JEE Main Online Exam 2026

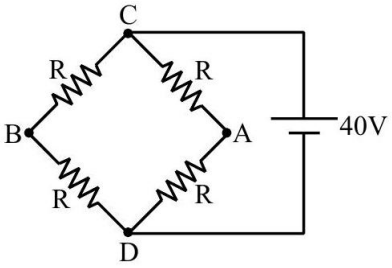
Memory Based

Questions & Solution

28th January 2026 | Evening

PHYSICS

1.

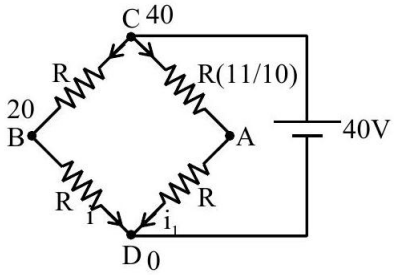


If resistance between A & C is increased by 10% through heating, then calculate $|V_A - V_B|$.

(1) $\frac{10}{21}$ (2) $\frac{5}{21}$ (3) $\frac{20}{21}$ (4) $\frac{5}{7}$

Ans. **[3]**

Sol.



$$i_1 = \frac{40}{\frac{21}{10}R} = \frac{400}{21R}$$

$$V_A - V_D = \frac{400}{21R} \times R = \frac{400}{21}$$

$$|V_A - V_B| = \left(\frac{400}{21} - 20\right)$$

$$= \left|\frac{400 - 420}{21}\right| = \left|\frac{20}{21}\right|$$

2. Two light sources of 450 nm and 550 nm are used for YDSE with slit distance 2.25 mm and distance between the slits and screen is 1.5 m. Then the distance from central maxima for which minima of both wavelength coincide :

(1) 1.65 mm (2) 1.55 mm (3) 1.45 mm (4) 1.85 mm

Ans. **[1]**

Sol. $y = (2n-1)\frac{\lambda D}{2d}$

$y_1 = y_2$

$(2n-1)\lambda_1 \frac{D}{2d} = (2m-1)\lambda_2 \frac{D}{2d}$

$\frac{(2n-1)}{2m-1} = \frac{\lambda_2}{\lambda_1} = \frac{550}{450} = \frac{11}{9}$

So $n = 6,\ m = 5$

$y = 11 \times \frac{\lambda_1 D}{2d} = \frac{11 \times 450 \times 10^{-9} \times 1.5}{2 \times 2.25 \times 10^{-3}}$

$y = \frac{33}{2} \times 10^{-4}$

$y = 1.65$ mm

3. The minimum deviation produced by a prism is equal to refracting angle of prism, then choose the range of refractive index (μ) of material of prism :

(1) $1 < \mu < \sqrt{2}$ (2) $1 < \mu < 2$ (3) $1 < \mu < 2\sqrt{2}$ (4) $1 < \mu < \sqrt{3}$

Ans. **[1]**

Sol. $\delta_{min} = 2i - A \Rightarrow i = \delta_{min} = A$

$i_{max} = \frac{\pi}{2} \Rightarrow A_{max} = \frac{\pi}{2}$

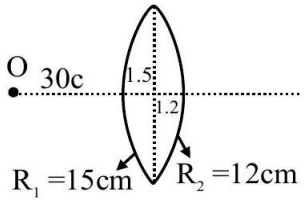
Also, $\mu = \frac{\sin\left(\frac{\delta_{min} + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$\Rightarrow \mu = \frac{\sin A}{\sin\frac{A}{2}} = 2\cos\left(\frac{A}{2}\right)$

$\therefore \mu_{max} = 2\cos\left(\frac{\pi}{4}\right) = \sqrt{2}$

$\mu_{min} = 1$

4. Find magnification due to lens :



(1) $m = +1$ (2) $m = -1$ (3) $m = +2$ (4) $m = -2$

Ans. **[4]**

Sol. $\frac{1}{v} - \frac{1}{u} = \frac{1}{f_{net}} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{v} + \frac{1}{30} = 0.5\left(\frac{1}{15} - \frac{1}{\infty}\right) + 0.2\left(\frac{1}{\infty} + \frac{1}{12}\right)$

$$\frac{1}{v}+\frac{1}{30}=\frac{1}{30}+\frac{1}{60}$$

$$v=60$$

$$m=\frac{v}{u}=\frac{60}{-30}=-2$$

5. Mass number of a nucleus is α and its radius is R_α. Radius of other nucleus of mass number β is R_β. If $\beta=8\alpha$ than $\frac{R_\alpha}{R_\beta}$?

(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{1}{8}$ (4) 2

Ans. **[2]**

Sol. $R_\alpha=R_0\alpha^{1/3}$

$R_\beta=R_0\beta^{1/3}$

$$\frac{R_\alpha}{R_\beta}=\left(\frac{\alpha}{\beta}\right)^{1/3}=\frac{1}{2}$$

6. (A) Equivalent capacitance is lower than least of capacitors present in series.
(B) One method of increasing the capacitance is to decrease the distance between plates and increasing cross section area:
(C) Electric field inside the isolated capacitor decreases after inserting dielectric
(D) Displacement of charge does not happen when a dielectric is inserted in isolated capacitor because dielectric acts like an insulator.
(E) Energy of isolated capacitor increases when a dielectric is inserted in capacitor.
Of the following statements which of the following are true.

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

Ans. **[3]**

Sol. Theoretical

7. Consider the following electromagnetic waves :
wave A :- wavelength $=400$ nm
wave B :- frequency $=10^{16}$ Hz
wave C :- wave number $=10^4$ cm^{-1}
order of energies is :

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

Ans. **[3]**

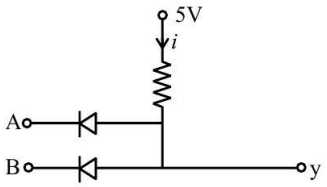
Sol. $\lambda_A=400\text{ nm}=4\times10^{-7}$ m

$$\lambda_B=\frac{3\times10^8}{10^{16}}=3\times10^{-8}\text{ m}$$

$\lambda_C=10^{-6}$ m

$$\therefore E=\frac{hC}{\lambda}\Rightarrow\lambda\uparrow E\downarrow$$

8. For the circuit below, identify the logic gate :



(1) AND (2) OR (3) NAND (4) NOR

Ans. **[1]**

Sol. $V_y = 5 - ir$

For high voltage at A and B diodes will not conduct & output will be high.
For either high input output will be small so it must be AND.

9. If percentage increase in Young's modulus Y is 1%, percentage increase in density of material is 0.5% and longitudinal wave traveling in metallic bar have wave velocity of 400 m/s, then find final velocity of wave.

(1) 398 (2) 355 (3) 401 (4) 402

Ans. **[3]**

Sol. $V_{sound} = \sqrt{\frac{Y}{\rho}}$

$$\frac{\Delta V}{V} = \frac{1}{2}\frac{\Delta Y}{Y} - \frac{1}{2}\frac{\Delta \rho}{\rho}$$

$$= \frac{1}{2} \times 1\% - \frac{1}{2} \times \frac{1}{2}\%$$

$$\frac{\Delta V}{V} = \frac{1}{4}\%$$

$$\frac{\Delta V}{V} = \frac{1}{4} \times \%$$

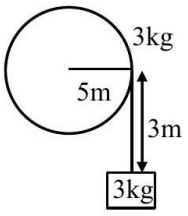
$$\Delta V = 1 \text{ m/s}$$

$$V_{final} = 400 + 1 = 401 \text{ m/s}$$

10. Block of mass 3 kg is connected to a flywheel of mass 3 kg and radius 5 m through a massless string wrapped around the flywheel. Find kinetic energy (in J) of flywheel when block descends by 3 m.

Ans. **[30]**

Sol.



$$mg \times 3 = \frac{1}{2} \cdot \frac{mR^2}{2}\omega^2 + \frac{1}{2}mv^2$$

$$\& v = \omega R$$

$$= g \times 3 = \frac{3}{4} \cdot v^2$$

$$\text{KE of flywheel} = \frac{1}{2} \cdot \frac{MR^2}{2} \cdot \omega^2 = \frac{1}{4}Mv^2 = \frac{1}{4} \times 3 \times 40 = 30 \text{ Joule}$$

11. (I) Gauss Law is defined for inverse square of distance forces.
(II) Work done by uniform electric field on a charge moving in a circle is zero.
(III) Electric field of a point-charge forms concentric circle around it.
(IV) Electric field line forms closed loop.
Choose correct option(s).
(1) 1,2 (2) 1,3 (3) 3,4 (4) 1,4

Ans. **[1]**

Sol. (I) Gauss law is valid for $\frac{1}{r^2}$ force.
(II) Electric force is conservative force.
(III) Electric field due to point charge is radial nature.
(IV) Electric field line does not forms closed loop.

12. Time period of a spring-block system is given by $T = 2\pi\sqrt{\frac{m}{k}}$. If mass of the block is given by $m = 10\ g \pm 10mg$ and time period is measured using stopwatch having least count of 2 sec and was found to be 60 sec for 50 oscillations, then the %error in measurement of ' k '.
(1) 5.6% (2) 6.8% (3) 7.7% (4) 5.9%

Ans. **[2]**

Sol. $\frac{\Delta K}{K} = \frac{2\Delta T}{T} + \frac{\Delta m}{m}$

$T = \frac{60}{50} = 1.5sec$

$\Delta T = \frac{1}{30}\ sec. \times 1.2$

$\therefore \frac{\Delta K}{K} = \frac{2\times1\times1.2}{30\times1.2} + \frac{10\times10^{-3}}{10} = 0.068$

$\therefore$ % Error $= 6.8\%$

13. Two tuning forks A and B produce 8 beats in 2 sec. When sounded together, frequency of vibration of B is 380 Hz. If A is loaded with some wax then they produce 4 beats in 2 sec. Find original frequency of A ?
(1) 384 (2) 388 (3) 380 (4) 392

Ans. **[1]**

Sol. $|f_A - f_B| = 4$

$|f_A - 380| = 4$

So

$f_A = 384\ Hz$ or $376\ Hz$

on loading with wax f_A decreases

so $f_A = 384\ Hz$

14. Find number of photons emitted per second by a light source of wavelength 663 nm at power 6 mW. If $h = 6.63\times10^{-34}$ J -sec is $N\times10^{15}$ then find N .

Ans. **[2]**

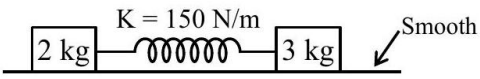
Sol. $P = \frac{nhC}{\lambda}$

$6\times10^{-3} = \frac{n\times1240}{663}\times1.6\times10^{-19}$

$n = 2\times10^{15}$ photons

$N = 2$

15. System is released after silghtly stretching it. Find angular frequency of its oscillations :



(1) 5 (2) $10\sqrt{5}$ (3) $2\sqrt{5}$ (4) $5\sqrt{5}$

Ans. **[4]**

Sol. $\omega = \sqrt{\frac{k}{\mu}} = \sqrt{\frac{150}{6/5}} = 5\sqrt{5}$

16. Measurement taken with Vernier calliper are as follows 1.21, 1.23, 1.24, 1.20 mm. What can be the least count of Vernier Calliper?

(1) 0.1 mm (2) 0.01 mm (3) 0.001 mm (4) 0.0001 mm

Ans. **[2]**

Sol. Least count will be 0.01 mm.

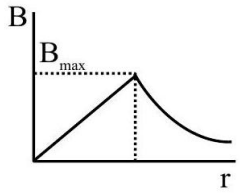
17. A current is flowing along the surface of long solid cylinder of radius R. Select correct statement :

(A) Magnetic field (B) is minimum along the axis of cylinder
(B) Magnetic field (B) is minimum at the surface of cylinder
(C) Magnetic field (B) is maximum at the surface of cylinder
(D) Magnetic field (B) is maximum along the axis of cylinder
(E) Magnetic field (B) is same all over the cross section of cylinder

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

Ans. **[2]**

Sol. Solid cylinder



B_{max} at surface

B_{min} at Axis

18. If position vector is given as $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and if its signs are reversed then which of the following physical quantity remains unaffected?

(1) Velocity (2) Displacement (3) Acceleration (4) Torque

Ans. **[4]**

Sol. $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$

$$\vec{a} = \frac{d^2\vec{r}}{dt^2} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$$

$$\vec{F} = m\vec{a}$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$= \left(x\hat{i} + y\hat{j} + z\hat{k}\right) \times m\left(a_x\hat{i} + a_y\hat{j} + a_z\hat{k}\right)$$

$$\vec{\tau} = m\left(ya_z - za_y\right)\hat{i} + \left(a_x z - xa_z\right)\hat{j} + \left(xa_y - ya_x\right)\hat{k}$$

When sign of $\vec{r}$ change so x, y, z, a_x, a_y, a_z changes but $\vec{\tau}$ constant.

19. Which of the following can not be measured :
(1) Resistance (2) Voltage (3) Voltage difference (4) Displacement current

Ans. **[2]**

Sol. We can measure potential difference between two points but not voltage at any point.

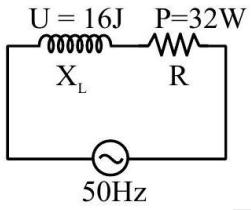
20. Match the following as per dimensional formula.

(1)	Pressure	(P)	$M^1 L^{-1} T^{-1}$
(2)	Coefficient of viscosity	(Q)	$M^1 L^0 T^{-2}$
(3)	Surface Tension	(R)	$M^1 L^{-1} T^{-2}$
(4)	Surface energy	(S)	$M^1 L^2 T^{-2}$

(1) 1-R, 2-P, 3-Q, 4-S (2) 1-S, 2-Q, 3-R, 4-S (3) 1-R, 2-P, 3-S, 4-Q (4) 1-S, 2-Q, 3-Q, 4-S

Ans. **[1]**

21. In the given circuit, energy stored in the inductor is 16 J and power dissipated in resistance is 32 W.
Find value of $\frac{X_L}{R}$



(1) 314 (2) 328 (3) 335 (4) 340

Ans. **[1]**

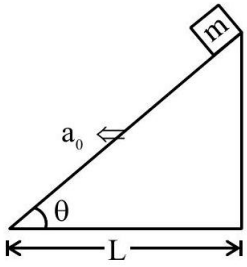
Sol. $\frac{1}{2}Li_{rms}^2 = 16$

$i_{rms}^2 R = 32$

$\frac{L}{R} = 1$

$\frac{X_L}{R} = \frac{2\pi fL}{R} = 100\pi$

22. Find time taken by the block to reach to the bottom

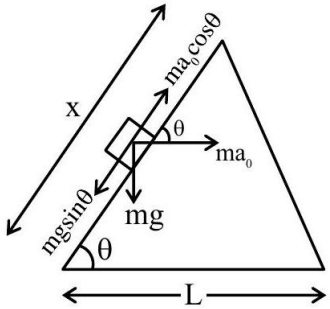


(1) $\left[\frac{4L}{\cos\theta(g\sin\theta - a_0\cos\theta)}\right]^{1/2}$ (2) $\left[\frac{2L}{\cos\theta(g\sin\theta - a_0\cos\theta)}\right]^{1/2}$

(3) $\left[\frac{8L}{\cos\theta(g\sin\theta - a_0\cos\theta)}\right]^{1/2}$ (4) $\left[\frac{L}{\cos\theta(g\sin\theta - a_0\cos\theta)}\right]^{1/2}$

Ans. **[2]**

Sol.



$$a_{down} = \frac{mg\sin\theta - ma_0\cos\theta}{m}$$

$$a_{down} = g\sin\theta - a_0\cos\theta$$

$$x = ut + \frac{1}{2}a_{down}t^2$$

$$x = ut + \frac{1}{2}a_{down}t^2$$

$$\left[\frac{2L}{\cos\theta(g\sin\theta - a_0\cos\theta)}\right]^{1/2} = t$$

= time to reach bottom standing from rest.

23. Electric field of an EM wave is given as $\vec{E} = 54\sin(kz - \omega t)\hat{i}$. Then what will be its corresponding magnetic field ?

(1) $18\times10^{-8}(kz - \omega t)\hat{j}$ (2) $162\times10^{8}\sin(kz - \omega t)\hat{j}$

(3) $18\times10^{-8}\sin(\omega t - kz)\hat{j}$ (4) $54\times10^{-8}\sin(kz - \omega t)\hat{i}$

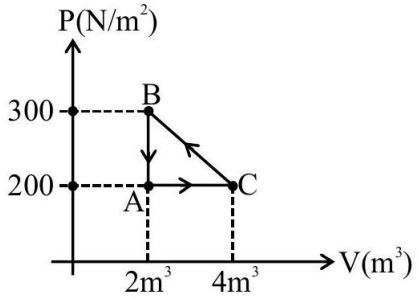
Ans. **[1]**

Sol. $\hat{B} = \hat{C}\times\hat{E} = \hat{k}\times\hat{i} = \hat{j}$

$$\therefore \vec{B} = \frac{54}{3\times10^{8}}\sin(kz - \omega t)\hat{j}$$

$$= 18\times10^{-8}\sin(kz - \omega t)\hat{j}$$

24. Find work done by gas in cyclic process :



(1) 100 J (2) –100 J (3) 200 J (4) –200 J

Ans. **[2]**

Sol. $w_{AC} = P_A(\Delta V) = P_A(V_C - V_A)$

$w_{AC} = (200)(4-2) = 400$ Joule

$w_{CB} = \frac{1}{2}(P_C + P_B)(V_B - V_C)$

$w_{CB} = -\frac{1}{2}(300+200)(2) = -\frac{500}{2} \times 2 = -500$ Joule

$w_{BA} = P\Delta V = 0$

$W_{Net} = W_{AC} + W_{CB} + W_{BA}$

$W_{Net} = 400 - 500 + 0 = -100$ Joule

25. For particle moving in x direction according to relation, $x = 4t^3 - 3t$

(a) at $t = 0.866$ $x = 0$

(b) direction of velocity particle remains same

(c) direction of velocity particle change at $x = -1$

(d) direction of velocity particle change at $x = 0.5$ m

(e) acceleration is non-negative

Correct statements are :

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

Ans. **[1]**

Sol. $x = 0$ $t = 0, \frac{\sqrt{3}}{2}$

$V = 12t^2 - 3$ $V = 0$

$t = \frac{1}{2} \Rightarrow x = \frac{4}{8} - \frac{3}{2} = -1$

$a = 24t$ (always positive)

CAREER POINT

JEE Main Online Exam 2026

Memory Based

Questions & Solution

28th January 2026 | Evening

CHEMISTRY

1. $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

In above reaction 90 g $CaCO_3$ is added to 300 ml, $38.55\%\, w/w, HCl$ solution with density $1.13\ g/ml$.

Which of the following option is correct.

(1) 64.97 gm of HCl gets reacted.
(2) 65.7 gm of HCl remain unreacted.
(3) 64.97 g HCl remain unreacted.
(4) 60 gm $CaCO_3$ remain unreacted.

Ans. **[3]**

Sol. LR

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

$\frac{90}{100}$ $d = 1.13\ g/ml$

$= 0.90$ mol $V = 300$ ml

Wt. of solution $= 339$ g

$\text{Wt. of HCl} = 339 \times \frac{38.55}{100} = 130.68$

$\text{Moles of HCl} = \frac{130.68}{36.5} = 3.58$

Moles of HCl remained = 1.78 mole.

Mass of HCl remained = 64.97 g.

2. Consider the following electromagnetic waves A, B and C :

(i) The wavelength of A is 400 nm.

(ii) The frequency of B is $10^{16}\ s^{-1}$.

(iii) Wave number of C = $10^4\ cm^{-1}$.

The correct order of their energies is :

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

Ans. **[2]**

Sol. (1) Wavelength of A = 400 nm.

(2) $v = \frac{C}{\lambda} \Rightarrow \text{wavelength of B}(\lambda) = \frac{3\times10^8}{10^{16}}$

$= 3\times10^{-8} = 30\times10^{-9} = 30$ nm.

(3) Wavelength of $C(\lambda) = \frac{1}{\bar{v}} = \frac{1}{10^4} = 10^{-4}$ cm

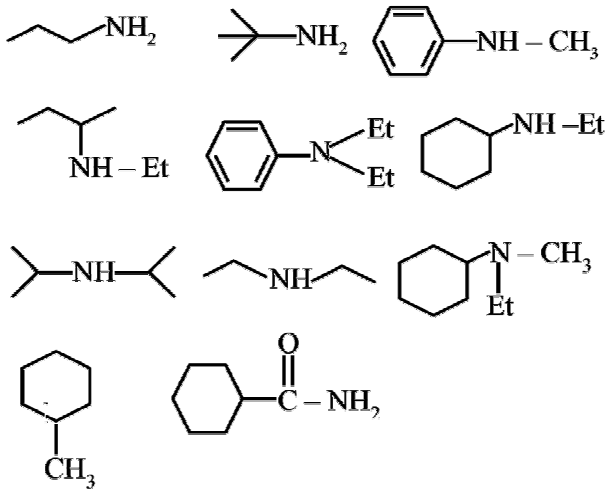
$= 10^{-6}$ m = 1000 nm

Here $\lambda_C > \lambda_A > \lambda_B$

$E \propto \frac{1}{\lambda}$

So $E_C < E_A < E_B$

3. Which of the following are insoluble in alkali when reacts with reacts with Hinsberg reagent :



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

Ans. **[2]**

Sol. Secondary amine are insoluble alkali after reaction with Hinsberg reagent.

4. 'X' $\xrightarrow[(2)\ H_2O]{(1)\ NaNO_2/HCl}$ $\xrightarrow[I_2]{NaOH}$ 'Y'

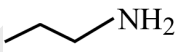
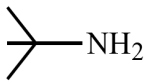
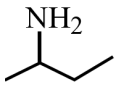
(gives positive iodoform test) :

X has % C = 65.75 %

% H = 15.25 %

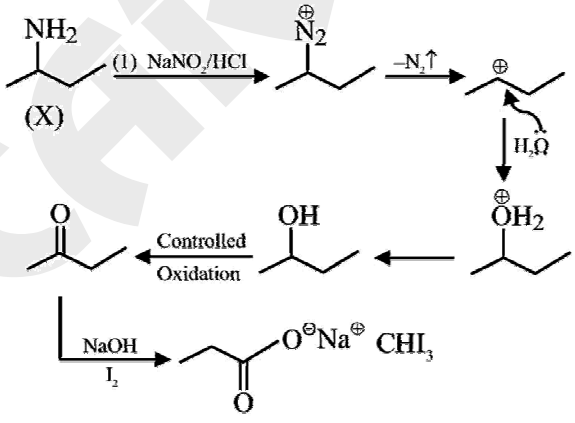
% N = 19 %

Identify 'X' among the following

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

Ans. **[4]**

Sol.



5. Consider following statements :
(A) $KMnO_4$ is diamagnetic while K_2MnO_4 is paramagnetic.
(B) Manganate ion contains Mn^{+6} while permanganate ion contains Mn^{+7}.
(C) Mn^{+2} ion on reaction with $S_2O_8^{2-}$ ions gives manganate ion.
(D) Both MnO_4^- and MnO_4^{2-} are tetrahedral.
Correct statements are :-
(1) A & B only (2) A, B and D only (3) A, B and C only (4) B and D only

Ans. **[2]**

Sol. $Mn^{2+} + S_2O_8^{2-} \rightarrow MnO_4^-$
So, (C) is incorrect.

6. Match isostructural species in Column I with Column II.

Column-I	Column-II
(A) XeF_2	(P) I_3^-
(B) $XeOF_4$	(Q) NH_3
(C) XeO_2F_2	(R) SF_4
(D) XeO_3	(S) BrF_5

The correct match is :
(1) $A \rightarrow P, B \rightarrow S, C \rightarrow R, D \rightarrow Q$ (2) $A \rightarrow P, B \rightarrow Q, C \rightarrow R, D \rightarrow S$
(3) $A \rightarrow S, B \rightarrow R, C \rightarrow Q, D \rightarrow P$ (4) $A \rightarrow S, B \rightarrow Q, C \rightarrow R, D \rightarrow P$

Ans. **[1]**

Sol. XeF_2 & I_3^- : 2 bond pair 3 lone pair
$XeOF_4$ & BrF_5 : 5 bond pair 1 lone pair
XeO_2F_2 & SF_4 : 4 bond pair 1 lone pair
XeO_3 & NH_3 : 3 bond pair 1 lone pair

7. $Na_2B_4O_7.10H_2O \xrightarrow[-10H_2O]{\Delta} 2X + Y$

$CuSO_4 + X \xrightarrow[\text{Non-Luminous Flame}]{\Delta} Z$

$Z \xrightarrow[\text{Luminous Flame}]{\Delta} Q$

Oxidation state of central metal of Z and Q are :
(1) +2 and +1 (2) +1 and +2 (3) +2 and +2 (4) +1 and +1

Ans. **[1]**

Sol.

$$Na_2B_4O_7.10H_2O \xrightarrow[-10\,H_2O]{\Delta} Na_2B_4O_7$$

$$\xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

$$CuSO_4 + B_2O_3 \xrightarrow[\text{Non-Luminous flame}]{\Delta} \underset{\substack{\text{(Blue bead)}\\(Z)}}{\overset{+2}{Cu}(BO_2)_2}$$

$$\underset{(Z)}{Cu(BO_2)_2} \xrightarrow[\text{Luminous Flame}]{\Delta} \underset{\substack{\text{Colorless}\\(Q)}}{\overset{+1}{Cu}BO_2}$$

Oxidation states of Cu in Z and Q are +2 & +1

8. (A) $\left[MnBr_4\right]^{2-}$ (B) $\left[Cu\left(H_2O\right)_6\right]^{2+}$

(C) $\left[Ni(CN)_4\right]^{2-}$ (D) $\left[Ni\left(H_2O\right)_6\right]^{2+}$

Select correct order of spin only magnetic moment among above complexes.

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

Ans. **[1]**

Sol. $Mn^{2+}\ 3d^5 \quad n = 5$

$Cu^{2+} 3d^9\ t_{2g}^{2,2,2}\ e_g^{2,1} n = 1$

$Ni^{2+}\ 3d^8$ square planar n = 0

$Ni^{2+}\ 3d^8$ tetrahedral $e^{2,2}\ t_2^{2,1,1}$ n = 2

9. The plot of $\log K$ versus 1/T is a straight line. The intercept and slope of this line are respectively given by _____ . (Where K is the equilibrium constant).

(1) $\frac{\Delta S^o}{2.303R}, \frac{-\Delta H^o}{2.303R}$ (2) $\frac{\Delta S^o}{R}, \frac{-\Delta H^o}{R}$ (3) $-\frac{\Delta S^o}{2.303R}, \frac{\Delta H^o}{2.303R}$ (4) $-\frac{\Delta H^o}{2.303R}, \frac{\Delta S^o}{2.303R}$

Ans. **[1]**

Sol. $\log K = -\frac{\Delta H^o}{2.303RT} + \frac{\Delta S^o}{2.303R}$

$\text{Slope} = -\frac{\Delta H^o}{2.303R},$

$\text{y-intercept} = \frac{\Delta S^o}{2.303R}$

10. Out of N, P, S, Cl, F number of valence electrons in least metallic element and most metallic element respectively is :

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

Ans. **[2]**

Sol. Least metallic = F, valence electrons = 7

Most metallic = P, valence electrons = 5

11. Among Sc^{3+}, Cr^{2+}, Mn^{3+}, Fe^{3+}, Co^{3+}, 'n' is the number of isoelectronic species. 'n' moles of $AgNO_3$ reacts with 1 mole of complex $Co(en)_2NH_3Cl_3$. The number of electrons in t_{2g} set of the complex is :

Ans. **[6]**

Sol. Cr^{2+} and Mn^{3+} are isoelectronic

n = 2

Complex is : $\left[Co(en)_2NH_3Cl\right]Cl_2$

$\Rightarrow Co^{3+}\ 3d^6\ t_{2g}^{2,2,2}\ e_g^{0,0}$

12. The relation between molar conductivity and concentration is given by $\Lambda_m = \Lambda^0{}_m - A\sqrt{c}$.

For various solution concentrations of 0.04 M, 0.09 M, 0.01 M and 0.16 M, the corresponding molar conductivities are $95.7, 95.3, 94.9$ and 94.5 S $cm^2 mol^{-1}$, respectively. Using the given data, determine the value of A.

Ans. **[4]**

Sol. Using equation : $\Lambda_m = \Lambda^0{}_m - A\sqrt{c}$

$95.7 = \Lambda^0{}_m - A\sqrt{0.04}$

$95.7 = \Lambda^0_m - A \times 0.2$ ...(1)

$95.3 = \Lambda^0{}_m - A \times \sqrt{0.09}$

$95.3 = \Lambda^0_m - A \times 0.3$ ...(2)

From eq. (1) and eq. (2)

A = 4

13. **Statement-I :** $KMnO_4$ is a good reducing agent.

Statement-II : $KMnO_4$ reduces nitrite, oxalate and iodide ions.

(1) Both statements are correct.

(2) Both statements are incorrect.

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

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

Ans. **[2]**

Sol. $KMnO_4$ is a good oxidizing agent and it oxidises $NO_2^-, C_2O_4^{2-}$ and I^- ions.

14. For the reaction A $\rightleftharpoons$ B, the number of moles of A and B at equilibrium in a 1 L vessel are 0.50 and 0.375 , respectively. If 0.10 mol of A is added further, determine the number of moles of A and B at the new equilibrium.

(1) 0.557, 0.557 (2) 0.418, 0.557 (3) 0.33, 0.56 (4) 0.6, 0.2

Ans. **[1]**

Sol. A $\rightleftharpoons$ B

0.5 0.375

$$K_{eq} = \frac{[B]_{eq}}{[A]_{eq}} = \frac{0.375}{0.5} = 0.75$$

Now 0.1 mole of A is added so reaction will move in forward direction.

A $\rightleftharpoons$ B

$0.6-x$ $0.375+x$

$$K_{eq} = 0.75 = \frac{0.375 + x}{0.6 - x}$$

$0.45 - 0.75x = 0.375 + x$

$1.75x = 0.075$

$$X = \frac{0.075}{1.75} = \frac{3}{70} = 0.043$$

Moles of A = 0.043 = 0.557

Moles of B = 0.418

15. The reactions A $\xrightarrow{K_1}$ B and C $\xrightarrow{K_2}$ D follows 1^{st} order kinetics. At 500 K, rate constant K_1 and K_2 respectively ($K_2 = 2K_1$) and activation energies E_{a_1} and E_{a_2} are related such that $E_{a_2} = \frac{E_{a_1}}{2}$ and rate constant for first reaction at 300 K is half that of rate constant at 500 K . Find the value of $10 \times (K_2)_{at\,300\,K}$.

(Given half-life of 1^{st} reaction is 2 hrs. at 500 K)

Ans. **[5]**

Sol. For A → B

$$\ln(2) = \frac{E_{a_1}}{R}\left[\frac{1}{300} - \frac{1}{500}\right]$$

$$E_{a_1} = \frac{\ln 2 \times R \times 1500}{2}$$

$$E_{a_2} = \frac{E_{a_1}}{2} = \frac{\ln 2 \times R \times 1500}{4}$$

$$(K_1)_{at\,500\ K} = \frac{\ln 2}{2}$$

$$(K_2)_{at\,500\ K} = \ln 2$$

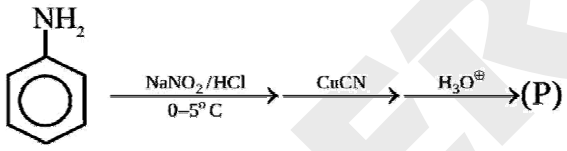
Now for C → D

$$\ln\left[\frac{(K_2)_{at\,500\ K}}{(K_2)_{at\,300\ K}}\right] = \left(\frac{\ln 2 \times R \times 1500}{4}\right) \times \frac{1}{R} \times \left[\frac{1}{300} - \frac{1}{500}\right]$$

$$(K_2)_{at\,300\ K} = \frac{\ln 2}{\sqrt{2}} = 0.49$$

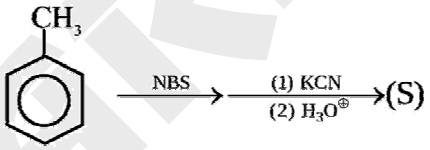
$(K_2)_{at\ 300\ K} \times 10 = 4.9 \simeq 5$

16. Find correct order of acidic strength in the following reaction product P, Q, R & S

(I) 

(II) $CH_4 \xrightarrow[}{Mo_2O_3} \xrightarrow[}{K_2Cr_2O_7} (Q)$

(III) $H_3C-CH_2-CH_3 \xrightarrow{Mn(OAc)_2} (R)$

(IV) 

(1) P > Q > R > S (2) Q > P > S > R (3) Q > S > P > R (4) R > S > P > Q

Ans. **[2]**

Sol. Product of I is PhCOOH

Product of II is HCOOH

Product of III is $H_3C–CH_2COOH$

Product of IV is $Ph–CH_2COOH$

Order of acidic strength HCOOH > PhCOOH > $Ph–CH_2COOH$ > CH_3CH_2COOH

17. **Solution-1 :** 2.025 gm glucose, 125 ml .
Solution-2 : 9 gm urea, 500 ml .
Solution-3 : 1.9 gm $CaCl_2$, 250 ml..
Solution-4 : 20.5 gm $Al_2(SO_4)_3$, 750 ml..
Order of ΔT_b is :
(1) $Al_2(SO_4)_3$ > Urea > $CaCl_2$ > Glucose (2) $Al_2(SO_4)_3$ > $CaCl_2$ > Urea > Glucose
(3) Glucose > $Al_2(SO_4)_3$ > $CaCl_2$ > Urea (4) $CaCl_2$ > Urea > Glucose > $Al_2(SO_4)_3$

Ans. **[1]**

Sol. $\Delta T_b = i.k_b.m$
For dilute solution (M = m)

Molarity	i × m
$M_{glucose} = \frac{0.025}{180} \times \frac{1000}{125} = 0.09$	0.09 × 1
$M_{urea} = \frac{9}{60} \times \frac{1000}{500} = 0.3$	0.3 × 1
$M_{CaCl_2} = \frac{1.9}{111} \times \frac{1000}{250} = 0.068$	0.068 × 3
$M_{Al_2(SO_4)_2} = \frac{20.5}{342} \times \frac{1000}{750} \simeq 0.08$	0.08 × 5

Order of ΔT_b = $Al_2(SO_4)_3$ > Urea > $CaCl_2$ > Glucose

18. In 'S' estimation, 0.314 g of organic compound gave 0.4813 g of barium sulphate. What is percentage (%) of 'S' in organic compound? (Report to nearest integer)

Ans. **[21]**

Sol. Applying POAC as 's'

$$n_{BaSO_4} = \frac{0.4813}{233} = 0.0020$$

Moles of 's' = 0.0020
Mass of 's' in $BaSO_4$ = 0.0020 × 32 = 0.066 g
Same mass of 's' is present in 'OC'

$$\%\ \text{of 's' in OC} = \frac{0.066}{0.314} \times 100 = 20.9$$

19. E_{cell} of the following cell is 345.5 mV. The cell representation is

$Pt \mid HSnO_2^-(aq), [Sn(OH)_6]^{2-}(aq), OH^-(aq) \mid Bi_2O_3(s) \mid Bi(s)$
0.5M 0.05M

Given : $E^o_{[Sn(OH)_6]^{2-}/HSnO_2^-} = -0.9$ V

$E^o_{Bi_2O_3(s)|Bi(s)} = -0.44$ V

OH^- ion concentration is maintained by a buffer solution of x ml, 20 M $NaHCO_3(aq)$ and 10 ml, 10 M $H_2CO_3(aq)$, then find value of $\frac{x}{1000}$?

Ans. **[5]**

Sol. $Pt \mid HSnO_2^- (aq), [Sn(OH)_6]^{2-}(aq), OH^- (aq) \mid Bi_2O_3(s) \mid Bi(s)$

0.5M 0.05M

$E°_{cell} = +0.9 - 0.44 = 0.46\ V$

Oxidation Half :

$$HSnO_2^- + H_2O + 3OH^- \rightarrow [Sn(OH)_6]^{2-} + 2e^-$$

Reduction Half :

$$Bi_2O_3 + 3H_2O + 6e^- \rightarrow 2Bi + 6OH^-$$

$$3\,HSnO_2^- (aq) + Bi_2O_3(s) + 6H_2O + 3OH^- (aq) \rightarrow 3[Sn(OH)_6]^{2-} (aq) + 2Bi(s)$$

$$E_{cell} = E°_{cell} - \frac{0.059}{6}\log\left[\frac{(0.05)^3}{(0.5)^3 \times [OH^-]^3}\right]$$

$$0.3455 = 0.46 - \frac{0.059}{6} \times 3\log\left[\frac{0.1}{[OH^-]}\right]$$

$0.0295\,[-1 + pOH] = 0.1145$

$-1 + pOH = 3.88$

$pOH = 4.88$

$pH = 14 - 4.88 = 9.12$

$$pH = pK_{a_1} + \log\frac{[HCO_3^-]}{[H_2CO_3]}$$

$$9.12 = 6.12 + \log\frac{20x}{100}$$

$$3 = \log\frac{x}{5}$$

$x = 5 \times 10^3$ ml

$$\frac{x}{1000} = \frac{5\times10^3}{1000} = 5$$

20. When nitro group is attached to benzene ring, what effect we observe towards reactions :

(I) Deactivating towards electrophilic substitution

(II) Activating towards electrophilic substitution

(III) Deactivating towards nucleophilic substitution

(IV) Activating towards nucleophilic substitution

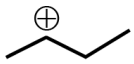
Find the correct statements :

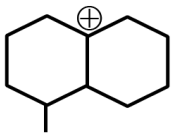
(1) I, II (2) II, III (3) I, IV (4) II, IV

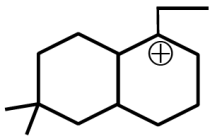
Ans. **[3]**

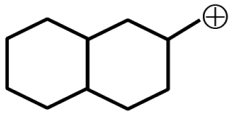
Sol. Nitro group is electron withdrawing group so it will decrease electron density from benzene ring. So, it is deactivating towards electrophilic substitution reaction (ESR) and it increases the electrophilicity of benzene ring so it is activating towards nucelophilic substitution reaction (NSR).

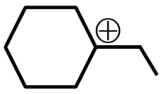
21. Which pair among following compounds have equal number of hyperconjugation:

(I) 

(II) 

(III) 

(IV) 

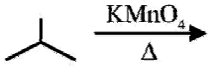
(V) 

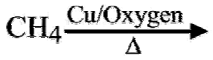
(1) I, II, III (2) I, III, V (3) I, II, V (4) II, III, V

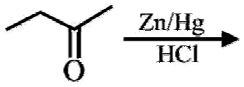
Ans. **[1]**

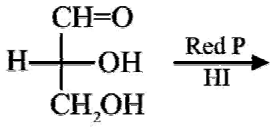
Sol. Number of hyperconjugation is directly related to number of $\alpha-H$ with respect to carbocation.

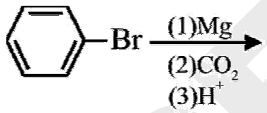
22. Which of the following reaction yield alcohol as major product :

(A) 

(B) 

(C) 

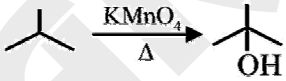
(D) 

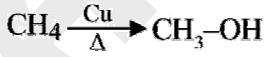
(E) 

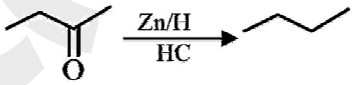
(1) A,B,C,D,E (2) A,B (3) A,B,C,E (4) B,C

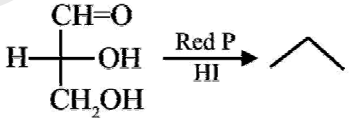
Ans. **[2]**

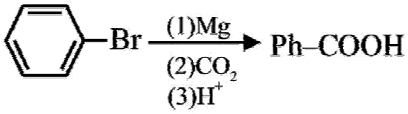
Sol.

(A) 

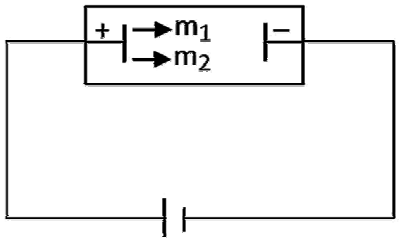
(B) 

(C) 

(D) 

(E) 

23. Two positively charged particles are accelerated by 200 keV. The masses of particles are m_1 = 1 amu, m_2 = 4 amu.



If the De-broglie wavelength $(\lambda_d)_{m_1}$ is x times of the second particle $(\lambda_d)_{m_2}$. Then determine the value of x.

Ans. **[2]**

Sol. $\lambda_d = \dfrac{h}{\sqrt{2mK.E.}}$

Here KE is same i.e. 200 k eV

So $\lambda_d \propto \dfrac{1}{\sqrt{m}}$

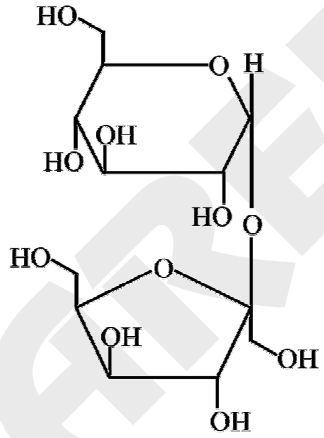
$$\frac{(\lambda_d)_{m_1}}{(\lambda_d)_{m_2}} = \sqrt{\frac{m_2}{m_1}} = \sqrt{4} = 2$$

$$(\lambda_d)_{m_1} = 2(\lambda_d)_{m_2}$$

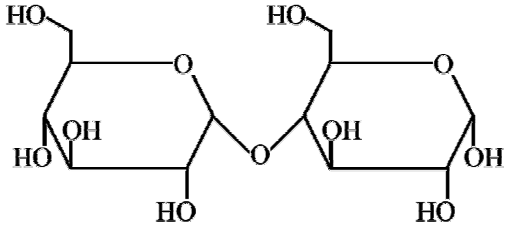
So x = 2.

24. Which of the following is nonreducing sugar?

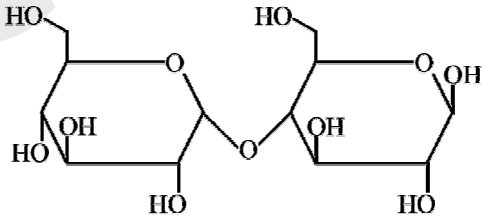
(1)



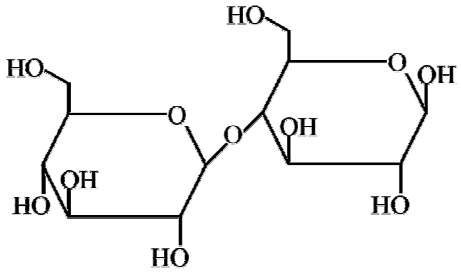
(2)



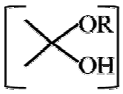
(3)



(4)



Ans. **[1]**

Sol. For nonreducing sugar compound should have acetal linkage  , not hemeacetal linkage 

Sucrose is non reducing sugar.

25. **Statement-I :** The boiling point order is HF > HI > HBr > HCl

Statement-II : The melting point order is HI > HF > HBr > HCl

(1) Both statements are correct.

(2) Both statements are incorrect.

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

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

Ans. **[1]**

Sol. B.P. HF > HI > HBr > HCl

M.P. HI > HF > HBr > HCl

JEE Main Online Exam 2026

Memory Based

Questions & Solution

28th January 2026 | Evening

MATHEMATICS

1. Find the maximum distance between the two curves :

$|z-2|=4$ & $|z-2|+|z+2|=5$

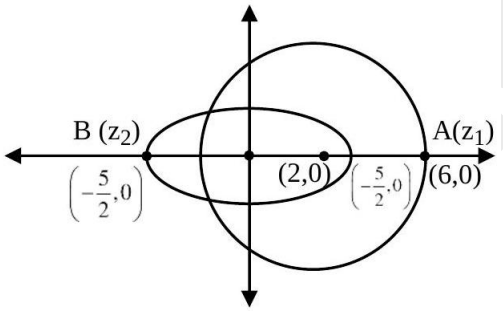
(1) $\frac{17}{2}$ (2) $\frac{15}{2}$ (3) 8 (4) 9

Ans. **[1]**

Sol. $|z-2|=4 \Rightarrow (x-2)+y^2=16$

$|z-2|+|z+2|=5 \Rightarrow \frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

$\Rightarrow \frac{4x^2}{25}+\frac{4y^2}{9}=1$



Maximum value of $|z_1-z_2|=6+\frac{5}{2}=\frac{17}{2}$

2. If $f(x)=1-2x+\int_0^x e^{x-t}f(t)dt$ & $g(x)=\int_0^x (f(t)+2)^{11}(t+12)^{17}(t-4)^4 dt$. If local minima and local maxima of $g(x)$ at $x=p$ & $x=q$ respectively then $|p|+q=$

(1) 12 (2) 15 (3) 9 (4) 20

Ans. **[2]**

Sol. $f(x)=1-2x+e^x\int_0^x e^{-t}f(t)dt$

$e^{-x}f(x)=(1-2x)e^{-x}+\int_0^x e^{-t}f(t)dt$

$e^{-x}f'(x)-e^{-x}f(x)=-2e^{-x}+(1-2x)e^{-x}(-1)+e^{-x}f(x)$

$f'(x)-2f(x)=2x-3$

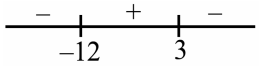
$\frac{dy}{dx} - 2y = 2x - 3$

$\Rightarrow y.e^{-2x} = \int e^{-2x}(2x-3)dx$

On solving we get

$y = 1 - x$

$g'(x) = (3-x)^{11}(x+12)^{17}(x-4)^4$



minima at $x = -12$ & maxima at $x = 3$

$p = -12, q = 3$

$\Rightarrow |p| + q = 15$

3. Let $y(x)$ is the solution of differential equation, $\frac{xdy}{dx} = y + x^2\cot x, y\left(\frac{\pi}{2}\right) = \frac{\pi}{2}$, the value of $6y\left(\frac{\pi}{6}\right) - 8y\left(\frac{\pi}{4}\right)$ equals :

(1) $-\pi$ (2) -2π (3) π (4) 2π

Ans. **[1]**

Sol. $xdy - ydx = x^2\cot x dx$

$x^2 d\left(\frac{y}{x}\right) = x^2\cot x dx$

$d\left(\frac{y}{x}\right) = \cot x dx$

$\int d\left(\frac{y}{x}\right) = \int \cot x dx$

$\frac{y}{x} = \log_e \sin x + C$

given $y\left(\frac{\pi}{2}\right) = \frac{\pi}{2}$

$\Rightarrow c = 1$

$y = x(\log_e \sin x + 1)$

$y\left(\frac{\pi}{6}\right) = \frac{\pi}{6}[-\log_e 2 + 1]$

$y\left(\frac{\pi}{4}\right) = \frac{\pi}{4}\left[-\frac{1}{2}\log_e 2 + 1\right]$

$6y\left(\frac{\pi}{6}\right) - 8y\left(\frac{\pi}{4}\right)$

$= \pi\left[(-\log_e 2 + 1) + 2\left(\frac{1}{2}\log_e 2 - 1\right)\right]$

$= \pi[1-2] = -\pi$

4. Consider two parabolas P_1, P_2 and a line L

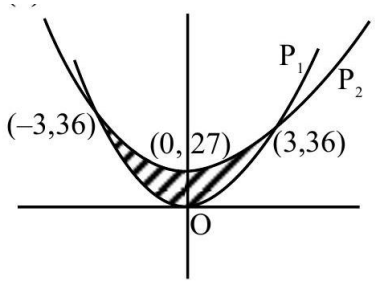
$P_1 : y = 4x^2$; $P_2 : y = x^2 + 27$ & line $L : y = \alpha x$

If area bounded by P_1 & P_2 is six times the area bounded by P_1 and L then find α

(1) 16 (2) 18 (3) 20 (4) 12

Ans. **[4]**

Sol.



Area bounded between P_1 & P_2 is

$\int_{-3}^{3}\left(\left(x^2+27\right)-\left(4x^2\right)\right)dx$

(P.O.I. of P_1 & P_2 is $x = \pm 3$)

$= 2\int_0^3\left(27-3x^2\right)dx = 2\left[27x - x^3\right]_0^3$

$= 2[81-27] = 108$

$\therefore$ Area bounded between P_1 & L is 18 sq. units

(Area between $x^2 = 4$ ay & line $x = my$) is $\frac{8a^2}{3\,m^3}$

$\therefore$ Area between $x^2 = \frac{y}{4}$ & $x = \frac{y}{\alpha}$ is

$$\frac{8\cdot\left(\frac{1}{16}\right)^2}{3\cdot\left(\frac{1}{\alpha}\right)^3} = 18$$

$$\Rightarrow \frac{8}{\frac{16.16}{3}{\alpha^3}} = 18 \Rightarrow \alpha^3 = 2^6.3^3$$

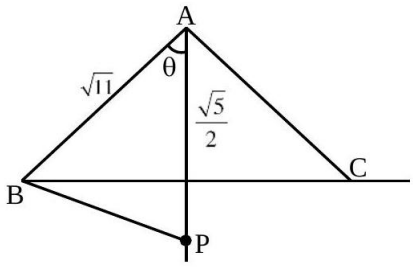
$$\Rightarrow \alpha = 12$$

5. Let $\overrightarrow{AB} = 3\hat{i} + \hat{j} - \hat{k}$ and $\overrightarrow{AC} = \hat{i} - \hat{j} + 3\hat{k}$. If P is the point on the bisector of angle between $\overrightarrow{AB}$ and $\overrightarrow{AC}$ such that $\left|\overrightarrow{AP}\right| = \frac{\sqrt{5}}{2}$. Then area ($\Delta$APB) is :

(1) $\sqrt{30}$ (2) $\sqrt{15}$ (3) $\frac{\sqrt{30}}{4}$ (4) $\frac{\sqrt{15}}{4}$

Ans. **[3]**

Sol. $\cos 2\theta = \dfrac{3-1-3}{\sqrt{11}\cdot\sqrt{11}} = -\dfrac{1}{11}$



$1-2\sin^2\theta = -\dfrac{1}{11} \Rightarrow 2\sin^2\theta = \dfrac{12}{11} \Rightarrow \sin\theta = \sqrt{\dfrac{6}{11}}$

$\therefore \text{Area}(\Delta APB) = \dfrac{1}{2}\times\sqrt{11}\cdot\dfrac{\sqrt{5}}{2}\cdot\sqrt{\dfrac{6}{11}} = \dfrac{\sqrt{30}}{4}$

6. Find the value of $\tan\left[\left(2\sin^{-1}\dfrac{2}{\sqrt{13}}\right) - 2\cos^{-1}\left(\dfrac{3}{\sqrt{10}}\right)\right]$

(1) $\dfrac{31}{56}$ (2) $\dfrac{29}{56}$ (3) $\dfrac{33}{56}$ (4) $\dfrac{37}{56}$

Ans. **[3]**

Sol. Let $\sin^{-1}\dfrac{2}{\sqrt{13}} = \theta$ & $\cos^{-1}\dfrac{3}{\sqrt{10}} = \phi$

$\sin\theta = \dfrac{2}{\sqrt{13}}$ & $\cos\phi = \dfrac{3}{\sqrt{10}}$

$\tan(2\theta - 2\phi) = \dfrac{\tan 2\theta - \tan 2\phi}{1+\tan 2\theta\tan 2\phi}$

$\left(\because \tan 2\theta = \dfrac{2\tan\theta}{1-\tan^2\theta}\right)$

$= \dfrac{\frac{12}{5}-\frac{3}{4}}{1+\frac{12}{5}\cdot\frac{3}{4}}$

$= \dfrac{33}{56}$

7. Find the value of $\dfrac{6}{3^{26}} + 10\cdot\dfrac{1}{3^{25}} + 10\cdot\dfrac{2}{3^{24}} + \ldots\ldots + 10\times\dfrac{2^{24}}{3^1}$:

(1) 2^{26} (2) 2^{25} (3) 2^{24} (4) 2^{27}

Ans. **[1]**

Sol. $S = \dfrac{6}{3^{26}} + \dfrac{10}{3^{25}}\left[\dfrac{(6)^{25}-1}{6-1}\right]$

$S = \dfrac{6}{3^{26}} + \dfrac{10}{3^{25}}\left[\dfrac{6^{25}-1}{5}\right]$

$$S=\frac{2}{3^{25}}+2\left[2^{25}-\frac{1}{3^{25}}\right]$$

$$S=2^{26}$$

8. If ellipse $\frac{x^2}{144}+\frac{y^2}{169}=1$ and hyperbola $\frac{x^2}{16}-\frac{y^2}{\lambda^2}=-1$ have same foci. If eccentricity and length of latus rectum of hyperbola are e and ℓ respectively then value of $24(e+\ell)=$

(1) 196 (2) 296 (3) 269 (4) 234

Ans. **[3]**

Sol. Equation of hyperbola: $\frac{y^2}{\lambda^2}-\frac{x^2}{16}=1$

Equation of ellipse : $\frac{x^2}{144}+\frac{y^2}{169}=1$

$e'=\sqrt{1-\frac{144}{169}}=\frac{5}{13}$

focus $\Rightarrow (0,5)$

$\Rightarrow \lambda\sqrt{1+\frac{16}{\lambda^2}}=5$

$\Rightarrow \lambda^2+16=25$

$\lambda=3$

Eccentricity of hyperbola $=\sqrt{1+\frac{16}{\lambda^2}}=\frac{5}{3}$

Length of latus rectum of hyperbola $=\frac{2(16)}{3}=\frac{32}{3}$

$$24(e+\ell)=24\left[\frac{5}{3}+\frac{32}{3}\right]=8\times 37=296$$

9. If $y=\text{sgn}(\sin x)+\text{sgn}(\cos x)+\text{sgn}(\tan x)+\text{sgn}(\cot x)$ where $\text{sgn}(p)$ denotes the signum function of p , then sum of elements in the range of y is :

(1) 4 (2) –2 (3) 0 (4) 2

Ans. **[4]**

Sol. $x\in(0,\pi/2)\Rightarrow y=1+1+1+1=4$

$x\in(\pi/2,\pi)\Rightarrow y=1-1-1-1=-2$

$x\in(\pi,3\pi/2)\Rightarrow y=-1-1+1+1=0$

$x\in(\pi,3\pi/2)\Rightarrow y=-1-1+1+1=0$

$\therefore$ Range of y is $\{-2,0,4\}$

Required sum $=-2+0+4=2$

10. Let matrix $A=\begin{pmatrix}3 & -4\\ 1 & -1\end{pmatrix}$ and $A^{100}=100\,B+I$. Find the sum of all the elements in B^{100} :

(1) –3 (2) 4 (3) 0 (4) –2

Ans. **[3]**

Sol. $A^2=A.A=\begin{pmatrix}3 & -4\\ 1 & -1\end{pmatrix}\begin{pmatrix}3 & -4\\ 1 & -1\end{pmatrix}=\begin{pmatrix}5 & -8\\ 2 & -3\end{pmatrix}$

$A^3=A^2\cdot A=\begin{pmatrix}5 & -8\\ 2 & -3\end{pmatrix}\begin{pmatrix}3 & -4\\ 1 & -1\end{pmatrix}=\begin{pmatrix}7 & -12\\ 3 & -5\end{pmatrix}$

$\vdots$

$A^n=\begin{pmatrix}2n+1 & -4n\\ n & -(2n-1)\end{pmatrix}$

$A^{100}=\begin{pmatrix}201 & -400\\ 100 & -199\end{pmatrix}$

$A^{100}-I=\begin{pmatrix}200 & -400\\ 100 & -200\end{pmatrix}=100\,B$

$B=\begin{pmatrix}2 & -4\\ 1 & -2\end{pmatrix}$

$B^2=B\cdot B=\begin{pmatrix}2 & -4\\ 1 & -2\end{pmatrix}\begin{pmatrix}2 & -4\\ 1 & -2\end{pmatrix}=\begin{pmatrix}0 & 0\\ 0 & 0\end{pmatrix}$

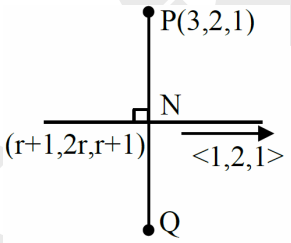
Sum of all elements in B^{100} is zero

11. If the image of a point $P(3,2,1)$ in the line $\frac{x-1}{1}=\frac{y}{2}=\frac{z-1}{1}$ is Q then distance of Q from the line $\frac{x-9}{3}=\frac{y-9}{2}=\frac{z-5}{-2}$ is

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

Ans. **[4]**

Sol.



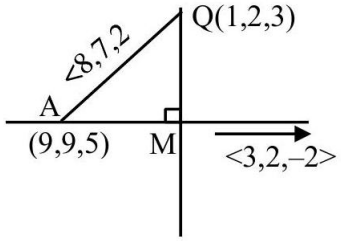
drs of $PN=<r-2,2r-2,r>$

$1.(r-2)+2(2r-2)+1.(r)=0$

$6r=6\Rightarrow r=1$

$\therefore N\equiv(2,2,2)$

$\Rightarrow Q\equiv(1,2,3)$



$AQ = \sqrt{64+49+4} = \sqrt{117}$

$AM = \left|\frac{24+14-4}{\sqrt{9+4+4}}\right| = \frac{34}{\sqrt{17}} = 2\sqrt{17}$

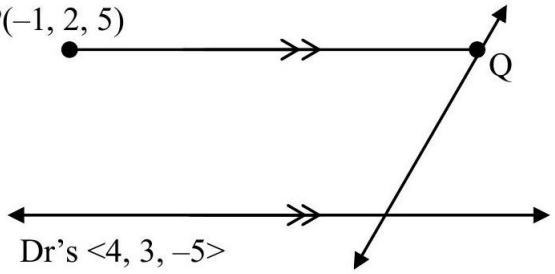
$\therefore QM = \sqrt{117-68} = \sqrt{49} = 7$

12. Let L be the distance of point $P(-1,2,5)$ from the line $\frac{x-1}{2} = \frac{y-3}{2} = \frac{z+1}{1}$ measured parallel to a line having direction ratios $4,3,-5$, then L^2 is equal to :

(1) 30 (2) 55 (3) 50 (4) 20

Ans. **[3]**

Sol. $\frac{x-1}{2} = \frac{y-3}{2} = \frac{z+1}{1}$



Let point Q be $(2\lambda+1, 2\lambda+3, \lambda-1)$

Now Dr's of PQ $(2\lambda+2),(2\lambda+1),(\lambda-6)$

So according to question $\frac{2\lambda+2}{4} = \frac{2\lambda+1}{3} = \frac{\lambda-6}{-5}$

$\Rightarrow \lambda = 1$

$\Rightarrow$ Point $Q \equiv (3,5,0)$

$\Rightarrow L^2 = 16+9+25 = 50$

13. A lift is going upto 10^{th} floor. Number of ways in which 3 people can exit the lift at three different floors if the lift will not stop at I^{st}, II^{nd} and III^{rd} floor is

(1) 210 (2) 343 (3) 720 (4) 205

Ans. **[1]**

Sol. Number of ways $= {}^7C_3 \times 3! = 7 \times 6 \times 5 = 210$

14. **Statement 1 :** The function f defined from $R \to R$ given by $f(x)=\frac{x}{1+|x|}$ is one-one.

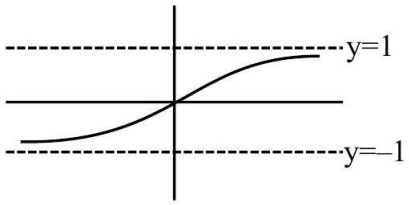
Statement 2 : The function f defined by $R \to R f(x)=\frac{x^2+4x-30}{x^2-8x+18}$ is many-one.

Which of the following is correct?
(1) Both Statements are correct
(2) Both Statements are false
(3) Statement 1 is false and Statement 2 is correct
(4) Statement 1 is correct and Statement 2 is false

Ans. **[1]**

Sol. **Statement 1:** $f(x)=\frac{x}{1+|x|}$

$$f(x)=\begin{cases}\frac{x}{1+x} & x \geq 0\\ \frac{x}{1-x} & x<0\end{cases}$$



$f(x)$ is one-one

Statement 2: $f(x)=\frac{x^2+4x-30}{x^2-8x+18}, f(0)=\frac{-30}{18}=\frac{-5}{3}$

$\frac{-5}{3}=\frac{x^2+4x-30}{x^2-8x+18}$

On solving $x=0,-1$

$\Rightarrow f(0)=f(-1)=\frac{-5}{3}$

$\therefore f(x)$ is many-one

15. The sum of coefficients of x^{499} and x^{500} in the expression :
$(1+x)^{1000}+x(1+x)^{999}+x^2(1+x)^{998}+....+x^{1000}$ is:

(1) ${}^{1001}C_{500}$ (2) ${}^{1003}C_{501}$ (3) ${}^{1002}C_{500}$ (4) ${}^{1004}C_{502}$

Ans. **[3]**

Sol. $S=(1+x)^{1000}+x(1+x)^{999}+x^2(1+x)^{998}+....+x^{1000}$

$$=(1+x)^{1000}\frac{\left(1-\left(\frac{x}{1+x}\right)^{1001}\right)}{1-\frac{x}{1+x}}$$

$=(1+x)^{1001}-x^{1001}$

Required sum $={}^{1001}C_{499}+{}^{1001}C_{500}={}^{1002}C_{500}$

16. A circle $x^2+y^2=4$ intersects x-axis at $A(-2,0)$ and $B(2,0)$ respectively. If two variable points $P(2\cos\alpha,2\sin\alpha)$ & $Q(2\cos\beta,2\sin\beta)$ varies on the circle such that $\alpha-\beta=\frac{\pi}{2}$, then find the locus of intersection of AP and BQ

(1) $x^2+y^2-4y-4=0$ (2) $x^2+y^2+4y-4=0$ (3) $x^2+y^2-4y+4=0$ (4) $x^2+y^2+4y+4=0$

Ans. **[1]**

Sol. Let point of intersection be (h, k)

$$\frac{k}{h+2}=\frac{2\sin\alpha}{2\cos\alpha+2}\Rightarrow\frac{k}{h+2}=\tan\frac{\alpha}{2}$$

$$\frac{k}{h-2}=\frac{2\sin\beta}{2\cos\beta-2}=\frac{\sin\beta}{\cos\beta-1}=-\cot\frac{\beta}{2}$$

$$\frac{\alpha}{2}-\frac{\beta}{2}=\frac{\pi}{4}$$

$$\tan\left(\frac{\alpha}{2}-\frac{\beta}{2}\right)=\tan\frac{\pi}{4}=1$$

$$\frac{\tan\frac{\alpha}{2}-\tan\frac{\beta}{2}}{1+\tan\frac{\alpha}{2}\tan\frac{\beta}{2}}=1$$

$$\frac{\frac{k}{h+2}+\frac{h-2}{k}}{1+\left(\frac{k}{h+2}\right)\left(\frac{2-h}{k}\right)}=1\Rightarrow\frac{k^2+h^2-4}{\frac{k(h+2)}{4}{h+2}}=1$$

$$\frac{h^2+k^2-4}{4k}=1$$

$$x^2+y^2-4y-4=0$$

17. The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\frac{12(3+[x])dx}{3+[\sin x]+[\cos x]}$ (where [.] denotes greatest integer function):

(1) $11\pi+2$ (2) $5\pi+20$ (3) $11\pi-20$ (4) $5\pi-2$

Ans. **[1]**

Sol. $I=\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\frac{12(3+[x])dx}{3+[\sin x]+[\cos x]}$

$$I=\int_{-\pi/2}^{-1}\frac{12(1)}{2}dx+\int_{-1}^{0}\frac{12(2)}{2}dx+\int_{0}^{1}\frac{12(3)}{2}dx+\int_{1}^{\pi/2}\frac{12(4)}{2}dx$$

$$I=6\left(\frac{\pi}{2}-1\right)+12(0+1)+12(1-0)+16\left(\frac{\pi}{2}-1\right)$$

$$I=3\pi-6+12+12+8\pi-16$$

$$I=11\pi+2$$

18. If the arithmetic mean of $\frac{1}{a}$ & $\frac{1}{b}$ is $\frac{5}{16}$ and $a, 4, \alpha, b$ are in increasing A.P. then both the roots of equation $\alpha x^2 - ax + 2(\alpha - 2b)$ lie between

(1) $(-3,0)$ (2) $(-2,3)$ (3) $(0,3)$ (4) $(-1,1)$

Ans. **[2]**

Sol. $a = 4 - d, \alpha = 4 + d, b = 4 + 2d$

$\Rightarrow (4+d)x^2 - (4-d)x + 2(4+d-8-4d) = 0$

$\Rightarrow (4+d)x^2 - (4-d)x + 2(-4-3d) = 0$

Also $\frac{\frac{1}{a}+\frac{1}{b}}{2} = \frac{5}{16}$

$\Rightarrow \frac{\frac{1}{4-d}+\frac{1}{4+2d}}{2} = \frac{5}{16}$

$\Rightarrow d = 2$

Equation becomes

$6x^2 - 2x - 20 = 0$

$3x^2 - x - 10 = 0$

$x = 2, \frac{-5}{3}$

19. Let $f(x) = \lim\limits_{\theta \to 0^+} \frac{\cos \pi x - x^{2/\theta} \sin(x-1)}{1 - x^{2/\theta}(x-1)}$

Statement 1: $f(x)$ is discontinuous at $x = 1$

Statement 2: $f(x)$ is continuous at $x = -1$

(1) Both Statements are correct
(2) Both Statements are false
(3) Statement 1 is false and Statement 2 is correct
(4) Statement 1 is correct and Statement 2 is false

Ans. **[2]**

Sol. $f(x) = \begin{cases} \cos \pi x & x \to 1^- \\ \frac{-\sin(x-1)}{-(x-1)} & x \to 1^+ \end{cases}$

$RHL = \lim\limits_{x \to 1} \frac{\sin(x-1)}{(x-1)} = 1$

$LHL = \lim\limits_{x \to 1} \cos \pi x = -1$

$f(x)$ is discontinuous at $x = 1$

$f(x) = \begin{cases} \frac{-\sin(x-1)}{-(x-1)} & x \to -1^- \\ \cos \pi x & x \to -1^+ \end{cases}$

$\text{RHL} = \lim\limits_{x\to -1} \cos \pi x = -1$

$\text{LHL} = \lim\limits_{x\to -1} \dfrac{-\sin(x-1)}{-(x-1)} = \dfrac{\sin 2}{2}$

$f(x)$ is discontinuous at $x = -1$

20. **Statement 1 :** $25^{13} + 20^{13} + 8^{13} + 3^{13}$ is divisible by 7.

Statement 2 : The value of integral part of $(7+4\sqrt{3})^{25}$ is an odd number.

(1) Both Statements are correct
(2) Both Statements are false
(3) Statement 1 is false and Statement 2 is correct
(4) Statement 1 is correct and Statement 2 is false

Ans. **[1]**

Sol. **Statement I :**

$25^{13} + 3^{13} + 20^{13} + 8^{13}$

divisible by (25+3) divisible by (20+8)

$\therefore$ divisible by 7

Statement II : $R = (7+4\sqrt{3})^{25} = I + f$

$R' = (7-4\sqrt{3})^{25} = f'$

$\therefore R + R' = 2\left[{}^{25}C_0 7^{25} + {}^{25}C_2 7^{23}(4\sqrt{3})^2 + \ldots.\right]$

$I + f + f' =$ even integer

$\therefore I =$ odd integer

$\because 0 < f + f' < 2 \Rightarrow f + f' = 1$

$\Rightarrow$ Both the statements are correct

21. Given $f(x) = \int \dfrac{dx}{x^{2/3} + 2\sqrt{x}}$ & $f(0) = -26 + 24\ell n2$. If $f(1) = A + B\ell n3$, then find $(A+B)$

(1) 10 (2) 11 (3) –11 (4) –10

Ans. **[3]**

Sol. $f(x) = \int \dfrac{dx}{x^{2/3} + 2x^{1/2}}$

Put $x = t^6 \Rightarrow dx = 6t^5 dt$

$= \int \dfrac{6t^5 dt}{t^4 + 2t^3} = 6\int \dfrac{(t^2-4)+4}{t+2} dt$

$= 6\left[\int (t-2)dt + 4\int \dfrac{1}{t+2} dt\right]$

$$= 6\left[\frac{t^2}{2} - 2t + 4\ell n(t+2)\right] + C$$

$$= 3x^{1/3} - 12x^{1/6} + 24\ell n\left(x^{1/6} + 2\right) + C$$

$$f(0) = 24\ell n2 + C = -26 + 24\ell n2 \text{ (given)}$$

$$\Rightarrow C = -26$$

Now

$$f(1) = -35 + 24\ell n3 = A + B\ell n3 \text{ (as given in ques.)}$$

$$\Rightarrow A = -35 \;\&\; B = 24$$

$$\Rightarrow A + B = -11$$

22. If $\sum_{r=1}^{25} \frac{r}{r^4 + r^2 + 1} = \frac{p}{q}$, where p and q are coprime positive integers, then $p+q$ is equal to

(1) 841 (2) 976 (3) 984 (4) 8

Ans. **[2]**

Sol. $$S = \sum \frac{r}{\left(r^2 + r + 1\right)\left(r^2 - r + 1\right)}$$

$$= \frac{1}{2}\sum_{r=1}^{25}\left(\frac{1}{r^2 - r + 1} - \frac{1}{r^2 + r + 1}\right)$$

$$= \frac{1}{2}\left[\left(\frac{1}{1} - \frac{1}{3}\right) + \left(\frac{1}{3} - \frac{1}{7}\right) + \ldots + \left(\frac{1}{601} - \frac{1}{651}\right)\right]$$

$$= \frac{1}{2}\left[\frac{1}{1} - \frac{1}{651}\right]$$

$$= \frac{1}{2}\left[\frac{650}{651}\right] = \frac{325}{651}$$

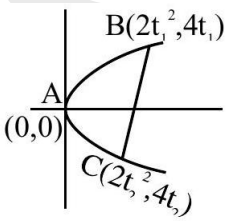
$$\frac{p}{q} = \frac{325}{651} \Rightarrow p + q = 976$$

23. Let a ΔABC such that $A(0,0)$ and vertex B and C lie on parabola $y^2 = 8x$ such that $\left(\frac{7}{3}, \frac{4}{3}\right)$ is the centroid of ΔABC then $(BC)^2$ is equal to

(1) 110 (2) 115 (3) 120 (4) 130

Ans. **[3]**

Sol.



Coordinates of centroid of triangle ABC are

$$x = \frac{2t_1^2 + 2t_2^2}{3} = \frac{7}{3}$$

$$t_1^2+t_2^2=\frac{7}{2}$$

$$y=\frac{4(t_1+t_2)}{3}=\frac{4}{3}$$

$$t_1+t_2=1$$

$$(t_1+t_2)^2-2t_1t_2=\frac{7}{2}$$

$$t_1t_2=\frac{-5}{4}$$

$$(t_2-t_1)^2=1+4\times\frac{5}{4}=6$$

$$(BC)^2=\left(4(t_2-t_1)\right)^2+\left(2\left(t_2^2-t_1^2\right)\right)^2$$

$$=4(t_2-t_1)^2\left[4+(t_2+t_1)^2\right]$$

$$=4\times5\times6=120$$