FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Thursday 04 April, 2024) TIME : 9 : 00 AM to 12 : 00 NOON

MATHEMATICS

TEST PAPER WITH SOLUTION

SECTION–A

١. Let f : R → R be a function given by

$$f(x) = \begin{cases} \frac{1 - \cos ٢x}{x^٢}, & x < ٠ \\ \alpha, & x = ٠, \text{ where } \alpha, \beta \in R. \text{ If} \\ \frac{\beta\sqrt{1 - \cos x}}{x}, & x > ٠ \end{cases}$$

f is continuous at x = ٠, then $\alpha^2 + \beta^2$ is equal to :

(١) ٤٨ (٢) ١٢

(٣) ٣ (٤) ٦

Ans. (٢)

Sol. $f(٠^-) = \lim_{x \to ٠^-} \frac{٢\sin^٢ x}{x^٢} = ٢ = \alpha$

$f(٠^+) = \lim_{x \to 0^+} \beta\sqrt{٢}\,\frac{\sin \frac{x}{٢}}{٢ \cdot \frac{x}{٢}} = \frac{\beta}{\sqrt{٢}} = 2$

$\beta = ٢\sqrt{٢}$

$\alpha^2 + \beta^2 = ٤ + ٨ = ١٢$

٢. Three urns A, B and C contain ٧ red, ٥ black; ٥ red, ٧ black and ٦ red, ٦ black balls, respectively. One of the urn is selected at random and a ball is drawn from it. If the ball drawn is black, then the probability that it is drawn from urn A is :

(١) $\frac{٤}{٧}$ (٢) $\frac{٥}{١٨}$

(٣) $\frac{٧}{١٨}$ (٤) $\frac{٥}{١٦}$

Ans. (٢)

Sol.

A	B	C
٧R, ٥B	٥R, ٧B	٦R, ٦B

$P(B) = \frac{١}{٣}\cdot\frac{٥}{١٢} + \frac{١}{٣}\cdot\frac{٧}{١٢} + \frac{١}{٣}\cdot\frac{٦}{١٢}$

required probability $= \frac{\frac{١}{٣}\cdot\frac{٥}{١٢}}{\frac{1}{3}\left(\frac{٥}{١٢} + \frac{٧}{١٢} + \frac{٦}{١٢}\right)} = \frac{٥}{١٨}$

٣. The vertices of a triangle are A(−١, ٣), B(−٢, ٢) and C(٣, −١). A new triangle is formed by shifting the sides of the triangle by one unit inwards. Then the equation of the side of the new triangle nearest to origin is :

(١) $x - y - (٢ + \sqrt{٢}) = ٠$

(٢) $-x + y - (٢ - \sqrt{٢}) = ٠$

(٣) $x + y - (٢ - \sqrt{٢}) = ٠$

(٤) $x + y + (٢ - \sqrt{٢}) = ٠$

Ans. (٣)

Sol.

(−١, ٣) A

(−٢, ٢) B

m = −١

C (٣, −١)

equation of AC ⇒ x + y = ٢

equation of line parallel to AC x + y = d

$\left|\frac{d - ٢}{\sqrt{٢}}\right| = ١$

$d = 2 \pm \sqrt{٢}$

eq of new required line

$x + y = ٢ - \sqrt{٢}$

٤. If the solution y = y(x) of the differential equation $(x^٤ + ٢x^٣ + ٣x^٢ + ٢x + ٢)dy - (٢x^٢ + ٢x + ٣)dx = ٠$ satisfies $y(-١) = -\frac{\pi}{٤}$, then y(٠) is equal to :

(١) $-\frac{\pi}{١٢}$ (٢) ٠

(٣) $\frac{\pi}{٤}$ (٤) $\frac{\pi}{٢}$

Ans. (٣)

Sol. $y=\int\frac{(2x^2+2x+3)}{x^4+2x^3+3x^2+2x+2}dx$

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

$y=\int\frac{dx}{x^2+2x+2}+\int\frac{dx}{x^2+1}$

$y=\tan^{-1}(x+1)+\tan^{-1}x+C$

$y(-1)=-\frac{\pi}{4}$

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

5. $\therefore y=\tan^{-1}(x+1)+\tan^{-1}x$

$y(0)=\tan^{-1}1=\frac{\pi}{4}$

Let the sum of the maximum and the minimum values of the function $f(x)=\frac{2x^2-3x+8}{2x^2+3x+8}$ be $\frac{m}{n}$, where gcd(m, n) = 1. Then m + n is equal to :

(1) 182 (2) 217

(3) 195 (4) 201

Ans. (4)

Sol. $y=\frac{2x^2-3x+8}{2x^2+3x+8}$

$x^2(2y-2)+x(3y+3)+8y-8=0$

use $D\geq 0$

$(3y+3)^2-4(2y-2)(8y-8)\geq 0$

$(11y-5)(5y-11)\leq 0$

$\therefore y\in\left[\frac{5}{11},\frac{11}{5}\right]$

y = 1 is also included

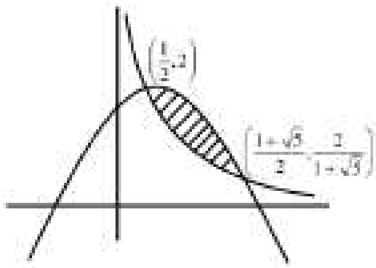
6. One of the points of intersection of the curves $y=1+3x-2x^2$ and $y=\frac{1}{x}$ is $\left(\frac{1}{2},2\right)$. Let the area of the region enclosed by these curves be $\frac{1}{24}\left(\ell\sqrt{5}+m\right)-n\log_e\left(1+\sqrt{5}\right)$, where $\ell, m, n\in N$. Then $\ell+m+n$ is equal to

(1) 32 (2) 30

(3) 29 (4) 31

Ans. (2)

Sol.



$A=\int_{\frac{1}{2}}^{\frac{1+\sqrt{5}}{2}}\left(1+3x-2x^2-\frac{1}{x}\right)dx$

$A=\left[x+\frac{3x^2}{2}-\frac{2x^3}{3}-\ell n\,x\right]_{\frac{1}{2}}^{\frac{1+\sqrt{5}}{2}}$

$A=\frac{1+\sqrt{5}}{2}+\frac{3}{2}\left(\frac{1+\sqrt{5}}{2}\right)^2-\frac{2}{3}\left(\frac{1+\sqrt{5}}{2}\right)^3-\ell n\left(\frac{1+\sqrt{5}}{2}\right)$

$-\left[\frac{1}{2}+\frac{3}{2}\left(\frac{1}{4}\right)-\frac{2}{3}\left(\frac{1}{8}\right)-\ell n\left(\frac{1}{2}\right)\right]$

$A=\frac{1}{2}+\frac{\sqrt{5}}{2}+\frac{9}{4}+\frac{3}{4}\sqrt{5}-\frac{15}{8}-\frac{4}{3}-\frac{2}{3}\sqrt{5}$

$-\frac{1}{2}-\frac{3}{8}+\frac{1}{12}-\ell n\left(1+\sqrt{5}\right)$

$=\sqrt{5}\left(\frac{1}{2}+\frac{3}{4}-\frac{2}{3}\right)+\frac{15}{8}-\frac{4}{3}-\frac{1}{12}-\ell n\left(1+\sqrt{5}\right)$

$=\frac{14}{24}\sqrt{5}+\frac{15}{24}-\ell n\left(1+\sqrt{5}\right)$

7. If the system of equations

$x+\left(\sqrt{2}\sin\alpha\right)y+\left(\sqrt{2}\cos\alpha\right)z=0$

$x+(\cos\alpha)y+(\sin\alpha)z=0$

$x+(\sin\alpha)y-(\cos\alpha)z=0$

has a non-trivial solution, then $\alpha\in\left(0,\frac{\pi}{2}\right)$ is equal to :

(1) $\frac{3\pi}{4}$ (2) $\frac{7\pi}{24}$

(3) $\frac{5\pi}{24}$ (4) $\frac{11\pi}{24}$

Ans. (3)

Sol. $\begin{vmatrix} ١ & \sqrt{٢}\sin□ & \sqrt{٢}\cos□ \\ ١ & \sin□ & □\cos□ \\ ١ & \cos□ & \sin□ \end{vmatrix} □ 0$

$□ 1□\sqrt{٢}\sin□□\sin□\cos□ □\sqrt{٢}\cos□□\cos□\sin□ □ □ □ 0$

$□ 1□\sqrt{٢}\cos ٢□ □\sqrt{٢}\sin ٢□ □ 0$

$\cos ٢□ □\sin ٢□ □ □ □\frac{١}{\sqrt{٢}}$

$\cos□\frac{□}{٢} □ □ \frac{□ □}{4 □} □ □ \frac{١}{٢}□$

$2□ □\frac{□}{٤} □ ٢n□ □\frac{٢}{٣}$

$□ □\frac{□}{٨} □ n□ □\frac{□}{٣}$

$n = ٠،$

$x □\frac{□}{٣} □\frac{□}{٨} □\frac{٥□}{٢٤}$

٨. There are ٥ points P١، P٢، P٣، P٤، P٥ on the side AB، excluding A and B، of a triangle ABC. Similarly there are ٦ points P٦، P٧، ... ، P١١ on the side BC and ٧ points P١٢، P١٣، ... ، P١٨ on the side CA of the triangle. The number of triangles، that can be formed using the points P١، P٢، ... ، P١٨ as vertices، is :

(١) ٧٧٦ (٢) ٧٥١

(٣) ٧٩٦ (٤) ٧٧١

Ans. (٢)

Sol. $^{١٨}C_٣ - {}^{٥}C_٣ - {}^{٦}C_٣ - {}^{٧}C_٣$

$= ٧٥١$

٩. Let $f(x) = \begin{cases} □ ٢، & □٢ □x □٠ \\ x □٢، & ٠ □x □٢ \end{cases}$ and $h(x) = f(|x|) + |f(x)|$.

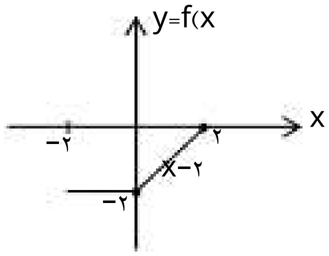
Then $\int_{□2}^{٢} h□x□dx$ is equal to :

(١) ٢ (٢) ٤

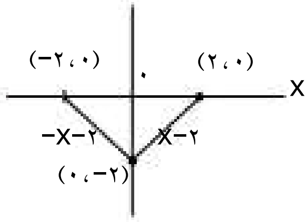
(٣) ١ (٤) ٦

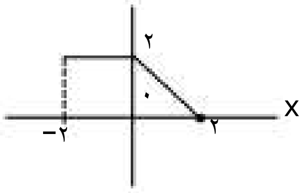
Ans. (١)

Sol.

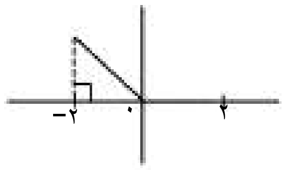


f(|x|) □ |f(x)|





$h(x) □ \begin{cases} □x □ 2 □ 2 □ x □٤ & ٠ □x □٢ \\ □ □x □ 2 □ 2 □x□ & □٢ □x □٠ \end{cases}$



$□ \int_{□2}^{٢} h(x)dx □ ٠$ and $\int_{□2}^{٠} h□x□dx □ ٢$

١٠. The sum of all rational terms in the expansion of $□ ٣^{٥} □ ٥^{٣} □$ is equal to :

(١) ٣١٣٣ (٢) ٦٣٣

(٣) ٩٣١ (٤) ٦١٣١

Ans. (١)

Sol. $T_{r+١} = {}^{١٥}C_r □ ٣^{\frac{١}{٥}} □^{١٥□r} □ ٥^{\frac{١}{٣}} □^{r}$

$□ {}^{١٥}C_r ٥^{\frac{r}{٣}} ٣^{\frac{١٥□r}{٥}}$

$R = ٣□، ١٥μ$

$□ r = ٠، ١٥$

٢ rational terms

$□ {}^{١٥}C_٠ ٣^٣ □ {}^{١٥}C_{١٥} ٥^٥ □$

$= ٨ + ٣١٢٥ = ٣١٣٣$

١١. Let a unit vector which makes an angle of ٦٠° with $٢\hat{i} + ٢\hat{j} - \hat{k}$ and an angle of ٤٥° with $\hat{i} - \hat{k}$ be $\vec{C}$. Then $\vec{C}$ is :

(١) $\frac{\sqrt{٢}}{٣}\hat{i} + \frac{\sqrt{٢}}{٣}\hat{j} + \left(\frac{١}{٢} + \frac{٢\sqrt{2}}{٣}\right)\hat{k}$

(٢) $\frac{\sqrt{٢}}{٣}\hat{i} + \frac{١}{٣\sqrt{٢}}\hat{j} - \frac{١}{٢}$

(٣) $\left(\frac{١}{\sqrt{٣}} + \frac{١}{٢}\right)\hat{i} + \left(\frac{١}{\sqrt{٣}} - \frac{١}{٣\sqrt{٢}}\right)\hat{j} + \left(\frac{١}{\sqrt{٣}} + \frac{\sqrt{2}}{٣}\right)\hat{k}$

(٤) $\frac{\sqrt{٢}}{٣}\hat{i} - \hat{k}$

Ans. (٤)

Sol. $\vec{C} = C_١\hat{i} + C_٢\hat{j} + C_٣\hat{k}$

$C_١^٢ + C_٢^٢ + C_٣^٢ = ١$

$\vec{C}\cdot(٢\hat{i} + ٢\hat{j} - \hat{k}) = |\vec{C}|\,|\ldots|\cos ٦٠°$

$٢C_١ + ٢C_٢ - C_٣ = \frac{٣}{٢}$

$C_١ - C_٣ = ١$

$C_١ + ٢C_٢ = \frac{١}{٢}$

$C_١ = \frac{\sqrt{٢}}{٣} + \frac{١}{٢}$

$C_٢ = \frac{-1}{٣\sqrt{٢}}$

$C_٣ = \frac{\sqrt{٢}}{٣} - \frac{١}{٢}$

١٢. Let the first three terms ٢, p and q, with $q \neq ٢$, of a G.P. be respectively the ٧th, ٨th and ١٣th terms of an A.P. If the ٥th term of the G.P. is the nth term of the A.P., then n is equal to

(١) ١٥١ (٢) ١٦٩

(٣) ١٧٧ (٤) ١٦٣

Ans. (٤)

Sol. $p^٢ = ٢q$

$٢ = a + ٦d$ ...(i)

$p = a + ٧d$ ...(ii)

$q = a + ١٢d$ ...(iii)

$p - ٢ = d$ ((ii) − (i))

$q - p = ٥d$ ((iii) − (ii))

$q - p = ٥(p - ٢)$

$q = ٦p - ١٠$

$p^٢ = ٢(٦p - ١٠)$

$p^٢ - ١٢p + ٢٠ = ٠$

$p = ١٠, ٢$

$p = ١٠;\ q = ٥٠$

$d = ٨$

$a = -٤٦$

٢, ١٠, ٥٠, ٢٥٠, ١٢٥٠

$ar^٤ = a + (n - ١)d$

$١٢٥٠ = -٤٦ + (n - ١)٨$

$n = ١٦٣$

١٣. Let $a, b \in R$. Let the mean and the variance of ٦ observations −٣, ٤, ٧, −٦, a, b be ٢ and ٢٣, respectively. The mean deviation about the mean of these ٦ observations is :

(١) $\frac{١٣}{٣}$ (٢) $\frac{١٦}{٣}$

(٣) $\frac{١١}{٣}$ (٤) $\frac{١٤}{٣}$

Ans. (١)

Sol. $\frac{\sum x_i}{٦} = ٢$ and $\frac{\sum x_i^٢}{N} - (2)^٢ = ٢٣$

$\alpha + \beta = ١٠$

$\alpha^٢ + \beta^٢ = ٥٢$

solving we get $\alpha = ٤,\ \beta = ٦$

$\frac{\sum |x_i - \bar{x}|}{٦} = \frac{٥ + ٢ + ٥ + ٨ + 2 + 4}{٦} = \frac{١٣}{٣}$

١٤. If ٢ and ٦ are the roots of the equation $ax + bx + ١ = ١٦٠.$ then the quadratic equation، whose roots are $\frac{١}{٢a+b}$ and $\frac{١}{٦a+b}$، is :

(١) $٢x^٢ + ١١x + ١٢ = ٠$ (٢) $٤x^٢ + ١٤x + ١٢ = ٠$

(٣) $x^٢ + ١٠x + ١٦ = ٠$ (٤) $x^٢ + ٨x + ١٢ = ٠$

Ans. (٤)

Sol. Sum $= ٨ = -\frac{b}{a}$

Product $= ١٢ = \frac{١}{a}$ $\Rightarrow a = \frac{١}{١٢}$

$b = -\frac{٢}{٣}$

$٢a + b = \frac{٢}{١٢} - \frac{٢}{٣} = -\frac{١}{٢}$

$٦a + b = \frac{٦}{١٢} - \frac{٢}{٣} = -\frac{١}{٦}$

sum $= -٨$

$P = ١٢$

$x^٢ + ٨x + ١٢ = ٠$

١٥. Let α and β be the sum and the product of all the non-zero solutions of the equation $(\bar{z})^٢ + |z| = ٠$، $z \in C$.

Then $٤(\alpha^٢ + \beta^٢)$ is equal to :

(١) ٦ (٢) ٤

(٣) ٨ (٤) ٢

Ans. (٢)

Sol. $z = x + iy$

$\bar{z} = x - iy$

$\bar{z}^٢ = x^٢ - y^٢ - ٢ixy$

$\Rightarrow x^٢ - y^٢ - ٢ixy + \sqrt{x^٢ + y^٢} = ٠$

$\Rightarrow x = ٠$ or $y = ٠$

$-y^٢ + |y| = ٠$ $x^٢ + |x| = ٠$

$|y| = |y|^٢$ $\Rightarrow x = ٠$

$y = ٠، \pm١$

$\Rightarrow i، -i$ $\Rightarrow \alpha = i - i = ٠$

are roots $\beta = i(-i) = ١$

$٤(٠ + ١) = ٤$

١٦. Let the point، on the line passing through the points $P(١، -٢، ٣)$ and $Q(٥، -٤، ٧)$، farther from the origin and at a distance of ٩ units from the point P، be (α, β, γ). Then $\alpha^٢ + \beta^٢ + \gamma^٢$ is equal to :

(١) ١٥٥ (٢) ١٥٠

(٣) ١٦٠ (٤) ١٦٥

Ans. (١)

Sol. PQ line

$\frac{x-١}{٤} = \frac{y+٢}{-2} = \frac{z-٣}{٤}$

pt $(٤t + ١، -٢t - ٢، ٤t + ٣)$

distance $= ١٦t^٢ + ٤t^٢ + ١٦t^٢ = ٨١$

$t = \frac{٣}{٢}$

pt $(٧، -٥، ٩)$

$\alpha^٢ + \beta^٢ + \gamma^٢ = ١٥٥$

option (١)

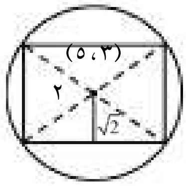
١٧. A square is inscribed in the circle $x^٢ + y^٢ - ١٠x - ٦y + ٣٠ = ٠$. One side of this square is parallel to $y = x + ٣$. If $(x_i، y_i)$ are the vertices of the square، then $\sum(x_i^٢ + y_i^٢)$ is equal to :

(١) ١٤٨ (٢) ١٥٦

(٣) ١٦٠ (٤) ١٥٢

Ans. (٤)

Sol.



$y = x + c$ & $x + y + d = ٠$

$\left|\frac{٥ - ٣ + c}{\sqrt{٢}}\right| = \sqrt{٢}$ $\left|\frac{٨ + d}{\sqrt{٢}}\right| = \sqrt{٢}$

$|c + ٢| = ٢$ $٨ + d = \pm٢$

$c = ٠، -٤$ $d = -١٠، -٦$

pts $(٥، ٥)، (٣، ٣)، (٧، ٣)، (٥، ١)$

$\sum x_i^٢ + y_i^٢ = ٢٥ + ٢٥ + 9 + 9 + ٤٩ + 9 + ٢٥ + ١$

$= ١٥٢$

Option (٤)

١٨. If the domain of the function $\sin^{-1}\left(\frac{٣x-٢٢}{٢x-١٩}\right)+\log_e\left(\frac{٣x^٢-٨x+٥}{x^٢-٣x-١٠}\right)$ is $(\alpha, \beta]$, then $٣\alpha+١٠\beta$ is equal to :

(١) ٩٧ (٢) ١٠٠

(٣) ٩٥ (٤) ٩٨

Ans. (١)

Sol. $-١ \le \frac{٣x-٢٢}{٢x-١٩} \le ١$ $\frac{٣x^٢-٨x+٥}{x^٢-٣x-١٠} > ٠$

$x \in \left(٥, \frac{٤١}{5}\right]$

$٣\alpha + ١٠\beta = ٩٧$

Option (١)

١٩. Let $f(x) = x^٥ + ٢e^{x/٤}$ for all $x \in R$. Consider a function $g(x)$ such that $(gof)(x) = x$ for all $x \in R$. Then the value of $٨g'(٢)$ is :

(١) ١٦ (٢) ٤

(٣) ٨ (٤) ٢

Ans. (١)

Sol. $f(x) = ٢$

when $x = ٠$

$\Rightarrow g'(f(x))\, f'(x) = ١$

$g'(2) = \frac{١}{f'(0)}$

$\because f'(x) = ٥x^٤ + \frac{٢}{٤}e^{x/٤}$

$g'(٢) = ٢$

Ans = ١٦

Option (١)

٢٠. Let $\alpha \in (٠, \infty)$ and $A = \begin{bmatrix} ١ & ٢ & \alpha \\ ١ & ٠ & ١ \\ ٠ & ١ & 2 \end{bmatrix}$.

If $\det(\operatorname{adj}(٢A - A^T) \cdot \operatorname{adj}(A - ٢A^T)) = ٢^٨$, then $(\det(A))^٢$ is equal to :

(١) ١ (٢) ٤٩

(٣) ١٦ (٤) ٣٦

Ans. (٣)

Sol. $|\operatorname{adj}(A - ٢A^T)(٢A - A^T)| = ٢^٨$

$|(A - ٢A^T)(٢A - A^T)| = ٢^٤$

$|A - ٢A^T||٢A - A^T| = \pm ١٦$

$(A - ٢A^T)^T = A^T - ٢A$

$|A - ٢A^T| = |A^T - ٢A|$

$\Rightarrow |A - ٢A^T| = ١٦$

$|A - ٢A^T| = \pm ٤$

$\begin{bmatrix} ١ & ٢ & \alpha \\ ١ & ٠ & ١ \\ ٠ & ١ & ٢ \end{bmatrix} - 2\begin{bmatrix} ١ & ١ & ٠ \\ ٢ & ٠ & ١ \\ \alpha & ١ & ٢ \end{bmatrix}$

$\begin{vmatrix} -١ & ٠ & \alpha \\ -٣ & ٠ & -١ \\ -٢\alpha & -1 & -2 \end{vmatrix}$

$١ + ٣\alpha = ٤$

$٣\alpha = ٣$

$\alpha = ١$

$|A| = \begin{vmatrix} ١ & ٢ & ١ \\ ١ & ٠ & ١ \\ ٠ & ١ & ٢ \end{vmatrix} = -1 - 3 = -4$

$|A|^٢ = ١٦$

SECTION-B

٢١. If $\lim_{x \to 1} \frac{(٥x+١)^{١/٣} - (x+5)^{١/٣}}{(٢x+٣)^{١/2} - (x+٤)^{١/٢}} = \frac{m\sqrt{٥}}{n(٢n)^{٢/٣}}$, where $\gcd(m, n) = ١$, then $٨m + ١٢n$ is equal to ______

Ans. (١٠٠)

Sol. $\lim_{x \to 1} \frac{\frac{١}{٣}(٥x+١)^{-٢/٣} \cdot ٥ - \frac{١}{٣}(x+٥)^{-٢/٣}}{\frac{١}{٢}(٢x+٣)^{-١/٢} \cdot ٢ - \frac{١}{٢}(x+٤)^{-١/٢}}$

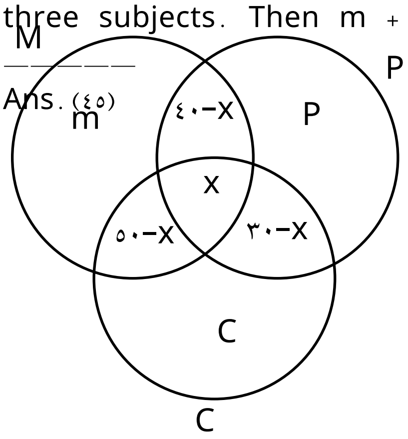
$= \frac{٨\sqrt{٥}}{٣ \cdot ٦^{٢/٣}}$ $\frac{m}{n} = \frac{٨}{3}$

$٨m + ١٢n = ١٠٠$

٢٢. In a survey of ٢٢٠ students of a higher secondary school، it was found that at least ١٢٥ and at most ١٣٠ students studied Mathematics؛ at least ٨٥ and at most ٩٥ studied Physics؛ at least ٧٥ and at most ٩٠ studied Chemistry؛ ٣٠ studied both Physics and Chemistry؛ ٥٠ studied both Chemistry and Mathematics؛ ٤٠ studied both Mathematics and Physics and ١٠ studied none of these subjects. Let m and n respectively be the least and the most number of students who studied all the three subjects. Then m + n is equal to ______

Ans. (٤٥)

Sol.



$١٢٥ \le m + ٩٠ - x \le ١٣٠$

$٨٥ \le P + ٧٠ - x \le ٩٥$

$٧٥ \le C + ٨٠ - x \le ٩٠$

$m + P + C + ١٢٠ - ٢x = ٢١٠$

$\Rightarrow ١٥ \le x \le ٤٥ \;\&\; ٣٠ - x \ge ٠$

$\Rightarrow ١٥ \le x \le ٣٠$

$٣٠ + ١٥ = ٤٥$

٢٣. Let the solution $y = y(x)$ of the differential equation $\frac{dy}{dx} - y = ١ + ٤\sin x$ satisfy $y(\pi) = ١$. Then $y\left(\frac{\pi}{٢}\right) + ١٠$ is equal to ______

Ans. (٧)

Sol. $ye^{-x} = \int e^{-x}(١ + ٤\sin x)dx$

$ye^{-x} = -e^{-x} - ٢e^{-x}(\sin x + \cos x) + C$

$y = -١ - ٢(\sin x + \cos x) + ce^{x}$

$\because y(\pi) = ١ \Rightarrow c = ٠$

$y(\pi/٢) = -١ - ٢ = -٣$ Ans $= ١٠ - ٣ = ٧$

٢٤. If the shortest distance between the lines $\frac{x+٢}{٢} = \frac{y+٣}{٣} = \frac{z-٥}{٤}$ and $\frac{x-٣}{١} = \frac{y-٢}{-٣} = \frac{z+٤}{٢}$ is $\frac{٣٨}{٣\sqrt{٥}}k$ and $\int_{٠}^{k}[x^{2}]dx = \alpha - \sqrt{\alpha}$, where $[x]$ denotes the greatest integer function, then $٦\alpha^{٣}$ is equal to ______

Ans. (٤٨)

Sol. $\frac{٣٨}{٣\sqrt{٥}}k = \frac{(٥\hat{i} + ٥\hat{j} - ٩\hat{k}) \cdot \begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ ٢ & ٣ & ٤\\ ١ & -٣ & ٢\end{vmatrix}}{\sqrt{٥}}$

$\frac{٣٨}{٣\sqrt{٥}}k = \frac{١٩}{\sqrt{٥}}$

$k = \frac{١٩}{\sqrt{٥}}$

$k = \frac{٣}{٢}$

$\int_{٠}^{٣/٢}[x^{2}]dx = \int_{٠}^{١}0\,dx + \int_{١}^{\sqrt{٢}}1\,dx + \int_{\sqrt{٢}}^{٣/٢}2\,dx$

$= \sqrt{2} - 1 + 2\left(\frac{3}{2} - \sqrt{٢}\right)$

$= 2 - \sqrt{٢}$

$\alpha = ٢$

$٦\alpha^{٣} = ٤٨$

٢٥. Let A be a square matrix of order ٢ such that $|A| = ٢$ and the sum of its diagonal elements is -٣. If the points (x, y) satisfying $A^{٢} + xA + yI = ٠$ lie on a hyperbola، whose transverse axis is parallel to the x-axis، eccentricity is e and the length of the latus rectum is ℓ، then $e^{٤} + \ell^{٤}$ is equal to ______

Ans. (Bouns)

NTA Ans. (٢٥)

Sol. Given $|A| = ٢$

trace $A = -٣$

and $A^{٢} + xA + yI = ٠$

$\Rightarrow x = ٣، y = ٢$

so، information is incomplete to determine eccentricity of hyperbola (e) and length of latus rectum of hyperbola (ℓ)

٢٦. Let a = ١ + $\frac{{}^{٢}C_{٢}}{٣!}$ + $\frac{{}^{٣}C_{٢}}{٤!}$ + $\frac{{}^{٤}C_{٢}}{٥!}$ + ...,

b = 1 + $\frac{{}^{١}C_{٠} + {}^{١}C_{١}}{١!}$ + $\frac{{}^{٢}C_{٠} + {}^{٢}C_{١} + {}^{٢}C_{٢}}{٢!}$ + $\frac{{}^{٣}C_{٠} + {}^{٣}C_{١} + {}^{٣}C_{٢} + {}^{٣}C_{٣}}{٣!}$ + ...

Then $\frac{٢b}{a^{٢}}$ is equal to ________

Ans. (٨)

Sol. f(x) = ١ + $\frac{(١+x)}{١!}$ + $\frac{(١+x)^{٢}}{٢!}$ + $\frac{(١+x)^{٣}}{٣!}$ + ...

$\frac{e^{(١+x)}}{1+x}$ = $\frac{١}{١+x}$ + ١ + $\frac{(١+x)}{٢!}$ + $\frac{(١+x)^{٢}}{٣!}$ + $\frac{(١+x)^{٣}}{٤!}$

coef $x^{٢}$ in RHS : ١ + $\frac{{}^{٣}C_{٢}}{٣!}$ + $\frac{{}^{٣}C_{٢}}{٤!}$ + ... = a

coeff. $x^{٢}$ in L.H.S.

$e\left(1 + x + \frac{x^{٢}}{٢!} + ...\right)\left(1 - x + \frac{x^{٢}}{٢!} ....\right)$

is $e - e + \frac{e}{٢!} = a$

b = $1 + \frac{٢}{١!} + \frac{٢^{٢}}{٢!} + \frac{٢^{٣}}{٣!} + ... = e^{٢}$

$\frac{٢b}{a^{٢}} = ٨$

٢٧. Let A be a ٣ × ٣ matrix of non-negative real elements such that $A\begin{bmatrix}1\\1\\1\end{bmatrix} = ٣\begin{bmatrix}1\\1\\1\end{bmatrix}$. Then the maximum value of det(A) is ________

Ans. (٢٧)

Sol. Let A = $\begin{bmatrix}a_{١} & a_{٢} & a_{٣}\\ b_{١} & b_{٢} & b_{٣}\\ c_{١} & c_{٢} & c_{٣}\end{bmatrix}$

$A\begin{bmatrix}١\\١\\١\end{bmatrix} = ٣\begin{bmatrix}١\\١\\١\end{bmatrix}$

⇒ $a_{١} + a_{٢} + a_{٣} = ٣$ .....(١)

⇒ $b_{١} + b_{٢} + b_{٣} = ٣$ .....(٢)

⇒ $c_{١} + ca_{٢} + c_{٣} = ٣$ .....(٣)

Now,

$|A| = (a_{١}b_{٢}c_{٣} + a_{٢}b_{٣}c_{١} + a_{٣}b_{١}c_{٢})$

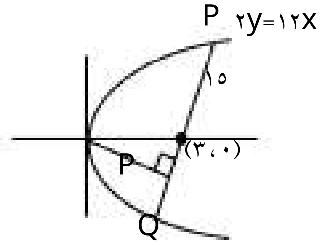
$- (a_{٣}b_{٢}c_{١} + a_{٢}b_{١}c_{٣} + a_{١}b_{٣}c_{٢})$

∴ From above in formation, clearly $|A|_{max}$ = ٢٧, when $a_{١} = ٣$, $b_{٢} = ٣$, $c_{٣} = ٣$

٢٨. Let the length of the focal chord PQ of the parabola $y^{٢} = ١٢x$ be ١٥ units. If the distance of PQ from the origin is p, then ١٠$p^{٢}$ is equal to ______

Ans. (٧٢)

Sol.



length of focal chord = ٤a $\text{cosec}^{٢}\theta$ = ١٥

١٢$\text{cosec}^{٢}\theta$ = ١٥

$\sin^{٢}\theta = \frac{٤}{٥}$

$\tan^{٢}\theta$ = ٤

$\tan\theta$ = ٢

equation $\frac{y-٠}{x-٣} = ٢$

y = ٢x − ٦

٢x − y − ٦ = ٠

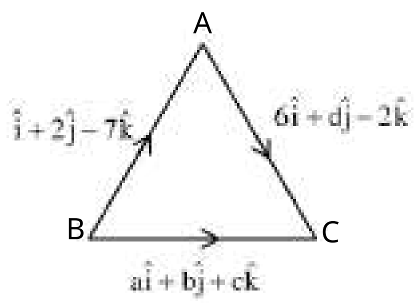
P = $\frac{٦}{\sqrt{٥}}$

١٠$p^{٢}$ = ١٠. $\frac{٣٦}{٥}$ = ٧٢

٢٩. Let ABC be a triangle of area ١٥$\sqrt{٢}$ and the vectors $\overline{AB} = \hat{i} + ٢\hat{j} - ٧\hat{k}$, $\overline{BC} = a\hat{i} + b\hat{j} + c\hat{k}$ and $\overline{AC} = ٦\hat{i} + d\hat{j} - ٢\hat{k}$, d > ٠. Then the square of the length of the largest side of the triangle ABC is

Ans. (٥٤)

Sol.



$$\text{Area} = \frac{١}{٢}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ ١ & ٢ & -٧ \\ ٦ & d & -٢ \end{vmatrix} = ١٥\sqrt{٢}$$

$(-٤ + ٧d)\hat{i} - \hat{j}(-٢ + ٤٢) + \hat{k}(d - ١٢)$

$(٧d - ٤)^٢ + (٤٠) + (d - ١٢)^٢ = ١٨٠٠$

$٥٠d^٢ - ٨٠d - ٤٠ = ٠$

$٥d^٢ - ٨d - ٤ = ٠$

$٥d^٢ - ١٠d + ٢d - ٤$

$٥d(d - ٢) + ٢(d - ٢) = ٠$

$d = ٢ \text{ or } d = -\frac{٢}{٥}$

$\because d > ٠,\ d = ٢$

$(a + ١)\hat{i} + (b + ٢)\hat{j} + (c - ٧)\hat{k} = ٦\hat{i} + ٢\hat{j} - ٢\hat{k}$

$a + ١ = ٦ \ \& \ b + ٢ = ٢,\ c - ٧ = -٢$

$a = ٥\ b = ٠\ c = ٥$

$|AB| = \sqrt{١+٤+٤٩} = \sqrt{٥٤}$

$|BC| = \sqrt{٢٥+٢٥+٠} = \sqrt{٥٠}$

$|AC| = \sqrt{٣٦+٤+٤} = \sqrt{٤٤}$

Ans. ٥٤

٣٠. If $\int_0^{\pi/٤} \frac{\sin^٢ x}{1 + \sin x \cos x}\,dx = \frac{١}{a}\log_e\left(\frac{a}{٣}\right) + \frac{\pi}{b\sqrt{٣}}$, where a, b ∈ N, then a + b is equal to ________

Ans. (٨)

Sol. $\int_0^{\pi/٤} \frac{\sin^٢ x}{١ + \frac{١}{٢}\sin ٢x}\,dx = \int_0^{\pi/٤} \frac{١ - \cos ٢x}{٢ + \sin ٢x}\,dx$

$= \int \frac{١}{2 + \sin ٢x} - \int \frac{\cos ٢x}{٢ + \sin ٢x}$

$(I_١) \quad - \quad (I_٢)$

$(I_١) = \int \frac{dx}{٢ + \frac{٢\tan x}{١ + \tan^٢ x}}$

$= \int_0^{\pi/٤} \frac{\sec^٢ x\,dx}{٢\tan^٢ x + ٢\tan x + ٢}$

$\tan x = t$

$\frac{١}{2}\int_0^١ \frac{dt}{\left(t + \frac{١}{٢}\right)^٢ + \frac{٣}{٤}} = \frac{\pi}{٦\sqrt{٣}}$

$I_٢ = \int_0^{\pi/٤} \frac{\cos ٢x}{٢ + \sin ٢x}\,dx = \frac{١}{٢}\left(\ell n\frac{٣}{٢}\right)$

$I_١ - I_٢ = \frac{١}{\sqrt{٣}}\left(\frac{\pi}{٦}\right) - \frac{١}{٢}\ell n\frac{٣}{٢}$

$\therefore a = ٢,\ b = ٦$

Ans. ٨

PHYSICS — TEST PAPER WITH SOLUTION

SECTION–A

٣١. An electron is projected with uniform velocity along the axis inside a current carrying long solenoid. Then :

(١) the electron will be accelerated along the axis.

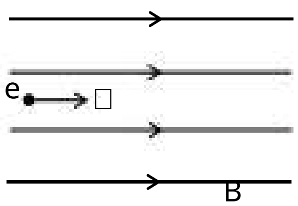
(٢) the electron will continue to move with uniform velocity along the axis of the solenoid.

(٣) the electron path will be circular about the axis.

(٤) the electron will experience a force at ٤٥° to the axis and execute a helical path.

Ans. (٢)

Sol.



Since $\vec{v} \parallel \vec{B}$ so force on electron due to magnetic field is zero. So it will move along axis with uniform velocity.

٣٢. The electric field in an electromagnetic wave is given by $\vec{E} = \hat{i}\,٤٠\cos\left(\omega\left(t - \frac{z}{c}\right)\right) NC^{-1}$. The magnetic field induction of this wave is (in SI unit):

(١) $\vec{B} = \hat{i}\frac{٤٠}{c}\cos\left(\omega\left(t - \frac{z}{c}\right)\right)$

(٢) $\vec{B} = \hat{j}\,٤٠\cos\left(\omega\left(t - \frac{z}{c}\right)\right)$

(٣) $\vec{B} = \hat{k}\frac{٤٠}{c}\cos\left(\omega\left(t - \frac{z}{c}\right)\right)$

(٤) $\vec{B} = \hat{j}\frac{٤٠}{c}\cos\left(\omega\left(t - \frac{z}{c}\right)\right)$

Ans. (٤)

Sol. $\vec{E} = \hat{i}\,٤٠\cos\left(\omega\left(t - \frac{z}{c}\right)\right)$

$\vec{E}$ is along +x direction

$\vec{v}$ is along +z direction

So direction of $\vec{B}$ will be along +y and magnitude of B will be $\frac{E}{c}$

So answer is $\frac{٤٠}{c}\cos\left(\omega\left(t - \frac{z}{c}\right)\right)\hat{j}$

٣٣. Which of the following nuclear fragments corresponding to nuclear fission between neutron $\left({}^{1}_{0}n\right)$ and uranium isotope $\left({}^{٢٣٥}_{٩٢}U\right)$ is correct :

(١) ${}^{١٤٤}_{٥٦}Ba + {}^{٨٩}_{٣٦}Kr + ٤\,{}^{1}_{0}n$

(٢) ${}^{١٤٠}_{٥٦}Xe + {}^{٩٤}_{٣٨}Sr + ٣\,{}^{1}_{0}n$

(٣) ${}^{١٥٣}_{٥١}Sb + {}^{٩٩}_{٤١}Nb + ٣\,{}^{1}_{0}n$

(٤) ${}^{١٤٤}_{٥٦}Ba + {}^{٨٩}_{٣٦}Kr + ٣\,{}^{1}_{0}n$

Ans. (٤)

Sol. Balancing mass number and atomic number

$${}^{٢٣٥}_{٩٢}U + {}^{1}_{0}n \rightarrow {}^{١٤٤}_{٥٦}Ba + {}^{٨٩}_{٣٦}Kr + ٣\,{}^{1}_{0}n$$

٣٤. In an experiment to measure focal length (f) of convex lens, the least counts of the measuring scales for the position of object (u) and for the position of image (v) are Δu and Δv, respectively. The error in the measurement of the focal length of the convex lens will be :

(١) $\frac{\Delta u}{u} + \frac{\Delta v}{v}$

(٢) $f^{2}\left[\frac{\Delta u}{u^{2}} + \frac{\Delta v}{v^{2}}\right]$

(٣) $2f\left[\frac{\Delta u}{u} + \frac{\Delta v}{v}\right]$

(٤) $f\left[\frac{\Delta u}{u} + \frac{\Delta v}{v}\right]$

Ans. (٢)

Sol. $f^{-1} = v^{-1} - u^{-1}$

$-f^{-2}\,df = -v^{-2}dv - u^{-2}du$

$$\frac{df}{f^{2}} = \frac{dv}{v^{2}} + \frac{du}{u^{2}}$$

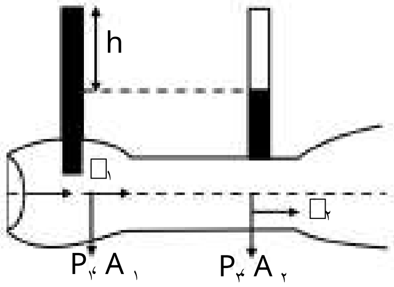
$$df = f^{2}\left[\frac{dv}{v^{2}} + \frac{du}{u^{2}}\right]$$

٣٥. Given below are two statements :

Statement I : When speed of liquid is zero everywhere, pressure difference at any two points depends on equation P١ – P٢ = □g (h٢ – h١)

Statement II : In ventury tube shown

2gh □ □2 □ □2



In the light of the above statements, choose the most appropriate answer from the options given below.

(١) Both Statement I and Statement II are correct.

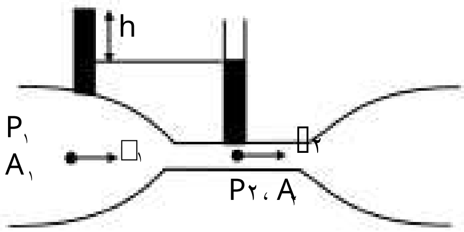
(٢) Statement I is incorrect but Statement II is correct.

(٣) Both Statement I and Statement II are incorrect.

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

Ans. (٤)

Sol.



Applying Bernoulli's equation

P١□□gh١□ ١/٢ □v١ = P٢□□gh٢□ ١/٢ □v٢

(h١ & h٢ are height of point from any reference level)

Given V١ = V٢ = ٠ (for statement-١)

□ P١ – P٢ = □g(h٢ – h٢)

For statement-٢

P1□ ١/٢ □M□P2□ ١/٢ □v٢

P١ – P٢ = □gh

P١ □P٢ □ ١/٢ □v٢ □ ١/٢ □v١

□gh□ ١/٢ □v٢□2□ ١/٢ □v١

٢gh □ v٢ □ v١

Hence answer (٤)

٣٦. The resistances of the platinum wire of a platinum resistance thermometer at the ice point and steam point are ٨□ and ١٠□ respectively. After inserting in a hot bath of temperature ٤٠٠°C, the resistance of platinum wire is :

(١) ٢□ (٢) ١٦□ (٣) ٨□ (٤) ١٠□

Ans. (٢)

Sol. Given R٠ = ٨□, R١٠٠ = ١٠□

□ R١٠٠ = R٠ (١ + □□T)

Also, R٤٠٠ = R٠ (١ + □□T)

□ ١٠ = ٨ (١ + □ × ١٠٠) □ ١٠٠□ = ١/٤

□ R٤٠٠ = ٨ (١ + ٤٠٠□) = ٨ (١ + ١) = ١٦□

Hence option (٢)

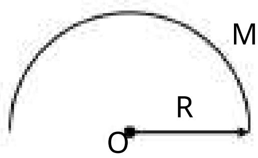
٣٧. A metal wire of uniform mass density having length L and mass M is bent to form a semicircular arc and a particle of mass m is placed at the centre of the arc. The gravitational force on the particle by the wire is :

(١) GMm□ / ٢L٢ (٢) ٠

(٣) GmM□٢ / L٢ (٤) ٢GmM□ / L٢

Ans. (٤)

Sol.



We have R □ $\frac{L}{□}$

g. □ $\frac{٢G\frac{M}{L}}{R}$ □ $\frac{٢GM□}{L٢}$

□ F m□mg٠□ $\frac{٢GMm□}{L^{٢}}$

Hence option (٤)

٣٨. On celcius scale the temperature of body increases by ٤٠°C. The increase in temperature on Fahrenheit scale is:

(١) ٧٠°F

(٢) ٦٨°F

(٣) ٧٢°F

(٤) ٧٥°F

Ans. (٣)

Sol. We know that per °C change is equivalent to ١.٨° change in °F.

□ ٤٠° change on celcius scale will corresponds to ٧٢° change on Fahrenheit scale.

Hence option (٣)

٣٩. An effective power of a combination of ٥ identical convex lenses which are kept in contact along the principal axis is ٢٥ D. Focal length of each of the convex lens is :

(١) ٢٠ cm

(٢) ٥٠ cm

(٣) ٥٠٠ cm

(٤) ٢٥ cm

Ans. (١)

Sol. We know that Peq = □Pi

□ given all lenses are identical

□ ٥P = ٢٥D

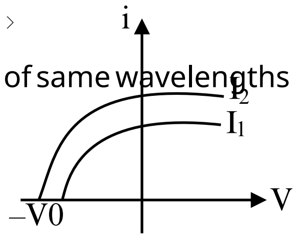
□ P = ٥D

□ $\frac{١}{f}$ 5□f□ $\frac{١}{٥}$ m□٢٠cm

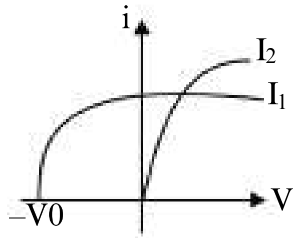
Hence option (١)

٤٠. Which figure shows the correct variation of applied potential difference (V) with photoelectric current (I) at two different intensities of light (I١ > I٢) of same wavelengths :

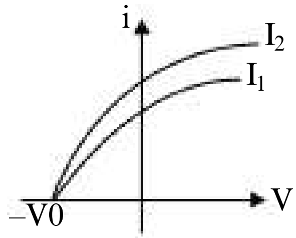
(١)



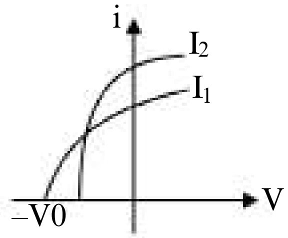
(٢)



(٣)



(٤)



Ans. (٣)

Sol. Given lights are of same wavelength.

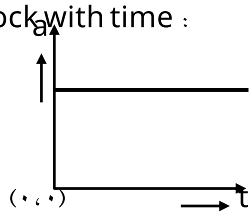
Hence stopping potential will remain same.

Since I٢ < I١, hence saturation current corresponding to I٢ will be greater than that corresponding to I١.

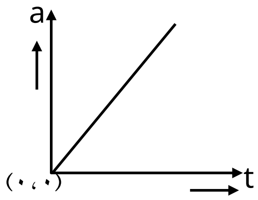
Hence option (٣)

٤١. A wooden block، initially at rest on the ground، is pushed by a force which increases linearly with time t. Which of the following curve best describes acceleration of the block with time :

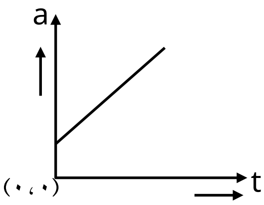
(١)



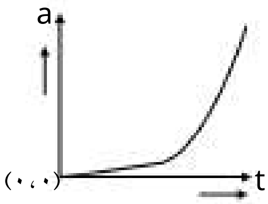
(٢)



(٣)

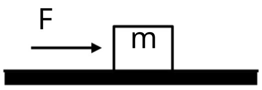


(٤)



Ans. (٢)

Sol.



$F = ma \Rightarrow a = \frac{F}{m} = \frac{k}{m}t$

a vs t will be straight line passing through origin.
Since option (٢).

٤٢. If a rubber ball falls from a height h and rebounds upto the height of h/٢. The percentage loss of total energy of the initial system as well as velocity ball before it strikes the ground، respectively، are :

(١) ٥٠٪، $\sqrt{\frac{gh}{٢}}$ (٢) ٥٠٪، $\sqrt{gh}$

(٣) ٤٠٪، $\sqrt{٢gh}$ (٤) ٥٠٪، $\sqrt{٢gh}$

Ans. (٤)

Sol. Velocity just before collision $=\sqrt{٢gh}$

Velocity just after collision $=\sqrt{٢g\left(\frac{h}{2}\right)}$

$\therefore \Delta KE = \frac{١}{٢}m(٢gh) - \frac{١}{٢}mgh$

$= \frac{١}{٢}mgh$

$\therefore$ ٪ loss in energy

$= \frac{\Delta KE}{KE_i} \times ١٠٠ = \frac{\frac{١}{٢}mgh}{\frac{١}{٢}m٢gh} \times ١٠٠ = ٥٠٪$

Hence option (٤)

٤٣. The equation of stationary wave is :

$y = ٢a \sin\left(\frac{٢\pi nt}{\lambda}\right)\cos\left(\frac{٢\pi x}{\lambda}\right)$

Which of the following is NOT correct

(١) The dimensions of nt is [L]

(٢) The dimensions of n is [LT⁻¹]

(٣) The dimensions of n/λ is [T]

(٤) The dimensions of x is [L]

Ans. (٣)

Sol. Comparing the given equation with standard

equation of standing $\frac{٢\pi n}{\lambda} = \omega$ & $\frac{٢\pi}{\lambda} = k$

$\frac{n}{\lambda} = \frac{\omega}{٢\pi} = \frac{١}{T} = [T^{-1}]$

$[nt] = [\lambda] = L$

$[n] = [\lambda\omega] = LT^{-1}$

$[x] = [\lambda] = L$

Hence option (٣)

٤٤. A body travels ١٠٢.٥ m in n^{th} second and ١١٥.٠ m in (n + ٢) th second. The acceleration is :

(١) ٩ $m/s^٢$ (٢) ٦.٢٥ $m/s^٢$

(٣) ١٢.٥ $m/s^٢$ (٤) ٥ $m/s^٢$

Ans. (٢)

Sol. Given، ١٠٢.٥ = u + $\frac{a}{٢}$ (٢n − ١) &

١١٥ = u + $\frac{a}{٢}$ (٢n + ٣)

⇒ ١٠٢.٥ = u + an − $\frac{a}{٢}$ &

١١٥ = u + an + $\frac{٣a}{٢}$

١٢.٥ = ٢a ⇒ a = ٦.٢٥ m/s ٢

Hence option (٢)

٤٥. To measure the internal resistance of a battery، potentiometer is used. For R = ١٠ Ω، the balance point is observed at ℓ = ٥٠٠ cm and for R = ١ Ω the balance point is observed at ℓ = ٤٠٠ cm. The internal resistance of the battery is approximately :

(١) ٠.٢ Ω (٢) ٠.٤ Ω

(٣) ٠.١ Ω (٤) ٠.٣ Ω

Ans. (٤)

Sol. Let potential gradient be λ.

⇒ i × ١٠ = λ × ٥٠٠ = ε − ir_s

⇒ 500λ = ε – 50λrs

Also,

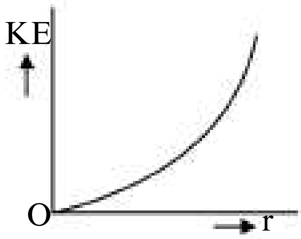
i' × 1 = λ × 400 = ε – i'rs

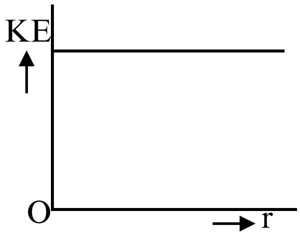
⇒ 400λ = ε – 400 λrs

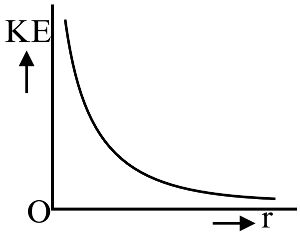
⇒ 100λ = 350λ rs ⇒ rs = $\frac{١٠}{٣٥}$ ≈ 0.3Ω

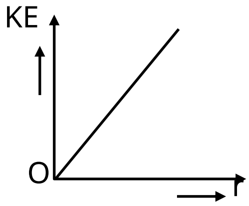
Hence option (4)

٤٦. An infinitely long positively charged straight thread has a linear charge density λ $Cm^{-١}$ An electron revolves along a circular path having axis along the length of the wire. The graph that correctly represents the variation of the kinetic energy of electron as a function of radius of circular path from the wire is :

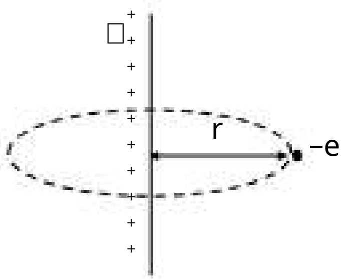
(١)


(٢)


(٣)


(٤)


Ans. (٢)

Sol.


Electric field E at a distance r due to infinite long wire is E = $\frac{٢k\lambda}{r}$

Force of electron, $F = eE$

$$F = e\left(\frac{2k\lambda}{r}\right)$$

$$F = \frac{2k\lambda e}{r}$$

This force will provide required centripetal force

$$F = \frac{mv^2}{r} = \frac{2k\lambda e}{r}$$

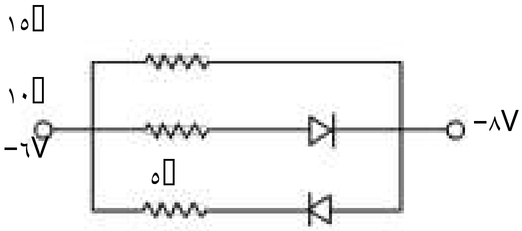
$$v = \sqrt{\frac{2k\lambda e}{m}}$$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{2k\lambda e}{m}\right)$$

$$= k\lambda e$$

This is constant so option (2) is correct.

47. The value of net resistance of the network as shown in the given figure is :

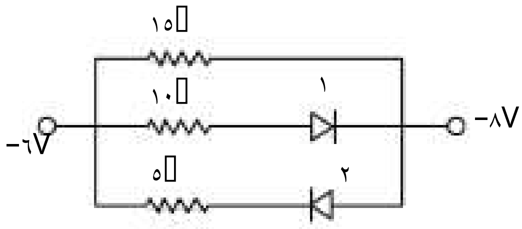


(1) $\left(\frac{5}{2}\right)\Omega$ (2) $\left(\frac{15}{4}\right)\Omega$

(3) 6 Ω (4) $\left(\frac{30}{11}\right)\Omega$

Ans. (3)

Sol.

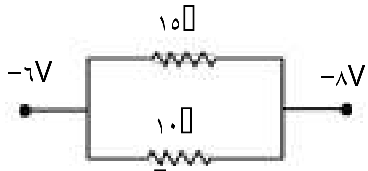


Diode 2 is in reverse bias

So current will not flow in branch of 2nd diode, So we can assume it to be broken wire.

Diode 1 is in forward bias

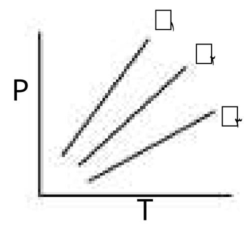
So it will behave like conducting wire. So new circuit will be



$$R_{eq} = \frac{15 \times 10}{15 + 10} = \frac{15 \times 10}{25} = 6\Omega$$

Correct answer (3)

48. P–T diagram of an ideal gas having three different densities ρ_1, ρ_2, ρ_3 (in three different cases) is shown in the figure. Which of the following is correct :



(1) $\rho_2 > \rho_3$ (2) $\rho_1 < \rho_2 < \rho_3$

(3) $\rho_1 > \rho_2$ (4) $\rho_1 = \rho_2 = \rho_3$

Ans. (2)

Sol. For ideal gas

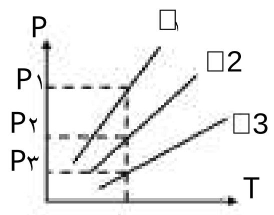
$PV = nRT$

$$PV = \frac{m}{M}RT$$

$$P = \left(\frac{m}{V}\right)\frac{RT}{M}$$

$$P = \frac{\rho RT}{M}$$

(Where m is mass of gas and M is molecular mass of gas)



for same temperature $P_1 < P_2 < P_3$

So $\rho_1 < \rho_2 < \rho_3$

So correct answer is (2)

٤٩. The co-ordinates of a particle moving in x-y plane are given by :

x = ٢ + ٤t، y = ٣t + ٨t ٢.

The motion of the particle is :

(١) non-uniformly accelerated.

(٢) uniformly accelerated having motion along a straight line.

(٣) uniform motion along a straight line.

(٤) uniformly accelerated having motion along a parabolic path.

Ans. (٤)

Sol. x = ٢ + ٤t

$\frac{dx}{dt} = v_x = ٤$

$\frac{dv_x}{dt} = a_x = ٠$

y = ٣t + ٨t ٢

$\frac{dy}{dt} = v_y = ٣ + ١٦t$

$\frac{dv_y}{dt} = a_y = ١٦$

the motion will be uniformly accelerated motion.

For path

x = ٢ + ٤t

$\frac{(x - 2)}{٤} = t$

Put this value of t is equation of y

$y = 3\left(\frac{x-2}{٤}\right) + 8\left(\frac{x-2}{٤}\right)^{٢}$

this is a quadratic equation so path will be parabola.

Correct answer (٤)

٥٠. In an ac circuit، the instantaneous current is zero، when the instantaneous voltage is maximum. In this case، the source may be connected to : A. pure inductor. B. pure capacitor. C. pure resistor. D. combination of an inductor and capacitor. Choose the correct answer from the options given below : (١) A، B and C only (٣) A and B only

(٢) B، C and D only

(٤) A، B and D only

Ans. (٤)

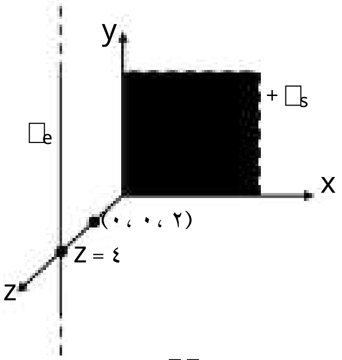
Sol. This is possible when phase difference is $\frac{\pi}{٢}$ between current and voltage so correct answer will be (٤)

SECTION-B

٥١. An infinite plane sheet of charge having uniform surface charge density +σs C/m² is placed on x-y plane. Another infinitely long line charge having uniform linear charge density +λe C/m is placed at z = ٤m plane and parallel to y-axis. If the magnitude values |σs| = ٢|λe| then at point (٠، ٠، ٢) the ratio of magnitudes of electric field values due to sheet charge to that of line charge is √n. The value of n is____________.

Ans. (١٦)

Sol.



$\frac{E_s}{E_\ell} = \frac{\sigma}{2\varepsilon_0} \times \frac{٢\pi\varepsilon_0 r}{\lambda}$

$= \frac{\sigma\pi r}{\lambda}$

$= \frac{(2)(2)(٤)}{\pi}$ ... $\frac{}{١}$

n = ١٦

٥٢. A hydrogen atom changes its state from n = ٣ to n = ٢. Due to recoil، the percentage change in the wave length of emitted light is approximately ١×١٠^{-n}. The value of n is________________.

(Given Rhc = ١٣.٦ eV، hc = ١٢٤٢ eV nm، $h = ٦.٦ \times ١٠^{-٣٤}$ J s، mass of the hydrogen atom $= ١.٦ \times ١٠^{-٢٧}$ kg)

Ans. (٧)

Sol. $\Delta E = ١٣.٦\left(\frac{1}{2^2} - \frac{١}{٣^٢}\right) = ١.٩ \text{ eV}$

$\Delta E = \frac{hc}{\lambda}$

$\Rightarrow \lambda = \frac{hc}{\Delta E}$

Pi = Pf

$٠ = mv - \frac{h}{\lambda'}$

$\Rightarrow v = \frac{h}{m\lambda'}$

$\Delta E = \frac{١}{٢} mv^٢ + \frac{hc}{\lambda'}$

$= \frac{١}{٢} m\left(\frac{h}{m\lambda'}\right)^٢ + \frac{hc}{\lambda'}$

Now

$\Delta E = \frac{h^٢}{٢m\lambda'^٢} + \frac{hc}{\lambda'}$

$\Rightarrow \lambda'^2 \Delta E - hc\lambda' - \frac{h^٢}{٢m} = ٠$

$\Rightarrow \lambda' = \frac{hc + \sqrt{h^٢c^٢ + \frac{٤\Delta E h^٢}{٢m}}}{٢\Delta E}$

$\Rightarrow \lambda' = \frac{hc + hc\sqrt{١ + \frac{٢\Delta E}{mc^٢}}}{٢\Delta E}$

$\Rightarrow \lambda' = \lambda\frac{1 + \left(1 + \frac{2\Delta E}{mc^٢}\right)^{\frac{١}{2}}}{٢} \approx \lambda\frac{1 + 1 + \frac{\Delta E}{mc^٢}}{٢}$

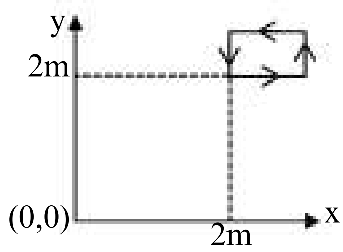
$\Rightarrow \frac{\lambda'}{\lambda} = 1 + \frac{\Delta E}{٢mc^٢}$

$\Rightarrow \frac{\lambda' - \lambda}{\lambda} = \frac{\Delta E}{٢mc^٢} = \frac{١.٩ \times ١.٦ \times ١٠^{-١٩}}{٢ \times ١.٦٧ \times ١٠^{-٢٧} \times ٩ \times ١٠^{١٦}} = ١٠^{-٩}$

$\Rightarrow$ ٪ change $= ١٠^{-٧}$

Correct answer ٧

٥٣. The magnetic field existing in a region is given by $\vec{B} = ٠.٢(١ + ٢x)\hat{k}$ T. A square loop of edge ٥٠ cm carrying ٠.٥ A current is placed in x-y plane with its edges parallel to the x-y axes، as shown in figure. The magnitude of the net magnetic force experienced by the loop is_________ mN.



Ans. (٥٠)

Sol. Force on segment parallel to x-axis will cancel each other. Hence Fnet will be due to portion parallel to y-axis.

$F = ٠.٥ \times ٠.٥ \times ٦ \times ٠.٢ - ٠.٥ \times ٠.٥ \times ٠.٢ \times ٥$

$= ٠.٥ \times ٠.٥ \times ٠.٢$

$= ٠.٢٥ \times ٠.٢$

$= ٥٠ \times ١٠^{-٣}$ N

$= ٥٠$ mN

٥٤. A alternating current at any instant is given by $i = ٦ + \sqrt{٥٦}\sin(١٠٠\pi t + \frac{\pi}{٣})$ A. The rms value of the current is_________________ A.

Ans. (٨)

Sol. $I_{rms} = \sqrt{\frac{\int i^2 dt}{\int dt}}$

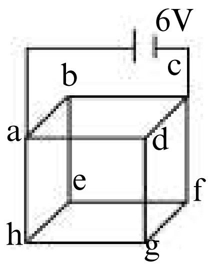
$I_{rms} = \sqrt{6^2 + \frac{(\sqrt{٥٦})^2}{٢}}$

$= \sqrt{٣٦ + ٢٨}$

$= \sqrt{٦٤}$

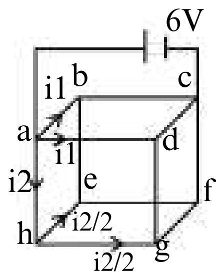
= ٨A

٥٥. Twelve wires each having resistance ٢Ω are joined to form a cube. A battery of ٦ V emf is joined across point a and c. The voltage difference between e and f is________ V.



Ans. (١)

Sol.



From symmetry, current through e-b & g-d = ٠

$\therefore R_{eq} = \frac{٣}{٤}R = \frac{٣}{٢}\Omega$

$\therefore$ Current through battery $= \frac{٦ \times ٢}{٣} = ٤$ A

$i_٢ = \frac{٤}{٨} \times ٢ = ١$ A

$\therefore \Delta V$ across e-f $= \frac{i_٢}{٢} \times R = \frac{١}{٢} \times 2 = ١$ V

٥٦. A soap bubble is blown to a diameter of ٧ cm. ٣٦٩٦٠ erg of work is done in blowing it further. If surface tension of soap solution is ٤٠ dyne/cm then the new radius is __________ cm. Take $\left(\pi = \frac{٢٢}{7}\right)$

Ans. (٧)

Sol. $W = \Delta U = S\Delta A$

$٣٦٩٦٠ \text{ erg} = \frac{٤٠ \text{ dyne}}{\text{cm}} \times ٨\pi\left[r^٢ - \left(\frac{7}{2}\right)^٢\right]\text{cm}^٢$

r = ٧ cm

٥٧. Two wavelengths $\lambda_١$ and $\lambda_٢$ are used in Young's double slit experiment $\lambda_١$ = ٤٥٠ nm and $\lambda_٢$ = ٦٥٠ nm. The minimum order of fringe produced by $\lambda_٢$ which overlaps with the fringe produced by $\lambda_١$ is n. The value of n is ______.

Ans. (٩)

Sol. $n_٢\lambda_٢ = n_١\lambda_١$

$\frac{n_٢}{n_١} = \frac{\lambda_1}{\lambda_٢} = \frac{٤٥٠}{٦٥٠} = \frac{٩}{١٣}$

$n_٢ = ٩$

٥٨. An elastic spring under tension of ٣ N has a length a. Its length is b under tension ٢ N. For its length (٣a – ٢b), the value of tension will be________ N.

Ans. (٥)

Sol. $٣ = K(a - \ell)$

$٢ = K(b - \ell)$ $T = K(٣a - ٢b - \ell)$ $T = K(٣(a - \ell) - ٢(b - \ell))$

$= K\left(3\left(\frac{3}{K}\right) - 2\left(\frac{2}{K}\right)\right)$

= ٩ – ٤

= ٥ N

٥٩. Two forces $F_١$ and $F_٢$ are acting on a body. One force has magnitude thrice that of the other force and the resultant of the two forces is equal to the force of larger magnitude. The angle between $\vec{F}_١$ and $\vec{F}_٢$ is $\cos^{-١}\left(\frac{١}{n}\right)$. The value of $|n|$ is ______.

Ans. (٦)

Sol. $|\vec{F}_١| = F$

$|\vec{F}_R| = |\vec{F}_٢| = ٣F$

$F_R^٢ = F_١^٢ + F_٢^٢ + ٢F_١F_٢\cos\theta$

$٩F^٢ = F^٢ + ٩F^٢ + ٦F^٢\cos\theta$

$\cos\theta = -\frac{١}{٦}$

$\theta = \cos^{-1}\left(-\frac{1}{6}\right)$

$n = -٦$

$|n| = ٦$

٦٠. A solid sphere and a hollow cylinder roll up without slipping on same inclined plane with same initial speed v. The sphere and the cylinder reaches upto maximum heights $h_١$ and $h_٢$, respectively, above the initial level. The ratio $h_١ : h_٢$ is $\frac{n}{١٠}$. The value of n is ________.

Ans. (٧)

Sol Gain in P.E. = Loss in K.E.

$mgh = \frac{١}{٢}mv^٢\left(1 + \frac{K^٢}{R^٢}\right)$

$h \propto \left(١ + \frac{K^٢}{R^٢}\right)$

$\frac{h_١}{h_٢} = \frac{١ + \frac{٢}{٥}}{١ + ١} = \frac{٧}{٥ \times ٢} = \frac{٧}{١٠}$

$n = ٧$

CHEMISTRY TEST PAPER WITH SOLUTION

SECTION-A

٦١. What pressure (bar) of H٢ would be required to make emf of hydrogen electrode zero in pure water at ٢٥°C ?

(١) ١٠ $^{-١٤}$ (٢) ١٠ $^{-٧}$ (٣) ١ (٤) ٠.٥

NTA Ans. (٣)

Sol. ٢e⁻ + ٢H⁺(aq) □ H٢(g)

$$E = E^{o} - \frac{0.059}{n}\log\frac{P_{H_2}}{[H^+]^2}$$

$$0 = 0 - \frac{0.059}{2}\log\frac{P_{H2}}{(10^{-7})^2}$$

$$\log\frac{P_{H2}}{(10^{-7})^2} = 0$$

$$\frac{P_{H2}}{10^{-14}} = 1$$

$$P_{H_2} = 10^{-14}\ bar$$

٦٢. The correct sequence of ligands in the order of decreasing field strength is :

(١) CO□H ٢O□F□□S٢□

(٢) OH□ □F□□NH ٣□CN□

(٣) NCS⁻< EDTA ⁴⁻ < CN < CO

(٤) S ²⁻< OH⁻ < EDTA < CO⁴⁻

Ans. (١)

Sol. According to spectrochemical series ligand field strength is CO < H٢O < F⁻< S ²⁻

٦٣. Match List -I with List II :

List - I Mechanism steps		List - II Effect
(A)	NH □ NH٢⁺ □	(I) – E effect
(B)	+H⁺ □ H +	(II) – R effect
(C)	+ CN □ CN⁻	(III) + E effect
(D)	O □ N = O □ O⁻ – N□ O +	(IV) + R effect

Choose the correct answer from the options given below :

(١) (A) – (IV), (B) – (III), (C) – (I), (D) – (II)

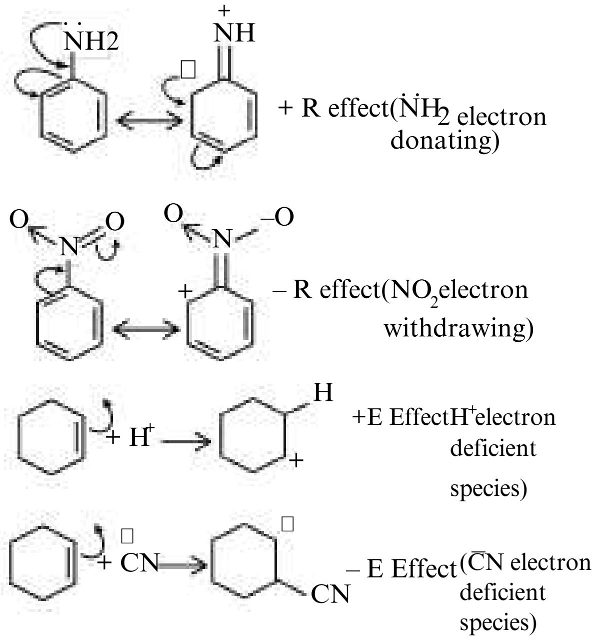
(٢) (A) – (III), (B) – (I), (C) – (II), (D) – (IV)

(٣) (A) – (II), (B) – (IV), (C) – (III), (D) – (I)

(٤) (A) – (I), (B) – (II), (C) – (IV), (D) – (III)

Ans. (١)

Sol.



٦٤. What will be the decreasing order of basic strength of the following conjugate bases ؟

^{-}OH ، $R\bar{O}$ ، $CH_3CO\bar{O}$ ، $\bar{Cl}$

(١) Cl^- < OH^- < RO^- < CH_3COO^-

(٢) RO^- < OH^- < CH_3COO^- < Cl^-

(٣) OH^- < RO^- < CH_3COO^- < Cl^-

(٤) Cl^- < RO^- < OH^- < CH_3COO^-

Ans. (٢)

Sol. Strong acid have weak conjugate base

Acidic strength :

H–Cl < CH_3COOH < H_2O < R–OH

Conjugate base strength :

Cl^- > CH_3COO^- > OH^- > RO^-

٦٥. In the precipitation of the iron group (III) in qualitative analysis، ammonium chloride is added before adding ammonium hydroxide to :

(١) prevent interference by phosphate ions

(٢) decrease concentration of OH^- ions

(٣) increase concentration of Cl^- ions

(٤) increase concentration of NH_4^+ ions

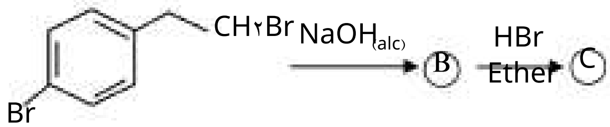
Ans. (٢)

Sol. $NH_4OH \rightleftharpoons NH_4^+ + OH^-$

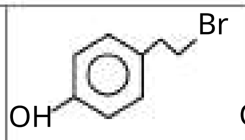
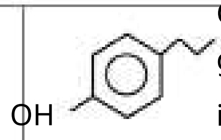
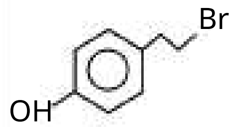
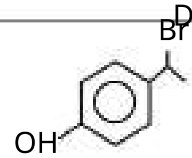
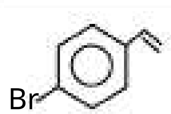
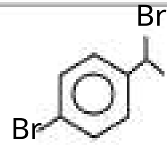
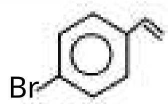
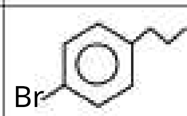
$NH_4Cl \rightarrow NH_4^+ + Cl^-$

Due to common ion effect of NH_4^+

OH^- decreases in such extent that only group-III cation can be precipitated، due to their very low Ksp in the range of ١٠^-٣٨.

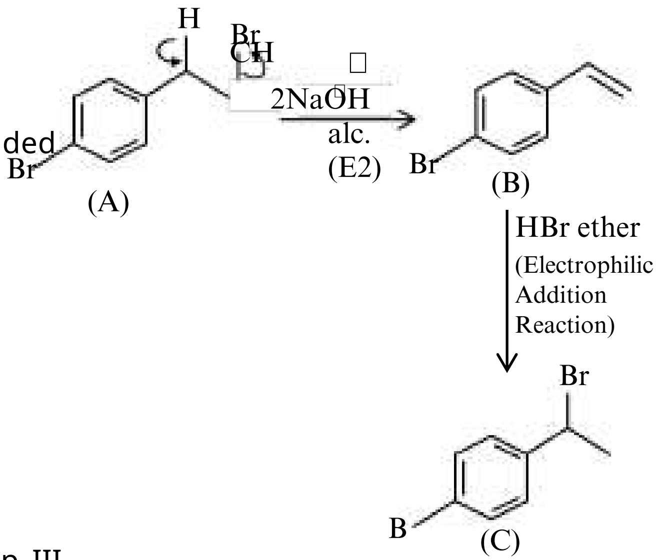
٦٦. 

Identify B and C and how are A and C related ؟

	(B)	(C)	
(١)			OH functional group isomers
(٢)			Derivative
(٣)			position isomers
(٤)			chain isomers

Ans. (٣)

Sol.



A and C are position isomer.

٦٧. One of the commonly used electrode is calomel electrode. Under which of the following categories calomel electrode comes ? (١) Metal – Insoluble Salt – Anion electrodes (٢) Oxidation – Reduction electrodes (٣) Gas – Ion electrodes (٤) Metal ion – Metal electrodes

Ans. (١)

Sol. Theory based

٦٨. Number of complexes from the following with even number of unpaired "d" electrons is______.

[V(H٢O)٦]٣+, [Cr(H٢O)٦]٢+, [Fe(H٢O)٦]٣+, [Ni(H٢O)٦]٣+, [Cu(H٢O)٦]٢+

[Given atomic numbers : V = ٢٣, Cr = ٢٤, Fe = ٢٦, Ni = ٢٨, Cu = ٢٩]

(١) ٢ (٢) ٤

(٣) ٥ (٤) ١

Ans. (١)

Sol. [V(H٢O)٦]٣+ ⇒ d٢sp٣

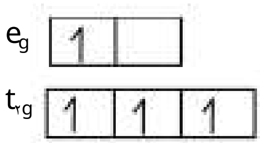
٢٣V :- [Ar]٣d٣٤s٢

V٣+ :- [Ar]٣d٢, n = ٢ (even number of unpaired e⁻)

[Cr(H٢O)٦]٢+ ⇒ sp٣d٢

٢٤Cr :- [Ar]٣d٥٤s١

Cr٢+ :- [Ar]٣d٤, n = ٤ (even number of unpaired e⁻)



[Fe(H٢O)٦]٣+ ⇒ sp٣d٢

Fe٣+ :- [Ar]٣d٥٤s٠

n = ٥ (odd number of unpaired e⁻)

[Ni(H٢O)٦]٣+ ⇒ sp٣d٢

Ni :- [Ar]٣d٨٤s٢

Ni٣+ :- [Ar]٣d٧, n = ٣ (odd number of unpaired e⁻)

[Cu(H٢O)٦]٢+ ⇒ sp٣d٢

Cu :- [Ar]٣d١٠٤s١

n = ١ (odd number of unpaired e⁻)

٦٩. Which one of the following molecules has maximum dipole moment ?

(١) NF٣ (٢) CH٤

(٣) NH٣ (٤) PF٥

Ans. (٣)

Sol. CH٤ & PF٥, μnet = ٠ (non polar)

μ_{NH_3} > μ_{NF_3}

Vector addition of bond moment & lone pair moment — Vector subtraction of bond moment & lone pair moment

٧٠. Number of molecules/ions from the following in which the central atom is involved in sp٣ hybridization is __________.

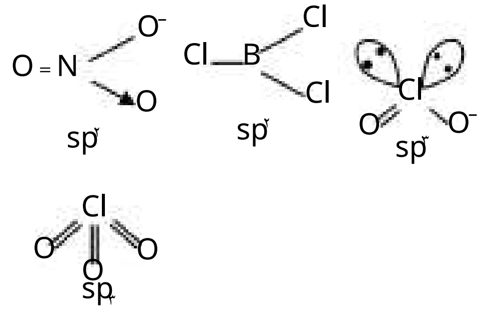
NO٣⁻, BCl٣, ClO٢⁻, ClO٣

(١) ٢ (٢) ٤

(٣) ٣ (٤) ١

Ans. (١)

Sol.



٧١. Which among the following is incorrect statement?

(١) Electromeric effect dominates over inductive effect

(٢) The electromeric effect is, temporary effect

(٣) The organic compound shows electromeric effect in the presence of the reagent only

(٤) Hydrogen ion (H⁺) shows negative electromeric effect

Ans. (٤)

Sol. Hydrogen ion (H⁺) shows positive electromeric effect.

٧٢. Given below are two statements :

Statement I : Acidity of □-hydrogens of aldehydes and ketones is responsible for Aldol reaction.

Statement II : Reaction between benzaldehyde and ethanal will NOT give Cross – Aldol product.

In the light of above statements, choose the most appropriate answer from the options given below.

(١) Both Statement I and Statement II are correct.

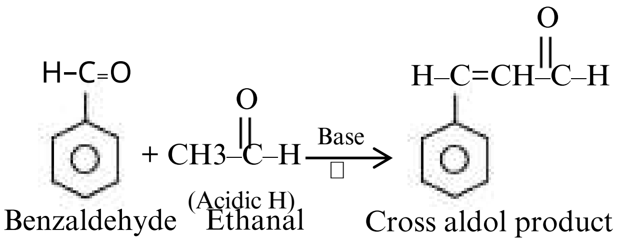
(٢) Both Statement I and Statement II are incorrect.

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

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

Ans. (٤)

Sol. Aldehyde and ketones having acidic □-hydrogen show aldol reaction



٧٣. Which of the following nitrogen containing compound does not give Lassaigne's test ?

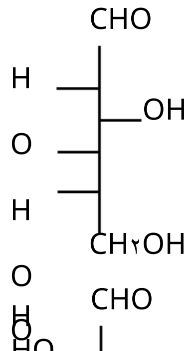
(١) Phenyl hydrazine (٢) Glycene

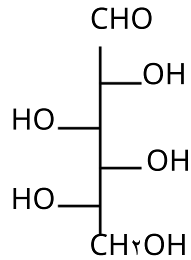
(٣) Urea (٤) Hydrazine

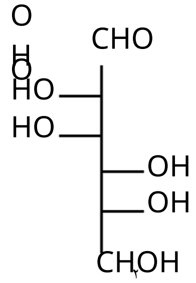
Ans. (٤)

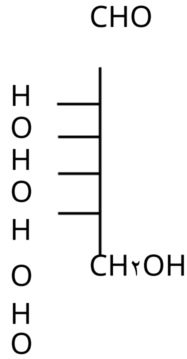
Sol. Hydrazine (NH٢–NH٢) have no carbon so does not show Lassaigne's test.

٧٤. Which of the following is the correct structure of L-Glucose ?

(١) 

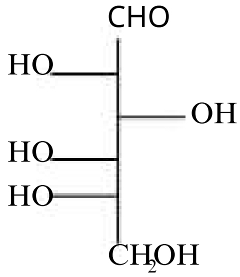
(٢) 

(٣) 

(٤) 

Ans. (١)

Sol. Structure of L-Glucose is



٧٥. The element which shows only one oxidation state other than its elemental form is :

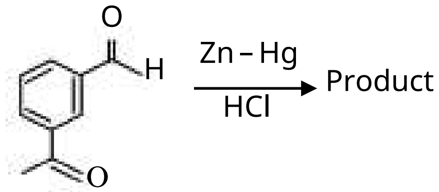
(١) Cobalt (٢) Scandium

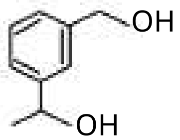
(٣) Titanium (٤) Nickel

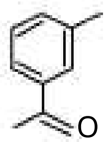
Ans. (٢)

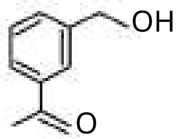
Sol. Co, Ti, Ni can show +٢, +٣ and +٤ oxidation state, But 'Sc' only shows +٣ stable oxidation state.

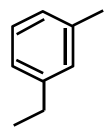
٧٦. Identify the product in the following reaction :



(١) 

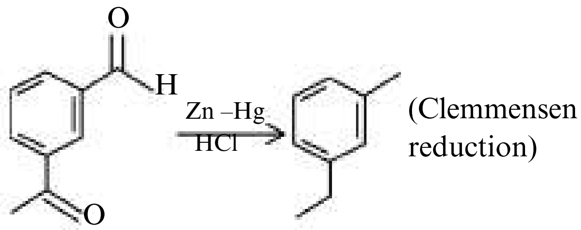
(٢) 

(٣) 

(٤) 

Ans. (٤)

Sol.



٧٧. Number of elements from the following that CANNOT form compounds with valencies which match with their respective group valencies is ________.

B، C، N، S، O، F، P، Al، Si

(١) ٧ (٢) ٥ (٣) ٦ (٤) ٣

Ans. (٤)

Sol. N،O، F can't extend their valencies upto their group number due to the non-availability of vacant ٢d like orbital.

٧٨. The Molarity (M) of an aqueous solution containing ٥.٨٥ g of NaCl in ٥٠٠ mL water is : (Given : Molar Mass Na : ٢٣ and Cl : ٣٥.٥ gmol⁻١)

(١) ٢٠ (٢) ٠.٢

(٣) ٢ (٤) ٤

Ans. (٢)

Sol. $M = \frac{n_{NaCl}}{V_{sol}\text{(in L)}}$

$M = \frac{5.85/58.5}{0.5} = 0.2M$

٧٩. Identify the correct set of reagents or reaction conditions 'X' and 'Y' in the following set of transformation.

CH٣ – CH٢ – CH٢ – Br $\xrightarrow{\text{'X'}}$ Product $\xrightarrow{\text{'Y'}}$ CH٣ – CH(Br) – CH٣

(١) X = conc.alc. NaOH، ٨٠°C، Y = Br٢ /CHCl٣

(٢) X = dil.aq. NaOH، ٢٠°C، Y = HBr /acetic acid

(٣) X = conc.alc. NaOH، ٨٠°C، Y = HBr /acetic acid

(٤) X = dil.aq. NaOH، ٢٠°C، Y = Br٢ /CHCl٣

Ans. (٣)

Sol. CH٣–CH٢–CH٢–Br $\xrightarrow[\text{٨٠oC}]{\text{X (conc. alc. NaOH)}}$

CH٣–CH=CH٢ $\xrightarrow{\text{Y (HBr / Acetic acid)}}$ CH٣–CHBr – CH٣

٨٠. The correct order of first ionization enthalpy values of the following elements is :

(A) O (C) Be (E) B (B) N (D) F

Choose the correct answer from the options given below :

(١) B > D > C > E > A

(٢) E > C > A > B > D

(٣) C > E > A > B > D

(٤) A > B > D > C > E

Ans. (٢)

Sol. Correct order of Ist IE

Li > B > Be > C > O > N > F > Ne

E > C > A > B > D

SECTION-B

٨١. The enthalpy of formation of ethane (C٢H٦) from ethylene by addition of hydrogen where the bond-energies of C – H، C – C، H – H are ٤١٤ kJ، ٣٤٧ kJ، ٦١٥ kJ and ٤٣٥ kJ respectively is – ______________

Ans. (١٢٥)

Sol. C٢H٤(g) + H٢(g) → C٢H٦(g)

ΔH = BE(C = C) + ٤BE (C – H) + BE (H – H)

– BE(C – C) – ٦BE (C – H)

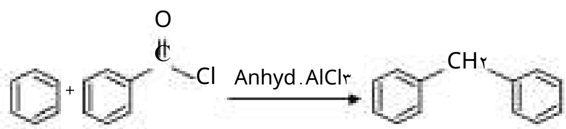
ΔH = BE(C = C) + BE(H – H) – BE(C – C)

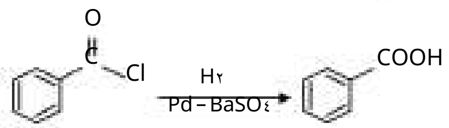
– ٢BE(C – H)

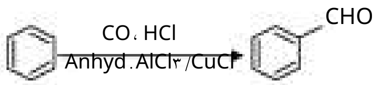
= ٦١٥ + ٤٣٥ – ٣٤٧ – ٢ × ٤١٤

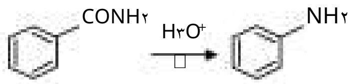
= – ١٢٥ kJ

٨٢. The number of correct reaction(s) among the following is ___________.

(A) 

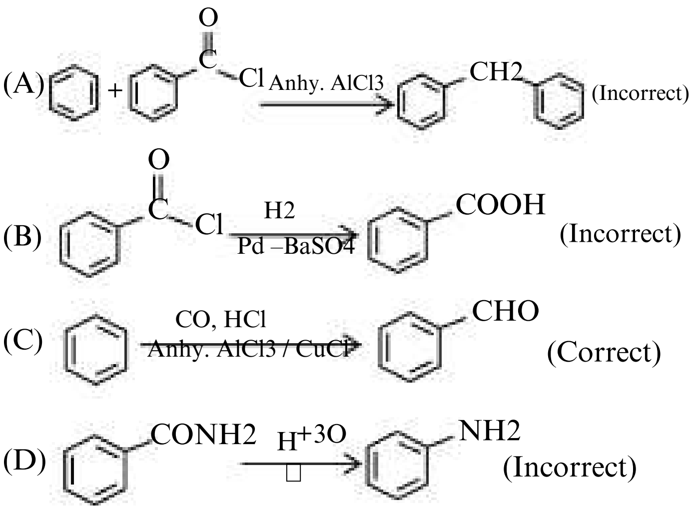
(B) 

(C) 

(D) 

Ans. (١)

Sol.



٨٣. X g of ethylamine is subjected to reaction with NaNO٢ /HCl followed by water؛ evolved dinitrogen gas which occupied ٢.٢٤ L volume at STP.

X is ___________ × ١٠⁻¹ g.

Ans. (٤٥)

Sol.

$CH_3CH_2NH_2 \xrightarrow{NaNO_2/HCl,\ H_2O} CH_3CH_2-OH + N_2$

Mol.wt.٤٥g ١٤g

given : N٢ evolved is ٢.٢٤ L i.e. ٠.١ mole.

i.e. CH٣CH٢NH٢ (ethyl amine) will be ٤.٥ g (=٠.١ mole)

Hence the answer = ٤٥ × ١٠⁻¹ g

٨٤. The de-Broglie's wavelength of an electron in the ٤th orbit is ____________ πa٠. (a٠ = Bohr's radius)

Ans. (٨)

Sol. ٢πrn = nλd

$2\pi a_0 \frac{n^2}{Z} = n\lambda d$

$2\pi a_0 \frac{4^2}{1} = 4\lambda_d$

$\lambda d = 8\pi a_0$

٨٥. Only ٢ mL of KMnO٤ solution of unknown molarity is required to reach the end point of a titration of ٢٠ mL of oxalic acid (٢ M) in acidic medium. The molarity of KMnO٤ solution should be ____________ M.

NTA Ans. (٥٠)

Sol. eq.(KMnO٤) = eq.(H٢C٢O٤)

M × ٢ × ٥ = ٢ × ٢٠ × ٢

M = 8M

٨٦. Consider the following reaction MnO٢ + KOH + O٢ → A + H٢O.

Product 'A' in neutral or acidic medium disproportionate to give products 'B' and 'C' along with water. The sum of spin-only magnetic moment values of B and C is ______________ BM.

(nearest integer)

(Given atomic number of Mn is ٢٥)

Ans. (٤)

Sol. MnO٢ + KOH + O٢ → K٢MnO٤ + H٢O

(A)

K٢MnO٤ $\xrightarrow{\text{Neutral/acidic solution}}$ KMnO٤ + MnO٢

Mn⁺⁴ – [Ar]٣d

n = ٣، μ = √(٣(٣+٢)) = ٣.٨٧ B.M.

Nearest integer is (٤)

٨٧. Consider the following transformation involving first order elementary reaction in each step at constant temperature as shown below. $A + B \underset{\text{Step ٣}}{\overset{\text{Step ١}}{\rightleftharpoons}} C \xrightarrow{\text{Step ٢}} P$

Some details of the above reaction are listed below.

Step	Rate constant (sec⁻¹)	Activation energy (kJ mol⁻¹)
١	k١	٣٠٠
٢	k٢	٢٠٠
٣	k٣	Ea٣

If the overall rate constant of the above transformation (k) is given as $k = \frac{k_١ k_٢}{k_٣}$ and the overall activation energy (Ea) is ٤٠٠ kJ mol⁻¹, then the value of Ea٣ is __________ kJ mol⁻¹ (nearest integer)

Ans. (١٠٠)

Sol. $K = \frac{K_1 K_2}{K_3}$

$$Ae^{\frac{-E_a}{RT}} = \frac{A_1 e^{\frac{-Ea_1}{RT}} A_2 e^{\frac{-Ea_2}{RT}}}{A_3 e^{\frac{-E_{a3}}{RT}}}$$

$$Ae^{\frac{-E}{RT}} = \frac{A_1 A_2}{A_3} e^{\frac{-(Ea_1 + E_{a2} - E_{a3})}{RT}}$$

$$Ea = Ea_1 + Ea_2 - E_{a3}$$

٤٠٠ = ٣٠٠ + ٢٠٠ − E_{a_3}

Ea_3 = ١٠٠ kJ/mole

٨٨. ٢.٥ g of a non-volatile, non-electrolyte is dissolved in ١٠٠ g of water at ٢٥°C. The solution showed a boiling point elevation by ٢°C. Assuming the solute concentration in negligible with respect to the solvent concentration, the vapour pressure of the resulting aqueous solution is ___________ mm of Hg (nearest integer)

[Given : Molal boiling point elevation constant of water (Kb) = ٠.٥٢ K. kg mol⁻¹,
١ atm pressure = ٧٦٠ mm of Hg, molar mass of water = ١٨ g mol⁻¹]

Ans. (٧٠٧)

Sol. ٢ = ٠.٥٢ × m

$$m = \frac{2}{0.52}$$

According to question, solution is much diluted

so $\frac{\Delta P}{P^o} = \frac{n_{solute}}{n_{solvent}}$

$$\frac{\Delta P}{P^o} = \frac{m}{1000} \times M_{solvent}$$

$$\Delta P = P^o \times \frac{m}{1000} \times M^{solvent}$$

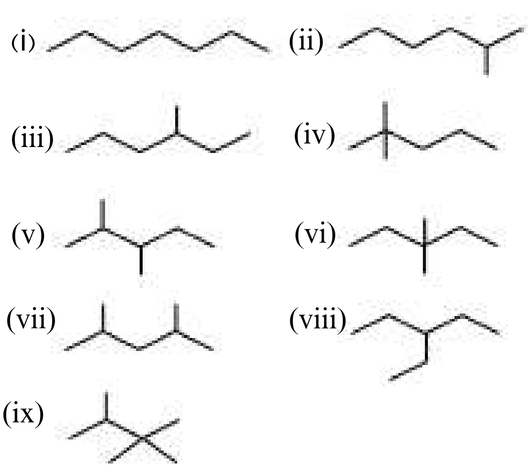
$$= 760 \times \frac{\frac{2}{0.52}}{1000} \times 18 = ٥٢.٦١٥$$

P٥ = ٧٦٠ − ٥٢.٦١٥ = ٧٠٧.٣٨٥ mm of Hg

٨٩. The number of different chain isomers for C٧H١٦ is ________________.

Ans. (٩)

Sol.



٩٠. Number of molecules/species from the following having one unpaired electron is ____________.

$O_٢$, $O_٢^-$, NO, CN^-, $O_٢^{2-}$

Ans. (٢)

Sol. According to M.O.T.

O٢ → no. of unpaired electrons = ٢

O٢⁻ → no. of unpaired electron = ١

NO → no. of unpaired electron = ١

CN⁻ → no. of unpaired electron = ٠

O٢²⁻ → no. of unpaired electron = ٠