left(\frac{(0.6)(0.1)^2}{4} + (0.6)(0.1)^2\right) + \left(\frac{0.6(0.1)^2}{4} + 0.6(0.2)^2\right) + \left(\frac{(0.6)(0.3)^2}{12} + (0.6)(0.05)^2\right)\right)\alpha$$

$43 \times 10^{-2} = ((0.0015 + 0.006) + 0.0015 + 0.024) + (0.0045 + 0.0015)\ \alpha$

$43 \times 10^{-2} = (0.039)\ \alpha$

$\alpha = 11.025 \text{ rad/s}^2$

**19.** **Statement-1 :** Planner wavefronts are incident on a prism, remain planner after passing through prism, but if planner wavefronts are passed through a pin hole then wavefronts may become spherical.

**Statement-2 :** If slit width is increased then curvature of wave front increases.

(1) Statement-1 is correct, statement-2 is incorrect.

(2) Statement-1 is incorrect, statement-2 is correct.

(3) Both statement are correct.

(4) Both statement are incorrect.

**Ans.** **[3]**

**Sol.** On increasing width size radius of curvature of wavefront increases and for very large slits it is almost plane.

**20.** An electromagnetic wave travelling in a medium has its electric field given by : $E = 2\sin\left(2\times10^{15}\,t - 10^{7}\,x\right)$. Find the refractive index of the medium :

(1) 1.1 (2) 1.7 (3) 1.3 (4) 1.5

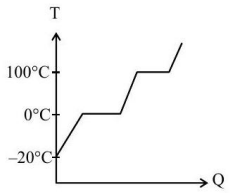
**Ans.** **[4]**

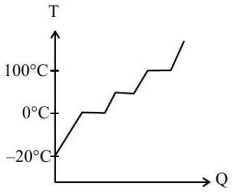
**Sol.** Speed of EM wave : $v = \frac{\omega}{k} = \frac{2\times10^{15}}{10^{7}}$

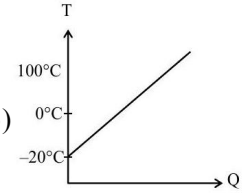
$= 2\times10^{8}$

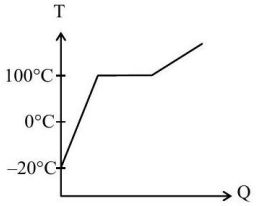
$\therefore \mu = \frac{c}{v} = \frac{3\times10^{8}}{2\times10^{8}} = 1.5$

**21.** Ice is heated from $-20^{\circ}C$ to $200^{\circ}C$. Which of the following temperature (T) vs heat (Q) graph is correct?

(1) 


(2) 


(3) 


(4) 


**Ans.** **[1]**

**Sol.** Theoretical

**22.** Electric current in a circuit is given by $i = i_0\frac{t}{T}$, then find the rms current for period $t = 0$ to $t = T$ :

(1) $\frac{i_0}{\sqrt{3}}$ (2) $\frac{i_0}{\sqrt{2}}$ (3) $\frac{i_0}{\sqrt{5}}$ (4) $\frac{i_0}{\sqrt{4}}$

**Ans.** **[1]**

**Sol.** $i_{rms} = \sqrt{\frac{1}{T}\int_0^T [i(t)]^2\,dt}$

$i_{rms} = i_0\sqrt{\frac{1}{T}\int_0^T \left(\frac{t}{T}\right)^2 dt}$

$i_{rms} = i_0\sqrt{\frac{1}{T^3}\left[\frac{t^3}{3}\right]_0^T}$

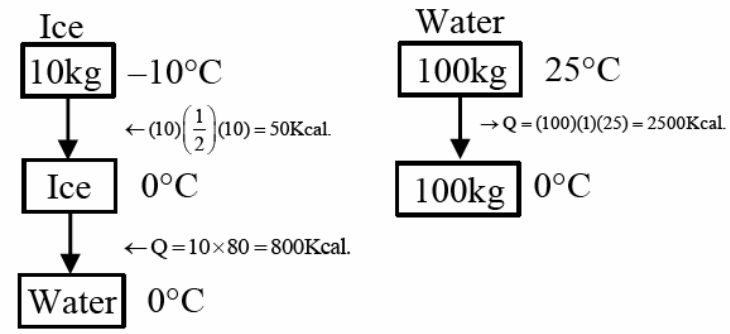
$i_{rms} = \frac{i_0}{\sqrt{3}}$

**23.** 10 kg ice at $-10^{\circ}C$ & 100 kg water at $25^{\circ}C$ are mixed together. Find final temperature. (Given $S_{ice} = \frac{1}{2}cal/g^{\circ}C$, $L_{fusion} = 80cal/g$ and $S_{water} = 1cal/g^{\circ}C$

(1) $15^{\circ}C$ (2) $10^{\circ}C$ (3) $25^{\circ}C$ (4) $20^{\circ}C$

**Ans.** **[1]**

**Sol.**




Whole ice will melt. Let final temperature is T. Net heat conserved.

$\therefore m_i S_i\left(0-(-10)\right)+m_i L_f+m_i S_w\left(T-0\right)+m_w S_w\left(T-25\right)=0$

$10\left(\frac{1}{2}\right)(10)+10\times 80+10(1)(T-0)+100(1)(T-25)=0$

$50+800+10\ T+100\ T-2500=0$

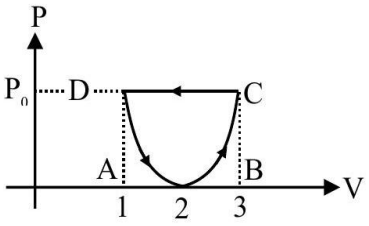
$110\ T=25\ W-800-50$

$110\ T=1650$

$T=\frac{165}{11}=15^{\circ}C$

Final temperature $T=15^{\circ}C$

**24.** For a gas $P-V$ curve is given as shown in the diagram. Curve path follows equations $(V-2)^2=4aP$. Find work done by gas in given cyclic process.




(1) $-\frac{1}{3a}$ (2) $\frac{1}{3a}$ (3) $\frac{1}{5a}$ (4) $\frac{1}{2a}$

**Ans.** **[1]**

**Sol.** Work done = Area of parabola

$=\frac{2}{3}$ Area of rectangle ABCD

$=\frac{2}{3}P_0(3-1)$

$=\frac{4P_0}{3}$

$V = 1 \Rightarrow (1-2)^2 = 4aP_0$

$P_0 = \frac{1}{4a}$

$= \frac{4}{3} \times \frac{1}{4a}$

Work done by gas $= \frac{-1}{3a}$

**25.** Two wires of cross sectional area 1 $cm^2$ and 2 $cm^2$ and lengths 20 cm and 30 cm are connected to the same load. If their extensions are same, find the ratio of their Young's modulus :

(1) $\frac{4}{2}$ (2) $\frac{4}{3}$ (3) $\frac{1}{2}$ (4) $\frac{3}{2}$

**Ans.** **[2]**

**Sol.** $\Delta\ell_1 = \Delta\ell_2$

$\Rightarrow \frac{F\ell_1}{A_1Y_1} = \frac{F\ell_2}{A_2Y_2}$

$\frac{Y_1}{Y_2} = \frac{A_2}{A_1} \times \frac{\ell_1}{\ell_2} = \frac{4}{3}$

# JEE Main Online Exam 2026

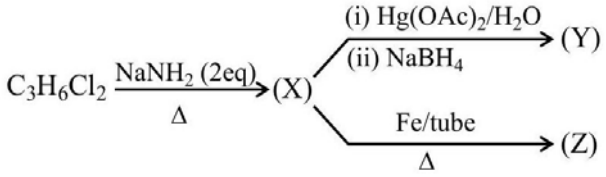
## Memory Based

## Questions & Solution

### 28th January 2026 | Morning

## CHEMISTRY

**1.**




**Statement-I :** Y gives yellow ppt. with $NaOH/I_2$.

**Statement-II :** Two types of H-atoms and one aromatic ring is present in Z and ratio of Z and X is 1 : 3 .

(1) Statement-I is correct and Statement-II is incorrect.

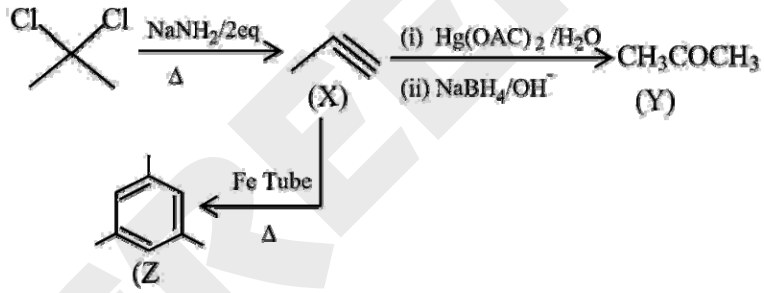
(2) Statement-I is incorrect and Statement-II is correct.

(3) Both Statements are correct.

(4) Both Statements are incorrect.

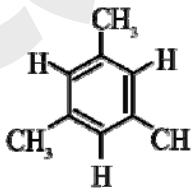
**Ans.** **[3]**

**Sol.**



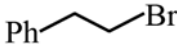

$$(Y) \xrightarrow{NaOH/I_2} \underset{\text{yellow}}{CHI_3} + CH_3COO^-$$

(Z)



**2.** $Ph - CH = CH_2 \xrightarrow[(PhCOO)_2]{HBr}$ Product

Correct statement(s) regarding product :

(a)  is minor product

(b) Benzene is also form a bi product

(c) Reaction follow free radical mechanism

(d) In absence of peroxide carbocation mechanism is followed

(1) b, c (2) a, c, d (3) c, d (4) a, b, c

**Ans.** **[3]**

**Sol.** It is a free addition reaction which follows Anti Markovnikov's rule.

**3.** Determine the values of $X, Y$ and $Z$ for the following complexes and calculate the sum $X + Y + Z$.

$X =$ number of geometrical isomers of $\left[Pt(NH_3)(Cl)(Br)(Py)\right]$

$Y =$ Number of optically inactive isomers of $\left[Cr(en)_2Cl_2\right]^{+1}$

$Z =$ Number of stereoisomers of $\left[Co(NH_3)_3(NO_3)_3\right]$

**Ans.** **[6]**

**Sol.** Here

$X = 3$ (Two cis + one trans isomers)

$Y = 1$ (trans isomer)

$Z = 2$ (Fac- mer isomer)

$X + Y + Z = 3 + 1 + 2 = 6$

**4.** **Statement-I :** Among $BF_4^-, SiF_4, SF_4$, and $XeF_4$, the bond lengths are not identical in two of these molecules.

**Statement-II :** Among $O_2^+, O_2^-, O_2^{2-}$ and $F_2$ the highest bond order is found in $O_2^-$.

(1) Statement I is true and statement II is false.

(2) Statement I is false and statement II is true.

(3) Both statement are true.

(4) Both statement are false.

**Ans.** **[4]**

**Sol.** In $BF_4^-, SiF_4$ and $XeF_4$ all bond lengths are identical

| **Molecules** | **B.O.** |
|---|---|
| $O_2^+ \rightarrow$ | 25. |
| $O_2^- \rightarrow$ | 1.5 |
| $O_2^{2-} \rightarrow$ | 1 |
| $F_1 \rightarrow$ | 1 |

**5.** For the given cell reaction

$BH_4^- + ClO_3^- \longrightarrow Cl^- + H_2BO_3^-$

Cell emf ' E ' is given as

$E = E^0 - \frac{RT}{nF}\ln(Q)$

Determine the value of 'n' in above equation

**Ans.** **[24]**

**Sol.** $3BH_4^- + 4ClO_3^- \longrightarrow 4Cl^- + 3H_2BO_3^- + 3H_2O$

n-factor $= 8$

moles $= 3$

$\therefore n = 3 \times 8 = 24$

**6.**

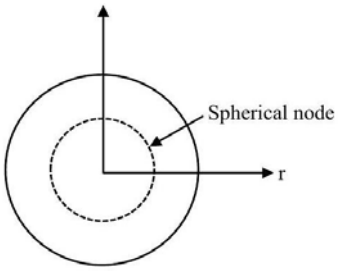



Figure-1

Spherical node shown in figure-1 is best represented by which point in figure-2.

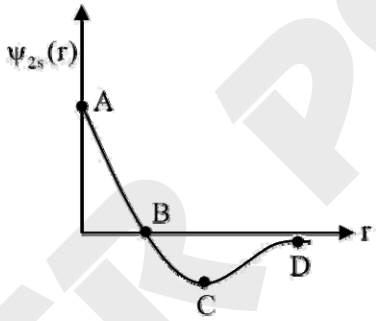



Figure-2

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

**Ans.** **[2]**

**Sol.** At spherical node

$\psi_r = 0$

**7.** There is a weak base 'B' having $pK_b = 5.691$ of molarity 0.02 M. When 0.02 M HCl solution has been added, then pH of resultant buffer solution has been found to be 9. Take total volume of resultant buffer solution to be 100 ml. Find the value of 'x' & 'y', where 'x' is volume of HCl solution in ml & y′ ' is volume of ' B ' solution in ml . Given $\log(5) = 0.691$

(1)

| x | y |
|---|---|
| 14.29 | 85.71 |

(2)

| x | y |
|---|---|
| 15 | 85 |

(3)

| x | y |
|---|---|
| 20 | 80 |

(4)

| x | y |
|---|---|
| 40 | 60 |

**Ans.** **[1]**

**Sol.**

| | HCl | + B | → | $BH^+ + Cl^-$ |
|---|---|---|---|---|
| | 0.02M | 0.02M | | |
| | x ml | y ml | | |
| $t_f$ | 0 | 0.02y–0.02x | | 0.02x |

$$P^{OH} = P^{k_b} + \log\left[\frac{\text{Salt}}{\text{Base}}\right]$$

$$5 = 5.691 + \log\left[\frac{\text{Salt}}{\text{Base}}\right]$$

$$\frac{x}{y-x} = \frac{1}{5}$$

$$6x = y$$

$$7x = 100$$

$$x = \frac{100}{7}\text{ml}$$

$$\&y = \frac{600}{7}\text{ml}$$

**8.** The wave number of three spectral line of H -atom are given. The correct set of spectral lines belonging to Balmer series?

(1) $\frac{5R}{36}, \frac{3R}{16}, \frac{21R}{100}$ (2) $\frac{3R}{4}, \frac{3R}{16}, \frac{7R}{144}$ (3) $\frac{7R}{144}, \frac{3R}{16}, \frac{16R}{255}$ (4) $\frac{5R}{36}, \frac{3R}{16}, \frac{21R}{24}$

**Ans.** **[1]**

**Sol.** Balmer series line $\Rightarrow \bar{v} = R_H z^2\left[\frac{1}{2^2} - \frac{1}{n^2}\right]$

if $n = 3 \Rightarrow \bar{v} = R(1)^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5R}{36}$

if $n = 4 \Rightarrow \bar{v} = \frac{3R}{16}$

if $n = 5 \Rightarrow \bar{v} = \frac{21R}{100}$

**9.** 1 gm of organic compound gave 1.32 g$CO_2$, 0.53 g of same compound gave 0.75g AgBr. If molecular formula of compound is $C_xH_yBr_z$ then calculate percentage of hydrogen in the given compound.

**Ans.** **[4]**

**Sol.**

$$\underset{1g}{C_xH_yBr_z} \rightarrow \underset{1.32g}{CO_2}$$

$$\%C = \frac{1.32 \times 12}{44 \times 1} \times 100 = 36\%$$

$$\underset{0.53g}{C_xH_yBr_z} \rightarrow \underset{0.75g}{AgBr}$$

$$\%Br = \frac{0.75 \times 80}{188 \times 0.53} \times 100 = 60.2\%$$

%H = 100 – (36 + 60.2)

%H $\simeq$ 4%

**10.** 2 moles of liquid A and 3 moles of liquid B are mixed to from an ideal solution. The vapour pressure of ideal solution is 320 mm Hg. When 1 mole of A & 1 mole of B is further added then new vapour pressure of solution is 328.57 mm Hg . Find the vapour pressure of pure $A\left(P_A^\circ\right)$ & pure B $\left(P_B^\circ\right)$:

(1) $P_A^\circ = 200$ mmHg, $P_B^\circ = 500$ mmHg (2) $P_A^\circ = 500$ mmHg, $P_B^\circ = 200$ mmHg

(3) $P_A^\circ = 300$ mmHg, $P_B^\circ = 400$ mmHg (4) $P_A^\circ = 200$ mmHg, $P_B^\circ = 300$ mmHg

**Ans.** **[2]**

**Sol.**

2 moles of A + 3 moles of B

$\Downarrow$

$X_A = 2/5, X_B = 3/5$

$$P_S = X_A P_A^\circ + X_B P_B^\circ$$

$$320 = P_A^\circ\left(\frac{2}{5}\right) + P_B^\circ\left(\frac{3}{5}\right)$$

$$2P_A^\circ + 3P_B^\circ = 1600 \quad \text{...(I)}$$

Now 1 mole of A & 1 mole of B is added

$$X_A^{'} = \frac{3}{7}, X_B^{'} = \frac{4}{7}$$

$$P_S^{'} = 328.57 = P_A^\circ\left(\frac{3}{7}\right) + P_B^\circ\left(\frac{4}{7}\right)$$

$$3P_A^\circ + 4P_B^\circ = 2300 \quad \text{...(II)}$$

Now eq (I) $\times 3 -$ eq (II) $\times 2$

$$6P_A^\circ + 9P_B^\circ = 4800$$

$$6P_A^\circ + 8P_B^\circ = 4600$$

$$P_B^\circ = 200 \text{ mm of Hg}$$

$$P_A^\circ = 500 \text{ mm of Hg}$$

**11.** 500ml,1.2MKI is completely react with 0.2 M , 500 ml $KMnO_4$ solution in basic medium. $I^-$ is oxidised to $I_2$ . The liberated $I_2$ react with 0.1 M $Na_2S_2O_3$ solution. Then find volume (in L ) of $Na_2S_2O_3$ solution required to completely react with liberated $I_2$ .

**Ans.** **[3]**

**Sol.** gram eq of $KMnO_4$ = gram eq of $Na_2S_2O_3$

$$0.2 \times \frac{500}{1000} \times 3 = 0.1 \times V \times 1$$

$$V = 3 \text{ L}$$

**12.** In $4^{th}$ period of periodic table the elements with the largest and smallest size respectively is :

(1) K and Br (2) Na and Cl (3) K and Se (4) Rb and Br

**Ans.** **[1]**

**Sol.** In a period moving from left to right atomic size decreases.

**13.** Select correct option :

(1) $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]$ both are diamagnetic while $[NiCl_4]^{2-}$ is paramagnetic

(2) $[Ni(CN)_4]^{2-}$ and $[NiCl_4]^{2-}$ both are diamagnetic while $[Ni(CO)_4]$ is paramagnetic

(3) $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ both are diamagnetic while $[Ni(CN)_4]^{2-}$ is paramagnetic

(4) Only $[Ni(CN)_4]^{2-}$ is diamagnetic while both $[NiCl^4]^{2-}$ and $[Ni(CO)_4]$ are paramagnetic

**Ans.** **[1]**

**Sol.** $[Ni(CN)_4]^{2-} \rightarrow 3\,d^8 \rightarrow$ diamagnetic $\rightarrow dsp^2$

$[Ni(CO)_4] \rightarrow 3\,d^{10} \rightarrow$ diamagnetic $\rightarrow sp^3$

$[NiCl_4]^{2-} \rightarrow 3\,d^8 \rightarrow e^{2,2}t_2^{2,1,1} \rightarrow sp^3 \rightarrow$ paramagnetic.

**14.** **Statement-I :** Consider the following pairs of ions $(Sc^{3+}, Ti^{3+}), (Ti^{4+}, Ni^{2+})(Cu^{2+}, Zn^{2+})$ and $(Cr^{3+}, Mn^{3+})$. Out of these pairs three pairs consist of ions that are both coloured :

**Statement-II :** Among the lanthanide ions $Eu^{2+}$, $Gd^{3+}, Ce^{4+}$ and $Tb^{4+}$, the ion $Tb^{4+}$ is the strongest reducing agent.

(1) Both statements are true (2) Both statements are false

(3) Statement-I is true and statement-II is false (4) Statement-I is false and statement-II is true.

**Ans.** **[2]**

**Sol.** $Sc^{3+}, Ti^{4+}$ and $Zn^{2+}$ are colourless

$Tb^{4+}$ cannot act as a reducing agent.

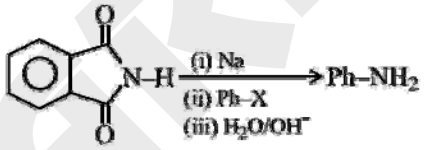
**15.** In carius method of estimation of ' Br ' 1.53 gm of an organic compound gave 1 gm AgBr. The % of Br in organic compound is (At. mass of Ag and Br are 108 and 80 amu respectively)

(1) 35.23 (2) 43.53 (3) 27.81 (4) 22.71

**Ans.** **[3]**

**Sol.** $$\% \text{ Br} = \frac{\left(\frac{1gm}{188}\right)\times 80}{1.53}\times 100 = 27.81\%$$

**16.** Which of the following reaction is correctly matched with their product?

(1) 

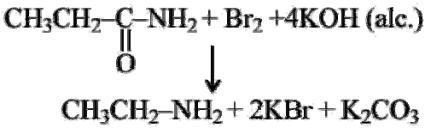

(2) $CH_3CH_2\underset{\underset{O}{\|}}{C}-NH_2 + Br_2 + 4KOH$ (alc.) $\rightarrow CH_3CH_2-NH_2 + 2KBr + K_2CO_3$

(3) $Ph - CH_2 - NH_2 + CHCl_3 + KOH$ (alc.) $\xrightarrow{\Delta}$ $Ph-CH_2-\overset{\oplus}{N}\equiv\overset{\ominus}{C}$ $\xrightarrow{\text{(i) Sn+HCl}}$ $PhCH_2NH_2$

(4) $Ph-\underset{\underset{O}{\|}}{C}-NH_2 \xrightarrow{LiAlH_4} Ph-NH_2$

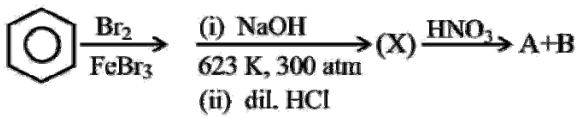
**Ans.** **[2]**

**Sol.**



It is Hofmann bromide degradation.

**17.**



The organic product (A) and (B) can be separated by :

(1) Steam distillation (2) Fractional distillation

(3) Distillation under reduced pressure (4) Azeotropic distillation

**Ans.** **[1]**

**Sol.** Product ( X ) is phenol.

Product (A) and (B) are ortho and para nitrophenol which are separated by Steam distillation.

**18.** Calculate pH of 10 mM weak acid (HA) dissociated in water. Assume $\alpha$ to be negligible. Given $pK_a = 4$

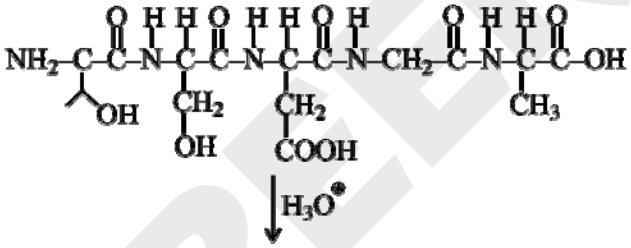
**Ans.** **[3]**

**Sol.** $pH = \frac{1}{2}[pK_a - \log c]$

$pH = \frac{1}{2}\left[4 - \log 10^{-2}\right]$

$pH = 3$

**19.**



Find out the sequence of amino acids from N-terminal to C-terminal in given polypeptide chain.

(1) Thr-Ser-Asp-Gly-Ala (Essential A. Acid = Thr)

(2) Ser-Thr-Asp-Gly-Ala (Essential A. Acid =Thr)

(3) Ser-Asp-Thr-Gly-Ala (Essential A. Acid = Asp)

(4) Thr-Ser-Asp-Gly-Ala (Essential A. Acid = Gly)

**Ans.** **[1]**

**Sol.** Theory based

**20.** For the 1st order decomposition reaction.

$A \rightarrow P$

The value of $\frac{t_{1/8}}{t_{1/10}} \times 10$ will be :-

$t_{1/8}$ = time at which concentration of A become 1/8 of initial concentration.

$t_{1/10}$ = time at which concentration of A becomes 1/10 of initial concentration.

(1) 3 (2) 6 (3) 9 (4) 0.9

**Ans.** **[3]**

**Sol.** $t = \frac{1}{k}\ln\frac{A_0}{A_t}$

$$t_{1/8} = \frac{1}{k}\ln\frac{A_0}{A_0/8} = \frac{1}{k}\ln 8$$

$$t_{1/10} = \frac{1}{k}\ln\frac{A_0}{A_0/10} = \frac{1}{k}\ln 10$$

$$\frac{t_{1/8}}{t_{1/10}} = \frac{\ln 8}{\ln 10} = \frac{\log 8}{\log 10}$$

$$\frac{t_{1/8}}{t_{1/10}} = \log 8 = 3\log 2 = 0.9$$

$$\frac{t_{1/8}}{t_{1/10}} \times 10 = 9$$

**21.** For an ideal gas undergo isothermal reversible process from 0.5 Mpa, 20 $dm^3$ to 0.2 Mpa at 600 K. Calculate correct option. [Given log5 = 0.6989, log2 = 0.3010]

(1) w = –3.9 kJ, $\Delta U = 0$, q = 3.9 kJ

(2) w = –9.1 kJ, $\Delta U = 0$, q = 9.1 kJ

(3) w = +9.1 kJ, $\Delta U = 0$, q = – 9.1 kJ

(4) w = +3.9 kJ, $\Delta U = 0$, q = –3.9 kJ

**Ans.** **[2]**

**Sol.** For isothermal reversible process $= \Delta U = 0$

$$w_{iso} = -p_1 v_1 \ln\frac{P_1}{P_2}$$

$$w_{iso} = -0.5\times10^6 \times 20\times10^{-3} \ln\frac{0.5}{0.2}$$

w = –9.1 kJ

q = –w = 9.1 kJ

**22.** Choose the correct statements in respect of hydrides of group 15.

(A) Reducing power increases down the group

(B) Basic nature increases down the group

(C) Stability decreases down the group

(D) Boiling point decreases regularly down the group.

(1) A, B and C only (2) A, B and D only

(3) A and C only (4) B, C and D only

**Ans.** **[3]**

**Sol.** Boiling point order $PH_3 < AsH_3 < NH_3 < SbH_3 < BiH_3$ So D is wrong

Basic nature $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$ So B is wrong.

**23.** **Statement-I :** Test for nitrite; sulphanilic acid and 1-napthylamine are used.

**Statement-II :** Acidified nitrite is di-azotized with sulphanilic acid and coupled with 1-napthylamine.

Select the correct statement.

(1) Both Statements are correct.

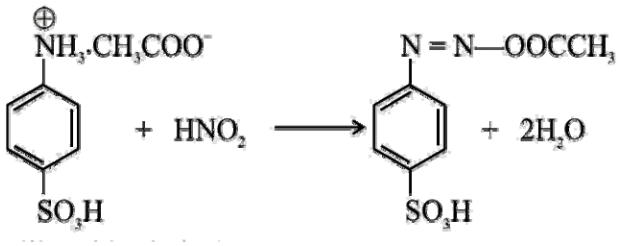
(2) Both Statements are incorrect.

(3) Statement I is correct but Statement II is incorrect.

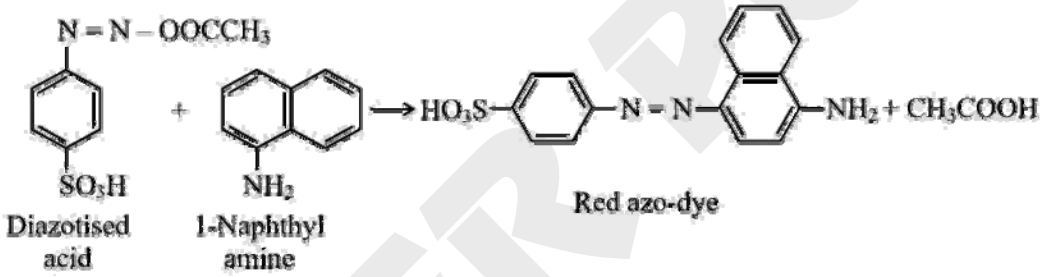
(4) Statement I is correct but Statement II is incorrect.

**Ans.** **[1]**

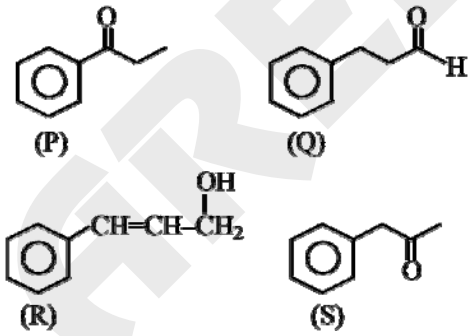
**Sol.** $NO_2^- + CH_3COOH \rightarrow HNO_2 + CH_3COO^-$




(Sulphanilic acid solution)




**24.**




Select the correct statement.

(1) Compound P, Q, R give +ve 2,4-DNP test

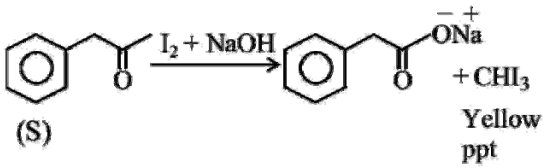
(2) Only compound S give yellow ppt with $NaOH + I_2$

(3) Compound Q and R gives Tollen's test

(4) Only compound P & S gives soothy flame

**Ans.** **[2]**

**Sol.**




Others compounds $P, Q, R$ do not give Iodoform test.

**25.** Consider the following anions

$CH_3-\overset{\ominus}{C}H_2$ $CH_2=\overset{\ominus}{C}H$ $HC\equiv\overset{\ominus}{C}$

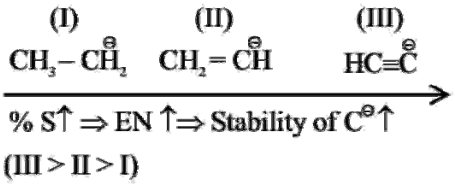
(i) (ii) (iii)

Correct stability order of given anions is

(1) III > II > I (2) II > III > I (3) I > II > III (4) I > III > II

**Ans.** **[1]**

**Sol.**



CAREER POINT

# JEE Main Online Exam 2026

## Memory Based

## Questions & Solution

### 28th January 2026 | Morning

## MATHEMATICS

**1.** Let $\tan\left(\frac{\pi}{4}+\frac{1}{2}\cos^{-1}\frac{2}{3}\right)+\tan\left(\frac{1}{2}\sin^{-1}\frac{2}{3}\right)=k$.

Then number of solution of the equation $\sin^{-1}(kx-1)=\sin x-\cos^{-1}x$ is/are :

(1) No solution (2) exactly one solution

(3) Two solutions (4) infinite solutions

**Ans.** **[2]**

**Sol.** $k=\tan\theta+\cot\theta=\frac{1}{\sin\theta\cos\theta}=\frac{2}{\sin2\theta}$

where $\theta=\frac{1}{2}\sin^{-1}\frac{2}{3}$

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

$\sin^{-1}(3x-1)=\sin^{-1}x-\cos^{-1}x$

$\sin^{-1}(3x-1)=\frac{\pi}{2}-2\cos^{-1}x$

$3x-1=\sin\left(\frac{\pi}{2}-2\cos^{-1}x\right)$

$3x-1=2x^2-1\Rightarrow x=0,\frac{3}{2}$

No. of solution = 1

**2.** If $g(x)=3x^2+2x-3, f(0)=-3, 4g(f(x))=3x^2-32x+72$ then find $f(g(2))$ where $f(x)>0$ for all valid x :

(1) $\frac{7}{2}$ (2) $\frac{5}{2}$ (3) $\frac{3}{2}$ (4) $\frac{1}{2}$

**Ans.** **[1]**

**Sol.** $g(2)=3(2)^2+4-3=13$

$f(g(2))=f(13)$

$4g(f(x))=3x^2-32x+72$

$4(3f^2(x)+2f(x)-3)=3x^2-32x+72$

$12f^2(x)+8f(x)-12=3x^2-32x+72$

Put $x = 13$

$12f^2(13) + 8f(13) - 12 = 3(13)^2 - 32(13) + 72$

$12f^2(13) + 8f(13) - 175 = 0$

$f(13) = \frac{-8 \pm 92}{24} \Rightarrow f(13) = \frac{7}{2}$ or

$f(13) = -\frac{15}{4}$( rejected)

**3.** Value of : $\sum_{k=1}^{\infty} \frac{(-1)^k \cdot k(k+1)}{k!}$

(1) $-\frac{1}{e}$ (2) $-\frac{2}{e}$ (3) $-\frac{3}{e}$ (4) $-\frac{4}{e}$

**Ans.** **[1]**

**Sol.** $\sum_{k=1}^{\infty} \frac{(-1)^k}{k!}\left(k(k-1) + 2k\right)$

$\sum_{k=1}^{\infty} \frac{(-1)^k}{(k-2)!} + 2\sum_{k=1}^{\infty} \frac{(-1)^k}{(k-1)!}$

$\sum_{k=1}^{\infty} \frac{(-1)^{k-2}}{(k-2)!} - 2\sum_{k=1}^{\infty} \frac{(-1)^{k-1}}{(k-1)!}$

$\sum_{k=0}^{\infty} \frac{(-1)^k}{k!} - 2\sum_{k=0}^{\infty} \frac{(-1)^k}{k!} = -\sum_{k=1}^{\infty} \frac{(-1)^k}{k!}$

$= -\left(\frac{1}{0!} - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} \ldots\right)$

$= -\frac{1}{e}$

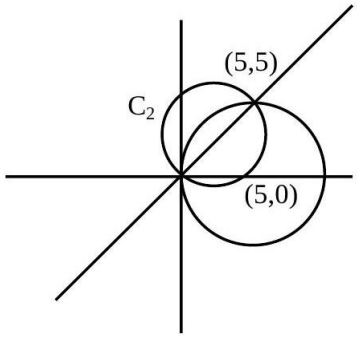
**4.** Consider a circle $C_1$, passing through origin and lying in region $0 \le x$ only, with diameter $= 10$. Consider a chord PQ of $C_1$ with equation $y = x$ and another Circle $C_2$ which has PQ as diameter. A chord is drawn to $C_2$ passing through $(2,3)$ such that distance of chord from centre of $C_2$ is maximum has equation $x + ay + b = 0$ then $|b - a|$ is equal to :

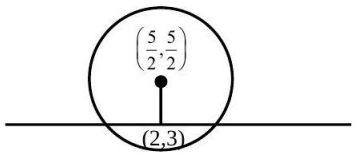
(1) 1 (2) 2 (3) 3 (4) 4

**Ans.** **[2]**

**Sol.** Equation of $C_2$ is $x(x-5) + y(y-5) = 0$

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






equation of chord is

$T = S_1$

Slope of chord is 1

Equation of line

$y-3=1(x-2)$

$x-y=-1$

$\Rightarrow \left.\begin{matrix} x-y+1=0 \\ x+ay+b=0 \end{matrix}\right\} \begin{matrix} b=1, a=-1 \\ |b-a|=2 \end{matrix}$

**5.** Let $\int \frac{1-5\cos^2 x}{\sin^5 x\cos^2 x}dx = f(x)+c$ then find $f\left(\frac{\pi}{4}\right)-f\left(\frac{\pi}{6}\right)$ :

(1) $4\sqrt{2}-\frac{32}{\sqrt{3}}$ (2) $4\sqrt{3}-\frac{32}{\sqrt{3}}$ (3) $4\sqrt{3}-\frac{32}{\sqrt{2}}$ (4) $4\sqrt{2}-\frac{32}{\sqrt{2}}$

**Ans.** **[1]**

**Sol.** $\int \frac{dx}{\sin^5\cos^2 x}-5\int \frac{dx}{\sin^5 x}$

$\int \frac{\sec^2 x dx}{\sin^5 x}-5\int \frac{dx}{\sin^5 x}$

IBP

$=\frac{\tan x}{\sin^5 x}-\int -\frac{5}{\sin^6 x}\cdot\cos x\cdot\tan x dx-5\int \frac{dx}{\sin^5 x}$

$=\frac{\tan x}{\sin^5 x}+c$

$f(x)=\frac{\tan x}{\sin^5 x}$

$f\left(\frac{\pi}{4}\right)-f\left(\frac{\pi}{6}\right)=(\sqrt{2})^5-\frac{2^2}{\sqrt{3}}=4\sqrt{2}-\frac{32}{\sqrt{3}}$

**6.** A bag contains ' k ' red balls and $(10-k)$ black balls. If 3 balls are drawn at random and they are found to be black then the probability that bag has 9 black balls & 1 red ball is

(1) $\frac{7}{11}$ (2) $\frac{14}{55}$ (3) $\frac{21}{55}$ (4) $\frac{6}{11}$

**Ans.** **[2]**

**Sol.** Sol. Probability $=\frac{{}^1C_0\cdot{}^9C_3}{\sum_{k=0}^{10}{}^kC_0\cdot{}^{10-k}C_3}$

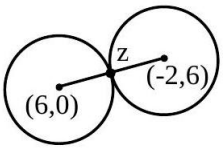
$=\frac{{}^9C_3}{{}^{10}C_3+{}^9C_3+{}^8C_3+\ldots.{}^3C_3}$

$=\frac{{}^9C_3}{{}^{11}C_4}=\frac{14}{55}$

**7.** A complex number '$z$' satisfy both $|z-6|=5$ & $|z+2-6i|=5$ simultaneously. Find the value of $z^3+3z^2-15z+141$.

**Ans.** **[53]**

**Sol.** $|z-6|=5 \;\&\; |z+2-6i|=5$




Locus of z is circle both equation

$z=2+3i$

$z-2=3i$

$\Rightarrow z^2-4z+4=-9$

$z^2-4z+13=0$

$z^3+3z^2-15z+141=\left(z^2-4z+13\right)(z+7)+53$

$=53$

**8.** The value of $\lim\limits_{x\to 0}\dfrac{\ln\left(\sec(ex)\cdot\sec\left(e^2x\right).....\cdot\sec\left(e^{10}x\right)\right)}{e^2-e^{2\cos x}}$ is :

(1) $\dfrac{1}{2}\dfrac{\left(e^2-1\right)}{\left(e^{20}-1\right)}$ (2) $\dfrac{1}{2}\dfrac{\left(e^{20}-1\right)}{\left(e^2-1\right)}$ (3) $\dfrac{1}{2}\dfrac{(e-1)}{\left(e^{20}-1\right)}$ (4) None of these

**Ans.** **[2]**

**Sol.** $\Rightarrow \lim\limits_{x\to 0}\dfrac{\ln\left(\sec(ex)\right)+\ln\left(\sec\left(e^2x\right)\right)+.....\ell n\left(\sec\left(e^{10}x\right)\right)}{e^{2\cos x}\left(\dfrac{e^{2-2\cos x}-1}{2-2\cos x}\right)\times\dfrac{2-2\cos x}{x^2}\times x^2}$

$\Rightarrow \lim\limits_{x\to 10}\dfrac{\ell n\left(\sec(ex)\right)+\ell n\left(\sec\left(e^2x\right)\right)+.....\ell n\left(\sec\left(e^{10}x\right)\right)}{e^2x^2}$

Using L'H rule

$\Rightarrow \lim\limits_{x\to 10}\dfrac{e\tan ex+e^2\tan^2x+.....+e^{10}\tan^{e10}x}{2e^2x}$

$\Rightarrow \dfrac{1}{2e^2}\left[e^2+e^4+e^6+....+e^{20}\right]$

$\Rightarrow \dfrac{1}{2}\dfrac{e^2\left(\left(e^2\right)^{10}-1\right)}{e^2\left(e^2-1\right)}$

$\Rightarrow \dfrac{1}{2}\dfrac{\left(e^{20}-1\right)}{\left(e^2-1\right)}$

**9.** In $\Delta ABC$ if $\frac{\tan(A-B)}{\tan A}+\frac{\sin^2 C}{\sin^2 A}=1$ where $A,B,C\in\left(0,\frac{\pi}{2}\right)$ then

(1) $\tan A, \tan B, \tan C$ are in A.P. (2) $\tan A, \tan C, \tan B$ are in A.P.

(3) $\tan A, \tan B, \tan C$ are in G.P. (4) $\tan A, \tan C, \tan B$ are in G.P.

**Ans.** **[4]**

**Sol.** $\frac{\tan A-\tan B}{\tan A(1+\tan A\tan B)}+\frac{1+\cot^2 A}{1+\cot^2 C}=1$

Let $\tan A = x$

$\tan B = y$

$\tan C = z$

$$\frac{x-y}{x(1+xy)}+\frac{1+\frac{1}{x^2}}{1+\frac{1}{z^2}}=1$$

$$\frac{(x-y)}{x(1+xy)}+\frac{z^2(x^2+1)}{x^2(z^2+1)}=1$$

$$x(x-y)(z^2+1)+z^2(x^2+1)(1+xy)=x^2(1+xy)(z^2+1)$$

After solving

$z^2 = xy$

$\Rightarrow \tan^2 C = \tan A \tan B$

**10.** Product of first 3 terms of a G.P. is 27 and sum is $R-\{a,b\}$, then $a^2+b^2$ is equal to :

(1) 90 (2) 81 (3) 9 (4) 18

**Ans.** **[1]**

**Sol.** $\frac{A}{r}\cdot A\cdot Ar = 27$

$\mathbf{A} = 3$

$$3\left(\frac{1}{r}+1+r\right)=3+3\left(r+\frac{1}{r}\right)$$

We know, $r+\frac{1}{r}\geq 2$ or $r+\frac{1}{r}\leq -2$

$S\in R-(-3,9)$

$a^2+b^2=9+81=90$

**11.** Consider the 10 observations $2,3,5,10,11,13,15,21$, a and b such that mean of observation is a and variance is 34.2. Then the mean deviation about median, is :

(1) 5 (2) 6 (3) 7 (4) 8

**Ans.** **[1]**

**Sol.** $\frac{2+3+5+10+11+13+15+21+a+b}{10}=9$

$$\frac{80+a+b}{10}=9\Rightarrow a+b=10 \quad ....(1)$$

$$\frac{\Sigma x_i^2}{10}-\left(\frac{\Sigma x_i}{10}\right)^2=34.2$$

$$\frac{2^2+3^2+5^2+10^2+11^2+13^2+15^2+21^2+a^2+b^2}{10}-(9)^2=34.2$$

$$1094+a^2+b^2-810=342$$

$$a^2+b^2=58 \quad ....(2)$$

$$a=7,\ b=3$$

or $a=3,\ b=7$

Number $\rightarrow 2,3,5,7,10,11,13,15,21$

$$\text{Mean}=\frac{7+10}{2}=8.5$$

$$\text{M.D}=\frac{6.5+5.5+5.5+3.5+1.5+1.5+2.5+4.5+6.5+12.5}{10}$$

$$=\frac{50}{5}$$

$$=5$$

**12.** Given $\frac{1}{\alpha}-\frac{1}{\beta}=\frac{1}{3}$ such that roots of the quadratic equation $\lambda x^2+(\lambda+1)x+3=0$ are $\alpha$ & $\beta$, then sum of values of $\lambda$ is equal to :

(1) 8 (2) 9 (3) 10 (4) 11

**Ans.** **[3]**

**Sol.** $\frac{\beta-\alpha}{\alpha\beta}=\frac{1}{3},\ \alpha+\beta=-\frac{(\lambda+1)}{\lambda},\ \alpha\beta=\frac{3}{\lambda},$

$$\beta-\alpha=\frac{\alpha\beta}{3}=\frac{3}{\lambda.3}=\frac{1}{\lambda}$$

sq. $\alpha^2+\beta^2-2\alpha\beta=\frac{1}{\lambda^2}$ ....(1)

sq. $\alpha^2+\beta^2+2\alpha\beta=\frac{(\lambda+1)^2}{\lambda^2}$ ....(2)

(2) $-$(1)

$$4\alpha\beta=\frac{(\lambda+1)^2}{\lambda^2}-\frac{1}{\lambda^2}$$

$$\frac{12}{\lambda}=\frac{\lambda^2+2\lambda+1-1}{\lambda^2}$$

$$\lambda^2-10\lambda=0$$

$$\lambda=0,10$$

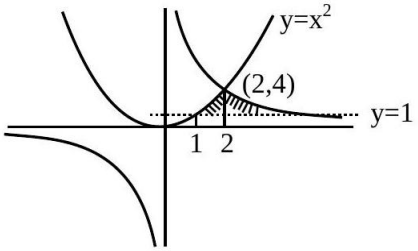
$$\lambda=10$$

**13.** Area bounded by $\{(x,y): xy \le 8; y \le x^2, y \ge 1\}$ is :

(1) $16\log_e 2 - \frac{14}{3}$ (2) $16\log_e 2 - \frac{13}{3}$ (3) $16\log_e 2 - \frac{17}{3}$ (4) $16\log_e 2 - \frac{19}{3}$

**Ans.** **[1]**

**Sol.**




$$A = \int_1^2 (x^2 - 1)\,dx + \int_2^8 \left(\frac{8}{x} - 1\right)dx$$

$$A = 8\log_e 4 - \frac{14}{3} = 16\log_e 2 - \frac{14}{3}$$

**14.** Find possible no. of triplets $(\delta, c, d)$, such that $x^2 + 2$ is divisor of

$x^3 + bx^2 + cx + d$ & $\delta, c, d \le 20$ & $\delta, c, d \in N$ :

**Ans.** **[10]**

**Sol.** $x^3 + bx^2 + \left(x + d = (x^2 + 2)\left(x + \frac{d}{2}\right)\right.$

$x^2 : b = \frac{d}{2}$

$x : c = 2$

$c = 2,\ b = \frac{d}{2}\ d \in \{2,4,\ldots\ldots,20\}$

No. of triplet = 10

**15.** Let x be the number of 9 digit numbers formed by taking digits from first 9 natural numbers, where only one digit is repeated twice & y be the number of 9 digit numbers formed from first 9 natural numbers, such that exactly 2 digits repeated twice then

(1) $x = 27y$ (2) $21x = 4y$ (3) $5x = 27y$ (4) $7x = 27y$

**Ans.** **[2]**

**Sol.** $S = \{1,2,3,\ldots.,9\}$

$$x = {}^9C_1 \cdot {}^8C_7 \times \frac{9!}{2} = \frac{9 \times 8 \times 9!}{2}$$

$$y = {}^9C_2 \cdot {}^7C_5 \times \frac{9!}{2! \times 2!} = \frac{9 \times 8}{2} \times \frac{7 \times 6}{2} \times \frac{9!}{2! \times 2!}$$

$$\Rightarrow \frac{x}{y} = \frac{4}{21}$$

$21x = 4y$

**16.** Given conic $x^2 - y^2\sec^2\theta = 8$ whose eccentricity is ' $e_1$ ' & length of latus rectum ' $\ell_1$ ' and for conic $x^2 + y^2\sec^2\theta = 6$, eccentricity is ' $e_2$ ' & length of latus rectum ' $\ell_2'$. If $e_1^2 = e_2^2\left(1+\sec^2\theta\right)$ then value of

$$\frac{e_1\ell_1}{e_2\ell_2}\tan\theta$$

**Ans.** **[2]**

**Sol.** $\frac{x^2}{8} - \frac{y^2}{8\cos^2\theta} = 1,\ e_1 = \sqrt{1+\frac{8\cos^2\theta}{8}}$

$$\ell_1 = \frac{2\,b^2}{a} = \frac{2\cdot\left(8\cos^2\theta\right)}{2\sqrt{2}}$$

$$\frac{x^6}{6} + \frac{y^2}{6\cos^2\theta} = 1;\ e_2 = \sqrt{1-\frac{6\cos^2\theta}{6}} = \sin\theta$$

$$\ell_2 = \frac{2b^2}{a} = \frac{2.6\cos^2\theta}{\sqrt{6}}$$

$$e_1^2 = e_2^2\left(1+\sin^2\theta\right)$$

$$1+\cos^2\theta = \sin^2\theta\left(1+\frac{1}{\cos^2\theta}\right)$$

$$1+\cos^2\theta = \sin^2\theta + \tan^2\theta$$

Solving we get $\theta = \frac{\pi}{4}$

$$\frac{e_1\ell_1}{e_2\ell_2}\tan\theta$$

$= 2$ by putting values.

**17.** If $f\left(x^2+1\right) = x^4 + 5x^2 + 1$, then find $\int_0^3 f(x)\,dx$ :

(1) 13.5 (2) 15.3 (3) 13 (4) 15.5

**Ans.** **[1]**

**Sol.** $\because f\left(x^2+1\right) = x^4 + 5x^2 + 1$

$$\left\{\text{put } x^2+1 = t\right\}$$

$$\Rightarrow f(t) = (t-1)^2 + 5(t-1) + 1$$

$$\Rightarrow f(t) = t^2 + 3t - 3$$

Now, $\int_0^3 f(t)\,dt = \int_0^3\left(t^2+3t-3\right)dt$

$$\left[\frac{t^3}{3} + \frac{3t^2}{2} - 3t\right]_0^3$$

$$\left[\frac{27}{3} + \frac{27}{2} - 9\right]$$

$$= \frac{27}{2} = 13.5$$

**18.** Let $x\frac{dy}{dx}-\sin 2y=x^3\left(2-x^3\right)\cos^2 y; y(2)=0$, then find $\tan\left(y(1)\right)$ :

(1) 5 / 4 (2) 3 / 4 (3) 7 / 4 (4) 9 / 4

**Ans.** **[3]**

**Sol.** $\sec^2 y\frac{dy}{dx}-\frac{2\tan y}{x}=x^3\left(2-x^3\right)$

$\tan y=t\Rightarrow \sec^2 y\frac{dy}{dx}=\frac{dt}{dx}$

$\frac{dt}{dx}-\frac{2t}{x}=x^3\left(2-x^3\right)$

I. $F=e^{\int -\frac{2}{x}dx}=e^{-2\ln x}=\frac{1}{x^2}$

$t\left(\frac{1}{x^2}\right)=\int\left(2-x^3\right)dx$

$\frac{t}{x^2}=2x-\frac{x^4}{4}+C$

$\frac{\tan y}{x^2}=2x-\frac{x^4}{4}+C$

$y(2)=0$

$\Rightarrow 0=4-\frac{16}{4}+C\Rightarrow C=0$

Now put $x=1$

$\tan y=2-\frac{1}{4}=\frac{7}{4}$

$\tan(1)=\frac{7}{4}$

**19.** If $\vec{a},\vec{b}$ & $\vec{c}$ are unit vectors such that

$(\vec{a}-\vec{b})^2+(\vec{b}-\vec{c})^2+(\vec{c}-\vec{a})^2=9$. Find positive $k$ if $\left|2\vec{a}+k\vec{b}+k\vec{c}\right|=3$:

(1) 2 (2) 4 (3) 5 (4) 7

**Ans.** **[3]**

**Sol.** $(\vec{a}-\vec{b})^2+(\vec{b}-\vec{c})^2+(\vec{c}-\vec{a})=9$

$\Rightarrow \vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}--=-\frac{3}{2}$

$\Rightarrow \vec{a}+\vec{b}+\vec{c}=0\Rightarrow \vec{b}+\vec{c}=-\vec{a}$

$\left|2\vec{a}+k\left(\vec{b}+\vec{c}\right)\right|=3$

$\left|\vec{a}(2-k)\right|=3$

$K=5$ or $-1$

**20.** The value of $S=\sum_{r=1}^{20}\sqrt{\pi\int_0^r x|\sin\pi x|dx}$ is :

(1) 210 (2) 201 (3) 120 (4) 102

**Ans.** **[1]**

**Sol.** $I_r=\int_0^r x|\sin\pi x|dx$

King

$=\int_0^r (r-x)|\sin\pi x|dx$

$2I_r=\int_0^r r|\sin\pi x|dx \Rightarrow I_r=\frac{r}{2}\int_0^r|\sin\pi x|dx$

$I_1=\frac{1}{2}\int_0^1|\sin\pi x|dx=\frac{1}{2\pi}\int_0^\pi|\sin t|dx=\frac{1}{2\pi}(2)$

$I_2=\frac{2}{2}\int_0^2|\sin\pi x|dx=\frac{2}{2\pi}\int_0^{2\pi}|\sin t|dt=\frac{2}{2\pi}(4)$

$S=\sqrt{\pi.\frac{1}{2\pi}.2}+\sqrt{\pi.\frac{2}{2\pi}.4}+\sqrt{\pi.\frac{3}{2\pi}.6}+....+\sqrt{\pi\frac{20}{2\pi}(2.20)}$

$=1+2+3+\ldots\ldots+20$

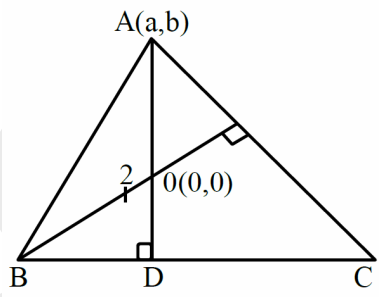
$=\frac{20\times21}{2}=210$

**21.** Orthocentre of equilateral $\triangle ABC$ is at the origin. If side BC lies along $x+2\sqrt{2}y=4$. If coordinates of vertex A are $(a,b)$. Find the value of $\left[|a+\sqrt{2}\,b|\right]$, where [.] denotes G.I.F. :

(1) 1 (2) 2 (3) 3 (4) 4

**Ans.** **[4]**

**Sol.**




$\because m_{BC}\cdot m_{AD}=-1$

$\Rightarrow\left(-\frac{1}{2\sqrt{2}}\right)\left(\frac{b}{a}\right)=-1$

$\Rightarrow b=2\sqrt{2}a \quad \ldots.(1)$

$$\because OD = \left|\frac{-4}{\sqrt{1+8}}\right| = \frac{4}{3} \Rightarrow AO = \frac{8}{3}$$

$$\text{So } AD = \frac{8}{3} + \frac{4}{3} = 4$$

$$\Rightarrow \frac{\left|a + 2\sqrt{2}b - 4\right|}{3} = 4 \Rightarrow a = \frac{16}{9} \text{ or } -\frac{8}{9}$$

$$\text{Now, } (a,b) = \left(\frac{16}{9}, \frac{32\sqrt{2}}{9}\right);$$

$$\left\{\begin{array}{l}\because A(a,\ b) \& (0,0) \text{ lies same} \\ \text{side of given line}\end{array}\right\}$$

$$\text{so}(a,b) = \left(-\frac{8}{9}, \frac{-16\sqrt{2}}{9}\right)$$

$$= \left[\left|a + \sqrt{2}b\right|\right] = \left[\left|\frac{-8-32}{9}\right|\right] = 4$$