FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Monday 08 April, 2024) TIME : 3 : 00 PM to 6 : 00 PM

MATHEMATICS

TEST PAPER WITH SOLUTION

SECTION-A

١. If the image of the point (-٤, ٥) in the line $x + ٢y = ٢$ lies on the circle $(x + ٤)^٢ + (y - ٣)^٢ = r^٢$, then r is equal to :

(١) ١ (٢) ٢

(٣) ٧٥ (٤) ٣

Ans. (٢)

Sol. Image of point (-٤, ٥)

$$\frac{x - x_١}{a} = \frac{y - y_١}{b} = -٢\left(\frac{ax_١ + by_١ + c}{a^٢ + b^٢}\right)$$

Line : $x + ٢y - ٢ = ٠$

$$\frac{x + ٤}{١} = \frac{y - ٥}{٢} = -2\left(\frac{-4 + 10 - ٢}{١^٢ + ٢^٢}\right)$$

$$= \frac{-8}{٥}$$

$$x = -٤ - \frac{٨}{٥} = -\frac{٢٨}{٥}$$

$$y = -\frac{١٦}{٥} + 5 = \frac{٩}{٥}$$

Point lies on circle $(x + ٤)^٢ + (y - ٣)^٢ = r^٢$

$$\frac{٦٤}{٢٥} + \left(\frac{٩}{٥} - 3\right)^٢ = r^٢$$

$$\frac{١٠٠}{٢٥} = r^٢, \boxed{r = ٢}$$

٢. Let $\vec{a} = \hat{i} + ٢\hat{j} + ٣\hat{k}$, $\vec{b} = ٢\hat{i} + ٣\hat{j} - ٥\hat{k}$ and $\vec{c} = ٣\hat{i} - \hat{j} + \lambda\hat{k}$ be three vectors. Let $\vec{r}$ be a unit vector along $\vec{b} + \vec{c}$. If $\vec{r}.\vec{a} = ٣$, then ٣λ is equal to :

(١) ٢٧ (٢) ٢٥

(٣) ٢٥ (٤) ٢١

Ans. (٢)

Sol. $\vec{r} = k(\vec{b} + \vec{c})$

$\vec{r}.\vec{a} = ٣$

$\vec{r}.\vec{a} = k(\vec{b}.\vec{a} + \vec{c}.\vec{a})$

$٣ = k(٢ + ٦ - ١٥ + ٣ - ٢ + ٣\lambda)$

$٣ = k(-٦ + ٣\lambda)$ ...(١)

$\vec{r} = k(٥\hat{i} + ٢\hat{j} + (\lambda - ٥)\hat{k})$

$|\vec{r}| = k\sqrt{٢٥ + ٤ + ٢٥ + \lambda^2 - 10\lambda} = 1$ ...(٢)

$k = \frac{٣}{-٦ + ٣\lambda} = \frac{١}{\lambda - ٢}$ put in (٢)

$٤ + \lambda^2 - ٤\lambda = ٥٤ + \lambda^٢ - ١٠\lambda$

$٦\lambda = ٥٠$

$٣\lambda = ٢٥$

٣. If $\alpha \neq a$, $\beta \neq b$, $\gamma \neq c$ and $\begin{vmatrix} \alpha & b & c \\ a & \beta & c \\ a & b & \gamma \end{vmatrix} = ٠$, then $\frac{a}{\alpha - a} + \frac{b}{\beta - b} + \frac{\gamma}{\gamma - c}$ is equal to :

(١) ٢ (٢) ٣

(٣) ٠ (٤) ١

Ans. (٣)

Sol. $R_١ \to R_١ - R_٢$, $R_٢ \to R_٢ - R_٣$

$$\begin{vmatrix} \alpha - a & b - \beta & ٠ \\ ٠ & \beta - b & c - \gamma \\ a & b & \gamma \end{vmatrix} = 0$$

$(\alpha - a)(\gamma(\beta - b) - b(c - \gamma)) - (b - \beta)(-a(c - \gamma)) = ٠$

$\gamma(\alpha - a)(\beta - b) - b(\alpha - a)(c - \gamma) + a(b - \beta)(c - \gamma)$

$$\frac{\gamma}{\gamma - c} + \frac{b}{\beta - b} + \frac{a}{\alpha - a} = ٠$$

٤. In an increasing geometric progression of positive terms، the sum of the second and sixth terms is $\frac{٧٠}{٣}$ and the product of the third and fifth terms is ٤٩. Then the sum of the ٤th، ٦th and ٨th terms is :–

(١) ٩٦ (٢) ٧٨

(٣) ٩١ (٤) ٨٤

Ans. (٣)

Sol. $T_٢ + T_٦ = \frac{٧٠}{٣}$

$ar + ar^٥ = \frac{٧٠}{٣}$

$T_٣ . T_٥ = ٤٩$

$ar^٢ . ar^٤ = ٤٩$

$a^٢r^٦ = ٤٩$

$ar^٣ = +٧$، $a = \frac{٧}{r^٣}$

$ar(١ + r^٤) = \frac{٧٠}{٣}$

$\frac{٧}{r^٢}(١ + r^٤) = \frac{٧٠}{٣}$، $r^٢ = t$

$\frac{١}{t}(١ + t^٢) = \frac{١٠}{٣}$

$٣t^٢ - ١٠t + ٣ = ٠$

$t = ٣، \frac{١}{٣}$

Increasing G.P. $r^٢ = ٣$، $r = \sqrt{٣}$

$T_٤ + T_٦ + T_٨$

$= ar^٣ + ar^٥ + ar^٧$

$= ar^٣(١ + r^٢ + r^٤)$

$= ٧(١ + ٣ + ٩) = ٩١$

٥. The number of ways five alphabets can be chosen from the alphabets of the word MATHEMATICS، where the chosen alphabets are not necessarily distinct، is equal to :

(١) ١٧٥ (٢) ١٨١

(٣) ١٧٧ (٤) ١٧٩

Ans. (٤)

Sol. AA، MM، TT، H، I، C، S، E

(١) All distinct

$^٨C_٥ = ٥٦$

(٢) ٢ same، ٣ different

$^٣C_١ \times {}^٧C_٣ = ١٠٥$

(٣) ٢ same I[st] kind، ٢ same ٢[nd] kind، ١ different

$^٣C_٢ \times {}^٦C_١ = ١٨$

Total = ١٧٩

٦. The sum of all possible values of $\theta \in [-\pi, ٢\pi]$، for which $\frac{١ + i\cos\theta}{١ - ٢i\cos\theta}$ is purely imaginary، is equal to

(١) ٢π (٢) ٣π

(٣) ٥π (٤) ٤π

Ans. (٢)

Sol. $Z = \frac{١ + i\cos\theta}{١ - ٢i\cos\theta}$

$Z + \bar{Z} = ٠ \Rightarrow \frac{١ + i\cos\theta}{١ - ٢i\cos\theta} + \overline{\left(\frac{١ + i\cos\theta}{١ - ٢i\cos\theta}\right)} = ٠$

$(١ + i\cos\theta)(١ + ٢i\cos\theta) = -(١ - ٢i\cos\theta)(١ - i\cos\theta)$

$(١ + i\cos\theta)(١ + ٢i\cos\theta) = -(١ - ٢i\cos\theta)(١ - i\cos\theta)$

$١ + ٣i\cos\theta - ٢\cos^٢\theta = -(١ - ٣i\cos\theta - ٢\cos^٢\theta)$

$٢ - ٤\cos^٢\theta = ٠$

$\Rightarrow \cos^٢\theta = \frac{1}{٢} \Rightarrow \theta = \frac{\pi}{٤}، \frac{٣\pi}{٤}، \frac{٥\pi}{٤}، \frac{٧\pi}{٤}، -\frac{\pi}{٤}، -\frac{٣\pi}{٤}$

sum = ٣π

٧. If the system of equations $x + ٤y - z = \lambda$، $٧x + ٩y + \mu z = -٣$، $٥x + y + ٢z = -١$ has infinitely many solutions، then $(٢\mu + ٣\lambda)$ is equal to :

(١) ٢ (٢) −٣

(٣) ٣ (٤) −٢

Ans. (٢)

Sol. $\Delta = \begin{vmatrix} ١ & ٤ & -1 \\ 7 & ٩ & \mu \\ ٥ & ١ & ٢ \end{vmatrix} = 0$

$\Rightarrow (١٨ - \mu) - ٤(١٤ - ٥\mu) - (٧ - ٤٥) = ٠ \Rightarrow \mu = ٠$

$\Delta = \Delta x = \Delta y = \Delta z = ٠$ (For infinite solution)

$\Delta_x = \begin{vmatrix} \lambda & ٤ & -1 \\ -3 & ٩ & \mu \\ -1 & ١ & ٢ \end{vmatrix} = ٠$

$\Rightarrow \lambda(١٨ - \mu) - ٤(-٦ + \mu) - ١(-٣ + ٩) = ٠$

$١٨\lambda + ٢٤ - ٦ = ٠ \Rightarrow \lambda = -١$

٨. If the shortest distance between the lines $\frac{x-\lambda}{٢} = \frac{y-٤}{٣} = \frac{z-٣}{٤}$ and $\frac{x-٢}{٤} = \frac{y-٤}{٦} = \frac{z-٧}{٨}$ is $\frac{١٣}{\sqrt{٢٩}}$, then a value of λ is :

(١) $-\frac{١٣}{٢٥}$ (٢) $\frac{١٣}{٢٥}$

(٣) ١ (٤) −١

Ans. (٣)

Sol. $\vec{r}_1 = (\lambda\hat{i} + ٤\hat{j} + ٣\hat{k}) + \lambda(٢\hat{i} + ٣\hat{j} + ٤\hat{k})$, $\vec{b} = ٢\hat{i} + ٣\hat{j} + ٤\hat{k}$

$\vec{r}_2 = (٢\hat{i} + ٤\hat{j} + ٧\hat{k}) + \mu(٢\hat{i} + ٣\hat{j} + ٤\hat{k})$, $\vec{a}_2 - \vec{a}_1 = (٢-\lambda)\hat{i} + ٤\hat{k}$

Shortest dist $= \left|\frac{\vec{b} \times (\vec{a}_2 - \vec{a}_1)}{|\vec{b}|}\right| = \frac{١٣}{\sqrt{٢٩}}$

$\frac{|(٢\hat{i} + ٣\hat{j} + ٤\hat{k}) \times ((٢-\lambda)\hat{i} + ٤\hat{k})|}{\sqrt{٢٩}} = \frac{١٣}{\sqrt{٢٩}}$

$|-٨\hat{j} - ٣(٢-\lambda)\hat{k} + ١٢\hat{i} + ٤(٢-\lambda)\hat{j}| = ١٣$

$|١٢\hat{i} - ٤\lambda\hat{j} + (٣\lambda - ٦)\hat{k}| = ١٣$

$١٤٤ + ١٦\lambda^2 + (٣\lambda - ٦)^2 = ١٦٩$

$١٦\lambda^2 + (٣\lambda - ٦)^2 = ٢٥ \Rightarrow \lambda = ١$

٩. If the value of $\frac{٣\cos ٣٦° + ٥\sin ١٨°}{٥\cos ٣٦° - ٣\sin ١٨°}$ is $\frac{a\sqrt{٥} - b}{c}$, where a, b, c are natural numbers and gcd(a, c) = ١, then a + b + c is equal to :

(١) ٥٠ (٢) ٤٠

(٣) ٥٢ (٤) ٥٤

Ans. (٣)

Sol. $\frac{٣\left(\frac{\sqrt{٥}+1}{٤}\right) + ٥\left(\frac{\sqrt{٥}-١}{٤}\right)}{٥\left(\frac{\sqrt{٥}+١}{٤}\right) - 3\left(\frac{\sqrt{٥}-١}{٤}\right)} = \frac{٨\sqrt{٥} - ٢}{٢\sqrt{٥} + ٨}$

$= \frac{٤\sqrt{٥} - ١}{\sqrt{٥} + ٤} \times \frac{\sqrt{٥} - ٤}{\sqrt{٥} - ٤}$

$= \frac{٢٠ - ١٦\sqrt{٥} - \sqrt{٥} + ٤}{-١١}$

$= \frac{١٧\sqrt{٥} - ٢٤}{١١} \Rightarrow a = ١٧, b = ٢٧, c = ١١$

a + b + c = ٥٢

١٠. Let y = y(x) be the solution curve of the differential equation $\sec y \frac{dy}{dx} + ٢x\sin y = x^{٣}\cos y$, $y(١) = ٠$. Then $y(\sqrt{٣})$ is equal to :

(١) $\frac{\pi}{٣}$ (٢) $\frac{\pi}{٦}$

(٣) $\frac{\pi}{٤}$ (٤) $\frac{\pi}{١٢}$

Ans. (٣)

Sol. $\sec y \frac{dy}{dx} + ٢x\sin y \sec y = x^{٣}\cos y \sec y$

$\sec^{٢} y \frac{dy}{dx} + ٢x\tan y = x^{٣}$

$\tan y = t \Rightarrow \sec^{٢} y \frac{dy}{dx} = \frac{dt}{dx}$

$\frac{dt}{dx} + ٢xt = x^{٣}$, I.F. $e^{\int ٢x\,dx} = e^{x^{٢}}$

$te^{x^{٢}} = \int x^{٣} \cdot e^{x^{٢}} dx + c$

$x^{٢} = Z \Rightarrow t \cdot e^{Z} = \frac{١}{٢}\int e^{Z} \cdot Z\,dZ = \frac{١}{٢}(Ze^{Z} - e^{Z}) + c$

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

$y(١) = ٠ \Rightarrow c = ٠ \Rightarrow y(\sqrt{٣}) = \frac{\pi}{٤}$

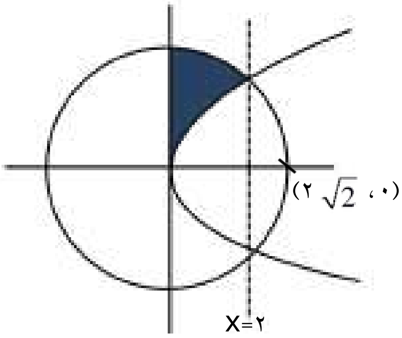
١١. The area of the region in the first quadrant inside the circle $x^{٢} + y^{٢} = ٨$ and outside the pnrabola $y^{٢} = ٢x$ is equal to :

(١) $\frac{\pi}{٢} - \frac{١}{٣}$ (٢) $\pi - \frac{٢}{٣}$

(٣) $\frac{\pi}{٢} - \frac{٢}{٣}$ (٤) $\pi - \frac{١}{٣}$

Ans. (٢)

Sol.



Required area = Ar(circle from ٠ to ٢) − ar(para from ٠ to ٢)

$= \int_{0}^{2}\sqrt{8-x^2}\,dx - \int_{0}^{2}\sqrt{2x}\,dx$

$= \left[\frac{x}{2}\sqrt{8-x^2} + \frac{8}{2}\sin^{-1}\frac{x}{2\sqrt{2}}\right]_0^2 - \sqrt{2}\left[\frac{x\sqrt{x}}{3/2}\right]_0^2$

$= \frac{2}{2}\sqrt{8-4} + \frac{8}{2}\sin^{-1}\frac{2}{2\sqrt{2}} - \frac{2\sqrt{2}}{3}\sqrt{2}\,2 - 0$

$= 2 + 4\cdot\frac{\pi}{4} - \frac{8}{3} = \pi - \frac{2}{3}$

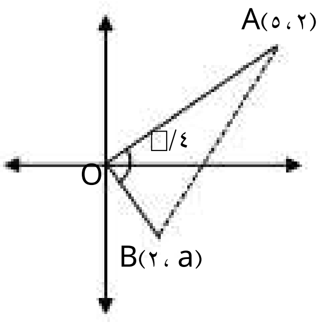
١٢. If the line segment joining the points (٥، ٢) and (٢، a) subtends an angle $\frac{\pi}{4}$ at the origin، then the absolute value of the product of all possible values of a is :

(١) ٦ (٢) ٨

(٣) ٢ (٤) ٤

Ans. (٤)

Sol.



$m_{OA} = \frac{2}{5}$

$m_{OB} = \frac{a}{2}$

$\tan\frac{\pi}{4} = \left|\frac{\frac{2}{5} - \frac{a}{2}}{1 + \frac{2}{5}\cdot\frac{a}{2}}\right|$

$1 = \left|\frac{4 - 5a}{10 + 2a}\right|$

٤ − ٥a = ±(١٠ + ٢a)

٤ − ٥a = ١٠ + ٢a ; ٤ − ٥a = −١٠ − ٢a

⇒ ٧a + ٦ = ٠ ; ٣a = ١٤

⇒ $a = -\frac{6}{7}$; $a = \frac{14}{3}$

$\Rightarrow \frac{14}{3} \times \frac{-6}{7} = -4$ ⇒ 4

١٣. Let $\vec{a} = 4\hat{i} + \hat{j} - \hat{k}$، $\vec{b} = 11\hat{i} - \hat{j} + \hat{k}$ and $\vec{c}$ be a vector such that

$(\vec{a} + \vec{b}) \times \vec{c} = \vec{c} \times (-2\vec{a} + 3\vec{b})$.

If $(2\vec{a} + 3\vec{b}) \cdot \vec{c} = 1670$، then $|\vec{c}|^2$ is equal to :

(١) ١٦٢٧ (٢) ١٦١٨

(٣) ١٦٠٠ (٤) ١٦٠٩

Ans. (٢)

Sol. $(\vec{a} + \vec{b}) \times \vec{c} - \vec{c} \times (-2\vec{a} + 3\vec{b}) = 0$

$(\vec{a} + \vec{b}) \times \vec{c} + (-2\vec{a} + 3\vec{b}) \times \vec{c} = 0$

$\Rightarrow (\vec{a} + \vec{b} - 2\vec{a} + 3\vec{b}) \times \vec{c} = 0$

$\Rightarrow \vec{c} = \lambda(4\vec{b} - \vec{a})$

$= \lambda(44\hat{i} - 4\hat{j} + 4\hat{k} - 4\hat{i} - \hat{j} + \hat{k})$

$= \lambda(40\hat{i} - 3\hat{j} + 3\hat{k})$

Now

$(8\hat{i} + 2\hat{j} - 2\hat{k} + 33\hat{i} - 3\hat{j} + 3\hat{k}) \cdot \lambda(40\hat{i} - 3\hat{j} + 3\hat{k}) = 1670$

$\Rightarrow (41\hat{i} - 5\hat{j} + 5\hat{k}) \cdot (40\hat{i} - 3\hat{j} + 3\hat{k})\lambda = 1670$

$\Rightarrow (1640 + 15 + 15)\lambda = 1670 \Rightarrow \lambda = 1$

so $\vec{c} = 40\hat{i} - 3\hat{j} + 3\hat{k}$

$\Rightarrow |\vec{c}|^2 = 1600 + 9 + 9 = 1618$

١٤. If the function f(x) = ٢x^٣ − ٩ax^٢ + ١٢a^٢x + ١، a < ٠ has a local maximum at x = □ and a local minimum x = □^٢، then □ and □^٣ are the roots of the equation :

(١) x^٢ − ٦x + ٨ = ٠ (٢) ٨x^٢ + ٦x − ٨ = ٠

(٣) ٨x^٢ − ٦x + ١ = ٠ (٤) x^٢ + ٦x + ٨ = ٠

Ans. (١)

Sol. f'(x) = ٦x^٢ − ١٨ax + ١٢a^٢ = ٠ □ / □^٢

□ + □^٢ = ٣a & □ × □^٢ = ٢a^٢

□□□□□□□

(□ + □^٢)^٣ = ٢٧a^٣

□ ٢a^٢ + ٤a^٢ + ٣(٣a)(٢a^٢) = ٢٧a^٣

□ ٢ + ٤a + ١٨a = ٢٧a

□ ٤a^٢ − ٩a + ٢ = ٠

□ ٤a^٢ − ٨a − a + ٢ = ٠

□ (٤a − ١)(a − ٢) = ٠ □ a = ٢

so ٦x^٢ − ٣٦x + ٤٨ = ٠

□ x^٢ − ٦x + ٨ = ٠ (١)

If we take a □ ١/٤ then □□ ١/٢ which is not possible

١٥. There are three bags X، Y and Z. Bag X contains ٥ one-rupee coins and ٤ five-rupee coins; Bag Y contains ٤ one-rupee coins and ٥ five-rupee coins and Bag Z contains ٣ one-rupee coins and ٦ five-rupee coins. A bag is selected at random and a coin drawn from it at random is found to be a one-rupee coin. Then the probability، that it came from bag Y، is :

(١) ١/٣ (٢) ١/٢

(٣) ١/٤ (٤) ٥/١٢

Ans. (١)

Sol. X Y Z

٥ one & ٤ five ٤ one & ٥ five ٣ one & ٦ five

P □ (٤/٩) / (٥/٩ □ ٤/٩ □ ٣/٩) □ ٤/١٢ □ ١/٣

١٦. Let $\int_{□}^{\log_e □} \frac{dx}{\sqrt{e^x □ ١}} □ \frac{□}{٦}$. Then e^□ and e^−□ are the roots of the equation :

(١) ٢x^٢ − ٥x + ٢ = ٠ (٢) x^٢ − ٢x − ٨ = ٠

(٣) ٢x^٢ − ٥x − ٢ = ٠ (٤) x^٢ + ٢x − ٨ = ٠

Ans. (١)

Sol. $\int_{□}^{\log_e □} \frac{dx}{\sqrt{e^x □ ١}} □ \frac{□}{٦}$

Let e^x − ١ = t^٢

e^x dx = ٢t dt

□ $\int \frac{٢dt}{t^٢ □ ١}$

= ٢ tan^−١ t

□ ٢tan□١ □ $\sqrt{e^x □ 1}$ □ (log_e □, □)

□ ٢ tan□١ $\sqrt{٣}$ □ tan□١ $\sqrt{e^□ □ 1}$ □ □ □/٦

□ □/٣ □ tan□١ $\sqrt{e^□ □ ١}$ □ □/١٢

□ tan□١ $\sqrt{e^□ □ ١}$ □ □/٤

e^□ □ 2 e^□□ □ ١/٢

x٢ □ □2 □ 1/2 □ x □ ١ □ ٠

٢x^٢ − ٥x + ٢ = ٠

١٧. Let f(x) □ □ □a, x□a if □ a □ x □ ٠; if ٠ □ x □ a

where a > ٠ and g(x) = (f|x|) − |f(x)|)/٢.

Then the function g : [−a، a] □ [−a، a] is

(١) neither one-one nor onto.

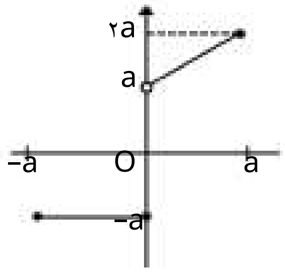
(٢) both one-one and onto.

(٣) one-one.

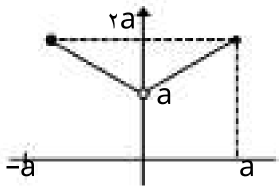
(٤) onto

Ans. (١)

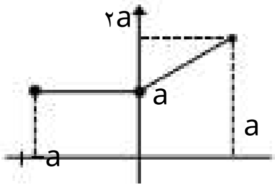
Sol. y = f(x)



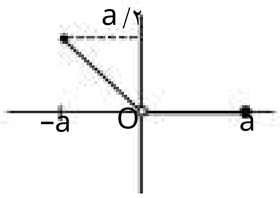
y = f|x|



y = |f(x)|



$g(x) = \dfrac{f(|x|) - |f(x)|}{٢}$



١٨. Let A = {٢، ٣، ٦، ٨، ٩، ١١} and B = {١، ٤، ٥، ١٠، ١٥}

Let R be a relation on A × B define by (a، b)R(c، d) if and only if ٣ad − ٧bc is an even integer. Then the relation R is

(١) reflexive but not symmetric.

(٢) transitive but not symmetric.

(٣) reflexive and symmetric but not transitive.

(٤) an equivalence relation.

Ans. (٣)

Sol. A = {٢، ٣، ٦، ٨، ٩، ١١} (a، b)R(c، d)

B = {١، ٤، ٥، ١٠، ١٥} ٣ad − ٧bc

Reflexive : (a، b) R(a، b)

⇒ ٣ab − ٧ba = − ٤ab always even so it is reflexive.

Symmetric : If ٣ad − ٧bc = Even

odd even Case-I (c، d)R(a، b) ⇒

٣bc − ٧ad Case-II : even

Case-I : odd odd

Case-II : even even

so symmetric relation

Transitive :

Set (٣، ٤)R(٦، ٤) Satisfy relation

Set (٦، ٤)R(٣، ١) Satisfy relation

but (٣، ٤) R(٣، ١) does not satisfy relation

so not transitive.

١٩. For a، b > ٠، let

$$f(x) = \begin{cases} \dfrac{\tan((a+١)x)+b\tan x}{x}, & x < ٠ \\ ٣, & x = ٠ \\ \dfrac{\sqrt{ax+b^٢x^٢}-\sqrt{ax}}{b\sqrt{a}\,x\sqrt{x}}, & x > ٠ \end{cases}$$

be a continous function at x = ٠. Then $\frac{b}{a}$ is equal to

(١) ٥ (٢) ٤

(٣) ٨ (٤) ٦

Ans. (٤)

Sol. $\lim\limits_{x\to ٠^+} f(x) = f(٠) = ٣$

$$\lim_{x\to 0^+} \frac{\sqrt{ax+b^٢x^٢}-\sqrt{ax}}{b\sqrt{a}\,x\sqrt{x}} = ٣$$

$$\lim_{x\to 0^+} \frac{ax+bx^٢-ax}{b\sqrt{a}\,x^{٣/٢}\left(\sqrt{ax+bx^٢}+\sqrt{ax}\right)}$$

$$\lim_{x\to 0^+} \frac{b^٢}{b\sqrt{a}\left(\sqrt{a+b^٢x}+\sqrt{a}\right)}$$

$$\frac{b}{\sqrt{a}\cdot ٢\sqrt{a}} = \frac{b}{٢a} = ٣ \Rightarrow \frac{b}{a} = ٦$$

٢٠. If the term independent of x in the expansion of $\left(\sqrt{a}x^{٢} - \frac{١}{٢x^{٣}}\right)^{١٠}$ is ١٠٥, then $a^{٢}$ is equal to :

(١) ٤ (٣) ٦ (٢) ٩

Ans. (١) (٤) ٢

Sol. $\left(\sqrt{a}x^{٢} - \frac{١}{٢x^{٣}}\right)^{١٠}$

General term = ${}^{١٠}C_r \left(\sqrt{a}x^{٢}\right)^{١٠-r}\left(-\frac{١}{٢x^{٣}}\right)^{r}$

$٢٠ - ٢r - ٣r = ٠$

$r = ٤$

${}^{١٠}C_{٤}\, a^{٣} \cdot \frac{١}{١٦} = ١٠٥$

$a^{٣} = ٨$

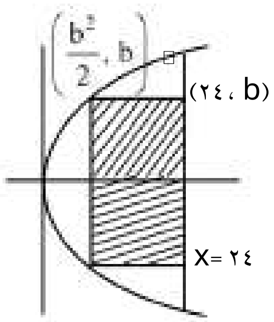
$a^{٢} = ٤$

SECTION-B

٢١. Let A be the region enclosed by the parabola $y^{٢} = ٢x$ and the line $x = ٢٤$. Then the maximum area of the rectangle inscribed in the region A is ______________ .

Ans. (١٢٨)

Sol.



$A = ٢\left(٢٤ - \frac{b^{٢}}{٢}\right) b$

$\frac{dA}{db} = ٠ \Rightarrow b = ٤$

$A = ٢(٢٤ - ٨)٤$

$= ١٢٨$

٢٢. If $\alpha = \lim_{x \to 0^+}\left(\frac{e^{\sqrt{\tan x}} - e^{\sqrt{x}}}{\sqrt{\tan x} - \sqrt{x}}\right)$ and $\beta = \lim_{x \to ٠}(١ + \sin x)^{\frac{١}{٢}\cot x}$ are the roots of the quadratic equation $ax^{٢} + bx - \sqrt{e} = ٠$, then $١٢ \log_e(a + b)$ is equal to ______________ .

Ans. (٦)

Sol. $\alpha = \lim_{x \to 0^+} e^{\sqrt{x}} \frac{\left(e^{\sqrt{\tan x} - \sqrt{x}} - 1\right)}{\sqrt{\tan x} - \sqrt{x}}$

$= ١$

$\beta = \lim_{x \to ٠}(١ + \sin x)^{\frac{١}{٢}\cot x}$

$= e^{١/٢}$

$x^{٢} - (١ + \sqrt{e})x + \sqrt{e} = ٠$

$ax^{٢} + bx - \sqrt{e} = ٠$

On comparing

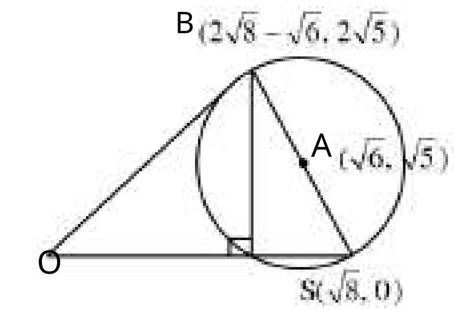
$a = -١,\ b = \sqrt{e} + ١$

$١٢ \ln(a + b) = ١٢ \times \frac{١}{٢} = ٦$

٢٣. Let S be the focus of the hyperbola $\frac{x^{٢}}{٣} - \frac{y^{٢}}{٥} = ١$, on the positive x-axis. Let C be the circle with its centre at $A(\sqrt{٦}, \sqrt{٥})$ and passing through the point S. if O is the origin and SAB is a diameter of C then the square of the area of the triangle OSB is equal to -

Ans. (٤٠)

Sol.

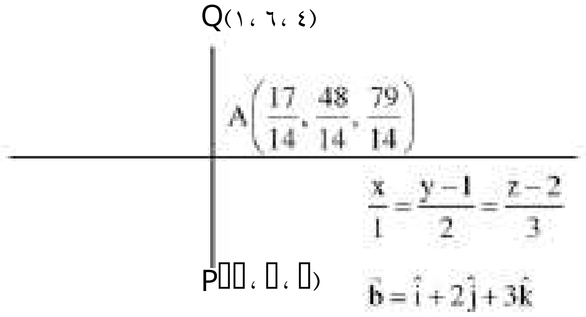


Area $= \frac{١}{٢}(OS)\, h = \frac{١}{٢}\sqrt{٨}\ ٢\sqrt{٥} = \sqrt{٤٠}$

٢٤. Let P(□,□□,□□) be the image of the point Q(١،٦،٤) in the line $\frac{x}{١} □ \frac{y □ ١}{٢} □ \frac{z □ ٢}{٣}$. Then ٢□ + □ + □ is equal to ___________ .

Ans. (١١)

Sol.



A(t، ٢t + ١، ٣t + ٢)

QA□(t□١)i^□(٢t□٥)j^□(٣t□٢)k^

QA.b□٠

(t − ١) + ٢(٢t − ٥) + ٣(٣t − ٢) = ٠

١٤t = ١٧

□ □ $\frac{٢٠}{١٤}$ □ □ $\frac{١٢}{١٤}$ □ □ $\frac{١٠٢}{١٤}$

2□□□□□□□□□□ $\frac{١٥٤}{١٤}$ = ١١

٢٥. An arithmetic progression is written in the following way

٢
٥ ٨
١١ ١٤ ١٧
٢٠ ٢٣ ٢٦ ٢٩

____

____

The sum of all the terms of the ١٠th row is __________ .

Ans. (١٥٠٥)

Sol. ٢، ٥، ١١، ٢٠، ......

General term = $\frac{٣n٢□٣n□٤}{٢}$

$T_{١٠}$ □ $\frac{٣(١٠٠)□٣(١٠)□٤}{٢}$

= ١٣٧

١٠ terms with c.d. = ٣

sum□ $\frac{١٠}{٢}$ □٢(١٣٧)□٩(٣)□

= ١٥٠٥

٢٦. The number of distinct real roots of the equation |x + ١| |x + ٣| − ٤ |x + ٢| + ٥ = ٠، is ____________ .

Ans. (٢)

Sol. |x + ١| |x + ٣| − ٤|x + ٢| + ٥ = ٠

case−١

x□□ −٣

(x + ١)(x + ٣) + ٤(x + ٢) + ٥ = ٠

x٢ + ٤x + ٣ + ٤x + ٨ + ٥ = ٠

x٢ + ٨x + ١٦ = ٠

(x + ٤)٢ = ٠

x = −٤

case−٢

−٣ □ x □□ −٢

−x٢ − ٤x − ٣ + ٤x + ٨ + ٥ = ٠

−x٢ + ١٠ = ٠

x□□ $\sqrt{١٠}$

case−٣

−٢ □ x □□ −١

−x٢ − ٤x − ٣ − ٤x − ٨ + ٥ = ٠

−x٢ − ٨x − ٦ = ٠

x٢ + ٨x + ٦ = ٠

x□ $\frac{□8□2\sqrt{١٠}}{٢}$ □□4□ $\sqrt{١٠}$

case−٤

x□□□ −١

x٢ + ٤x + ٣ − ٤x − ٨ + ٥ = ٠

x٢ = ٠

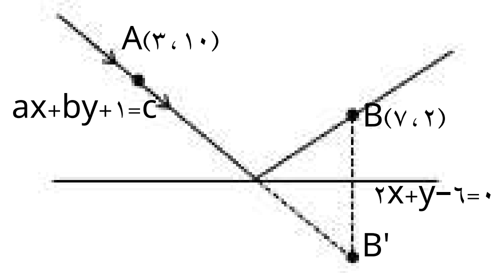
x = ٠

No. of solution = ٢

٢٧. Let a ray of light passing through the point (٣، ١٠) reflects on the line ٢x + y = ٦ and the reflected ray passes through the point (٧، ٢). If the equation of the incident ray is ax + by + ١ = ٠، then a٢ + b٢ + ٣ab is equal to __.

Ans. (١)

Sol.



For B' $\frac{x-٧}{٢}=\frac{y-٢}{١}=-٢\left(\frac{١٤-٢-٦}{٥}\right)$

$\frac{x-٧}{٢}=\frac{y-٢}{١}=-4$

$x=-١$ $y=-٢$ B'$(-١،-٢)$

incident ray AB'

$M_{AB'}=٣$

$y+٢=٣(x+١)$

$٣x-y+١=٠$

$a=٣$ $b=-١$

$a^٢+b^٢+٣ab=٩+١-٩=١$

٢٨. Let a، b، c ∈ N and a > b > c. Let the mean، the mean deviation about the mean and the variance of the ٥ observations ٩، ٢٥، a، b، c be ١٨، ٤ and $\frac{١٣٦}{٥}$ ، respectively. Then ٢a + b − c is equal to ____________ .

Ans. (٣٣)

Sol. a، b، c ∈ N   a > b > c

$\bar{x}=\text{mean}=\frac{٩+٢٥+a+b+c}{٥}=١٨$

$a+b+c=٥٦$

Mean deviation $=\frac{\sum|x_i-\bar{x}|}{n}=٤$

$=٩+٧+|١٨-a|+|١٨-b|+|١٨-c|=٢٠$

$=|١٨-a|+|١٨-b|+|١٨-c|=٤$

Variance $=\frac{\sum|x_i-\bar{x}|^٢}{n}=\frac{١٣٦}{٥}$

$=٨١+٤٩+|١٨-a|^٢+|١٨-b|^٢+|١٨-c|^٢=١٣٦$

$=(١٨-a)^٢+(١٨-b)^٢+(١٨-c)^٢=٦$

Possible values $(١٨-a)^٢=١$، $(١٨-b)^٢=١$ $(١٨-c)^٢=٤$

a > b > c

so $١٨-a=١$ $١٨-b=-١$ $١٨-c=-٢$

$a=١٧$ $b=١٩$ $c=٢٠$

$a+b+c=٥٦$

$٢a+b-c$ ٣٤ $=١٩-٢٠=٣٣$

٢٩. Lei $\alpha|x|=|y|e^{xy-\beta}$، α، β ∈ N be the solution of the differential equation $xdy-ydx+xy(xdy+ydx)=٠$، $y(1)=٢$. Then α + β is equal to __

Ans. (٤)

Sol. $a|x|=|y|e^{yx-b}$، a، b ∈ N

$xdy-ydx+xy(xdy+ydx)=٠$

$\frac{dy}{y}-\frac{dx}{x}+(xdy+ydx)=٠$

$\ell n|y|-\ell n|x|+xy=c$

$y(١)=٢$

$\ell n|٢|-٠+٢=c$

$c=٢+\ell n٢$

$\ell n|y|-\ell n|x|+xy=٢+\ell n٢$

$\ell n|x|=\ell n\left|\frac{y}{٢}\right|-٢+xy$

$|x|=\left|\frac{y}{٢}\right|e^{xy-٢}$

$٢|x|=|y|e^{xy-٢}$

$\alpha=٢$ $\beta=٢$ $\alpha+\beta=٤$

٣٠. If $\int\frac{1}{\sqrt[٥]{(x-١)^٤(x+٣)^٦}}dx=A\left(\frac{\alpha x-1}{\beta x+3}\right)^B+C$، where C is the constant of integration، then the value of α + β + ٢٠AB is ____________ .

Ans. (٧)

Sol. $\int\frac{1}{\sqrt[٥]{(x-١)^٤(x+٣)^٦}}dx=A\left(\frac{\alpha x-1}{\beta x+3}\right)^B+C$

$I=\int\frac{١}{(x-١)^{٤/٥}(x+٣)^{٦/٥}}dx$

$I=\int\frac{١}{\left(\frac{x-١}{x+٣}\right)^{٤/٥}(x+٣)^٢}dx$

$\left(\frac{x-١}{x+٣}\right)=t \Rightarrow \frac{٤}{(x+٣)^٢}dx=dt$ $t^{-٤/٥+١}$

$I=\frac{١}{4}\int\frac{١}{t^{٤/٥}}dt=\frac{١}{٤}\frac{t^{١/٥}}{١/٥}+c$

$I=\frac{٥}{٤}\left(\frac{x-١}{x+٣}\right)^{\frac{١}{٥}}+C$

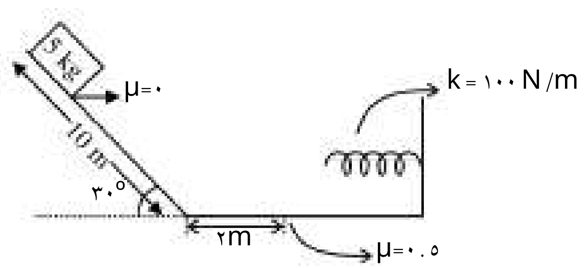
$A=\frac{٥}{٤}$ $\alpha=\beta=١$ $B=\frac{١}{٥}$

$\alpha+\beta+٢٠AB=٢+٢٠\times\frac{٥}{٤}\times\frac{١}{٥}=٧$

PHYSICS　　　　TEST PAPER WITH SOLUTION

SECTION–A

٣١.



A block is simply released from the top of an inclined plane as shown in the figure above. The maximum compression in the spring when the block hits the spring is :

(١) $\sqrt{٦}$ m　　(٢) ٢ m

(٣) ١ m　　(٤) $\sqrt{٥}$ m

Ans. (٢)

Sol. wg + wFr + ws = KE

٥ × ١٠ × ٥ − ٠.٥ × ٥ × ١٠ × x − $\frac{١}{٢}$ Kx٢ = ٠ − ٠

٢٥٠ = ٢٥x + ٥٠x ٢

٢x٢ + x − ١٠ = ٠

x = ٢

٣٢. In a hypothetical fission reaction

٩٢X٢٣٦ → ٥٦Y ١٤١ + ٣٦Z + ٣R

The identity of emitted particles (R) is :

(١) Proton　　(٢) Electron

(٣) Neutron　　(٤) –radiations

Ans. (٣)

Sol. Z in LHS = ٩٢

Z in RHS = ٥٦ + ٣٦ = ٩٢

A in LHS = ٢٣٦

A in RHS = ١٤١ + ٩٢ = ٢٣٣

So ٣ neutrons are released.

٣٣. If is the permittivity of free space and E is the electric field, then E٢ has the dimensions :

(١) M L T A　　(٢) M L T

(٣) M L T A ٢　　(٤) M L T

Ans. (٢)

Sol. E = $\frac{KQ}{R^٢}$

E = $\frac{Q}{٤\pi\varepsilon_o R^٢}$

$\varepsilon_o = \frac{Q}{٤\pi R^٢ E}$

Now, $\varepsilon_o E = \frac{Q}{٤\pi R^٢ E} . E^٢ = \frac{Q}{٤\pi R^٢} . E$

$\varepsilon_o E^2 = \frac{QE}{R^٢} = \frac{[Q][E]}{[R^٢]} = \frac{[Q][W]}{[R^٢][Q][R]}$

$= \frac{[W]}{[R^٣]} = \frac{ML^٢T^{-٢}}{L^٣} = ML^{-١}T^{-٢}$

٣٤. The position of the image formed by the combination of lenses is :

f١ = ١٠ cm　　f٢ = −١٠　　f٣ = ٣٠ cm

٣٠cm　　٥cm　　١٠cm

(١) ٣٠ cm (right of third lens)

(٢) ١٥ cm (left of second lens)

(٣) ٣٠ cm (left of third lens)

(٤) ١٥ cm (right of second lens)

Ans. (١)

Sol. For lens ١ : f١ = ١٠, u = −٣٠, v = ?

v = $\frac{uf}{u+f} = \frac{-٣٠ \times ١٠}{-٣٠ + ١٠}$ = ١٥

For lens ٢ : f١ = −١٠, u = ١٠, v = ?

v = $\frac{uf}{u+f} = \frac{١٠ \times -١٠}{١٠ - ١٠}$ = ∞

For lens ٣ : f = ٣٠, u = −∞, v = ?

So v will be ٣٠.

٣٥. Ay plane progressive wave is given $y = ٢ \cos ٢□(٣٣٠\, t - x)$ m. The frequency of the wave is :

(١) ١٦٥ Hz (٢) ٣٣٠ Hz

(٣) ٦٦٠ Hz (٤) ٣٤٠ Hz

Ans. (٢)

Sol. $y = ٢ \cos ٢□(٣٣٠\, t - x)$ m

$y = A\cos(□t - kx)$

by comparing $□ = ٢□□ \times ٣٣٠$

$٢□f = ٢□ \times ٣٣٠$

$f = ٣٣٠$

٣٦. A thin circular disc of mass M and radius R is rotating in a horizontal plane about an axis passing through its centre and perpendicular to its plane with angular velocity □. If another disc of same dimensions but of mass $M/٢$ is placed gently on the first disc co-axially، then the new angular velocity of the system is :

(١) $\frac{٤}{٥}□$ (٢) $\frac{٥}{٤}□$

(٣) $\frac{٢}{}□$ (٤) $\frac{٣}{٢}□$

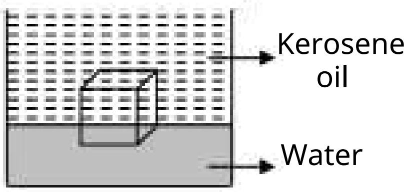
Ans. (٣) ٣

Sol. $I_١□ = I_٢□□$

$\frac{MR^٢}{٢}□ □ \frac{٣□MR^٢}{2□\ ٢}□□$

$□□ = \frac{٢}{٣}□$

٣٧. A cube of ice floats partly in water and partly in kerosene oil. The radio of volume of ice immersed in water to that in kerosene oil (specific gravity of Kerosene oil = ٠.٨، specific gravity of ice = ٠.٩)



(١) ٨ : ٩ (٢) ٥ : ٤

(٣) ٩ : ١٠ (٤) ١ : ١

Ans. (٤)

Sol. $v_١$ = volume immersed in water.

$v_٢$ = volume immersed in oil.

$v_١ □w\, g + v_٢ □o\, g = (v_١ + v_٢) □c\, g$

$v_١ + \frac{v_٢ □o}{□_w} □ (v_١ + v_٢) \frac{□}{□_w}$

$= V_١ + ٠.٨ V_٢ = ٠.٩ V_١ + ٠.٩ V_٢$

$= ٠.١ V_١ = ٠.١ V_٢$

$V_١ : V_٢ = ١ : ١$

٣٨. Given below are two statements :

Statement (I) : The mean free path of gas molecules is inversely proportional to square of molecular diameter.

Statement (II) : Average kinetic energy of gas molecules is directly proportional to absolute temperature of gas.

In the light of the above statements، choose the correct answer from the option given below:

(١) Statement I is false but Statement II is true.

(٢) Statement I is true but Statement II is false.

(٣) Both Statement I and Statement II are false

(٤) Both Statement I and Statement II are true.

Ans. (٤)

Sol. $□□ \frac{RT}{\sqrt{٢}□ d^2 N_A P}$

$KE = \frac{f}{٢} nRT$

٣٩. Two satellite A and B go round a planet in circular orbits having radii ٤ R and R respectively. If the speed of A is ٣v، the speed of B will be :

(١) $\frac{٤}{٣}v$ (٢) ٣v

(٣) ٦v (٤) ١٢v

Ans. (٣)

Sol. $v = \sqrt{\frac{GM}{R}}$

$\frac{v_A}{v_B} □ \sqrt{\frac{R_B}{R_A}} □ \sqrt{\frac{R}{٤R}} □ \frac{١}{٢}$

$v_B □ ٢v_A □ ٦v$

٤٠. A long straight wire of radius a carries a steady current I. The current is uniformly distributed across its cross section. The ratio of the magnetic field at $\frac{a}{٢}$ and ٢a from axis of the wire is :

(١) ١ : ٤ (٢) ٤ : ١

(٣) ١ : ١ (٤) ٣ : ٤

Ans. (٣)

Sol. $B_١\left(\frac{a}{٢}\right) = \mu_o \frac{I}{٤\pi a}$

$B_١ = \frac{\mu_o I}{٤\pi a}$

$B_٢(٢a) = \frac{\mu_o I}{٢\pi (٢a)}$

$B_٢ = \frac{\mu_o I}{٤\pi a}$

٤١. The angle of projection for a projectile to have same horizontal range and maximum height is :

(١) $\tan^{-١}(٣)$ (٢) $\tan^{-١}(٤)$

(٣) $\tan^{-١}\left(\frac{1}{4}\right)$ (٤) $\tan^{-١}\left(\frac{1}{2}\right)$

Ans. (٢)

Sol. $\frac{u^٢ \sin ٢\theta}{g} = \frac{u^٢ \sin^٢ \theta}{٢g}$

$٤\sin\theta \cos\theta = \sin^٢\theta$

$٤ = \tan\theta$

٤٢. Water boils in an electric kettle in ٢٠ minutes after being switched on. Using the same main supply, the length of the heating element should be ………….. to ………….. times of its initial length if the water is to be boiled in ١٥ minutes.

(١) increased $\frac{٤}{٣}$ (٢) increased $\frac{٣}{٤}$

(٣) decreased $\frac{٣}{٤}$ (٤) decreased $\frac{٤}{٣}$

Ans. (٣)

Sol. $P = \frac{V^٢}{R}$, $R = \frac{\rho \ell}{A}$

$P \propto \frac{١}{\ell}$

$\frac{P_1}{P_٢} = \frac{t_2}{t_١} = \frac{١٥}{٢٠} = \frac{\ell_٢}{\ell_١}$

$\ell_٢ = \frac{٣}{٤}\ell_١$

٤٣. A capacitor has air as dielectric medium and two conducting plates of area ١٢ $cm^٢$ and they are ٠.٦ cm apart. When a slab of dielectric having area ١٢ $cm^٢$ and ٠.٦ cm thickness is inserted between the plates, one of the conducting plates has to be moved by ٠.٢ cm to keep the capacitance same as in previous case. The dielectric constant of the slab is : (Given $\varepsilon_0 = ٨.٨٣٤ \times ١٠^{-١٢}$ F/m)

(١) ١.٥٠ (٢) ١.٣٣

(٣) ٠.٦٦ (٤) ١

Ans. (١)

Sol. $\frac{A\varepsilon_o}{d} = \frac{A\varepsilon_o}{\left(٠.٢ + \frac{d}{k}\right)}$

$٠.٦ = ٠.٢ + \frac{٠.٦}{k}$

$k = \frac{٣}{٢}$

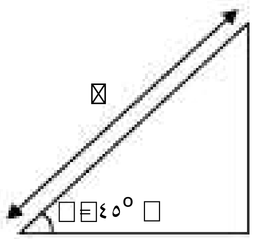
٤٤. A given object takes n times the time to slide down ٤٥° rough inclined plane as it takes the time to slide down an identical perfectly smooth ٤٥° inclined plane. The coefficient of kinetic friction between the object and the surface of inclined plane is :

(١) $١ - \frac{١}{n^٢}$ (٢) $١ - n^٢$

(٣) $\sqrt{١ - \frac{١}{n^٢}}$ (٤) $\sqrt{١ - n^٢}$

Ans. (١)

Sol.



Case-١ : No friction

$a = g\sin\theta$

$\ell = \frac{١}{٢}(g\sin\theta)t_١^٢$

$t_١ = \sqrt{\frac{٢\ell}{g\sin\theta}}$

Case-٢ : With friction

$a = g \sin\theta - \mu g \cos\theta$

$\ell = \frac{١}{٢}(g\sin\theta - \mu g\cos\theta)t^{٢}$

$\sqrt{\frac{٢\ell}{g\sin\theta - \mu g\cos\theta}} = n\sqrt{\frac{٢\ell}{g\sin\theta}}$

$\mu = ١ - \frac{١}{n^{٢}}$

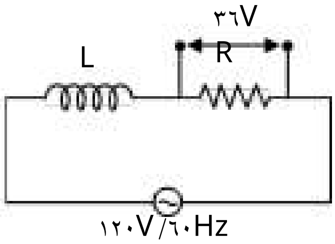
٤٥. A coil of negligible resistance is connected in series with ٩٠ Ω resistor across ١٢٠ V، ٦٠ Hz supply. A voltmeter reads ٣٦ V across resistance. Inductance of the coil is :

(١) ٠.٧٦ H (٢) ٢.٨٦ H

(٣) ٠.٢٨٦ H (٤) ٠.٩١ H

Ans. (١)

Sol.



$٣٦ = I_{rms}R$

$٣٦ = \frac{١٢٠}{\sqrt{X_L^{٢} + R^{٢}}} \times R$

$R = ٩٠ \Rightarrow ٣٦ = \frac{١٢٠ \times ٩٠}{\sqrt{X_L^{٢} + ٩٠^{٢}}}$

$\sqrt{X_L^{٢} + ٩٠^{٢}} = ٣٠٠$

$X_L^{٢} = ٨١٩٠٠$

$X_L = ٢٨٦.١٨$

$\omega L = ٢٨٦.١٨$

$L = \frac{٢٨٦.١٨}{٣٧٦.٨}$

$L = ٠.٧٦ H$

٤٦. There are ١٠٠ divisions on the circular scale of a screw gauge of pitch ١ mm. With no measuring quantity in between the jaws، the zero of the circular scale lies ٥ divisions below the reference line. The diameter of a wire is then measured using this screw gauge. It is found the ٤ linear scale divisions are clearly visible while ٦٠ divisions on circular scale coincide with the reference line. The diameter of the wire is : (١) ٤.٦٥ mm (٢) ٤.٥٥ mm (٣) ٤.٦٠ mm

(٤) ٣.٣٥ mm

Ans. (٢)

Sol. Least count $= \frac{١}{١٠٠}$ mm $=$ ٠.٠١mm

zero error = +٠.٠٥ mm

Reading = ٤ × ١ mm + ٦٠ × ٠.٠١ mm − ٠.٠٥ mm

= ٤.٥٥ mm

٤٧. A proton and an electron have the same de Broglie wavelength. If Kp and Ke be the kinetic energies of proton and electron respectively. Then choose the correct relation :

(١) Kp < Ke (٢) Kp = Ke

(٣) Kp = Ke^{٢} (٤) Kp > Ke

Ans. (٤)

Sol. De Broglie wavelength of proton & electron = λ

$\lambda = \frac{h}{p}$

$\Rightarrow$ pproton = pelectron

$\Rightarrow KE = \frac{p^{٢}}{٢m}$

$\Rightarrow$ KEproton > KEelectron

Kp > Ke

٤٨. Least count of a vernier caliper is $\frac{١}{٢٠N}$ cm. The value of one division on the main scale is ١ mm. Then the number of divisions of main scale that coincide with N divisions of vernier scale is :

(١) $\left(\frac{2N - 1}{20N}\right)$ (٢) $\left(\frac{2N - 1}{2}\right)$

(٣) (٢N − ١) (٤) $\left(\frac{2N - 1}{٢N}\right)$

Ans. (٢)

Sol. Least count of vernier calipers = $\frac{١}{٢٠N}$ cm

$\therefore$ Least count = ١ MSD − ١ VSD

let x no. of divisions of main scale coincides with N division of vernier scale، then

١ VSD = $\frac{x \times ١mm}{N}$

$\Rightarrow \frac{١}{٢٠N}$ cm = ١ mm − $\frac{x \times ١mm}{N}$

$\frac{١}{٢N}$ mm = ١mm − $\frac{x}{N}$ mm

x = $\left(1 - \frac{١}{٢N}\right) N$

x = $\frac{٢N - ١}{٢}$

٤٩. If M_o is the mass of isotope $^{١٢}_{٥}B$، M p and Mn are the masses of proton and neutron، then nuclear binding energy of isotope is :

(١) (٥ Mp + ٧Mn − Mo)$C^٢$

(٢) (Mo − ٥Mp)$C^٢$

(٣) (Mo − ١٢Mn)$C^٢$

(٤) (Mo − ٥Mp − ٧Mn)$C^٢$

Ans. (١)

Sol. B.E. = $\Delta m C^٢$

(٥ Mp + ٧Mn − Mo)$C^٢$

٥٠. A diatomic gas (γ = ١.٤) does ١٠٠ J of work in an isobaric expansion. The heat given to the gas is :

(١) ٣٥٠ J (٢) ٤٩٠ J

(٣) ١٥٠ J (٤) ٢٥٠ J

Ans. (١)

For Isobaric process

w = PΔv = nRΔT = ١٠٠ J

Q = Δu + w

$\Rightarrow$ Q = $\frac{F}{٢}$ nRΔT + nRΔT

$= \left(\frac{f}{2} + ١\right)$ nRΔT

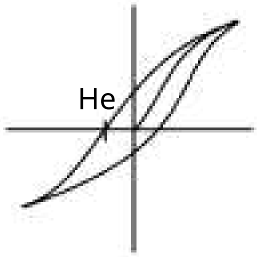
$= \left(\frac{5}{2} + ١\right)$ ١٠٠ = ٣٥٠ J

SECTION-B

٥١. The coercivity of a magnet is ٥ × ١٠^٣ A/m. The amount of current required to be passed in a solenoid of length ٣٠ cm and the number of turns ١٥٠، so that the magnet gets demagnetised when inside the solenoid is .... A.

Ans. (١٠)

Sol.



$H_c = \frac{\mu_o n i}{\mu_o}$

٥ × ١٠^٣ = $\frac{١٥٠}{٣٠} \times ١٠٠ \times$ i

$\frac{٥٠}{٥}$ = i

I = ١٠

٥٢. Small water droplets of radius ٠.٠١ mm are formed in the upper atmosphere and falling with a terminal velocity of ١٠ cm/s. Due to condensation، if ٨ such droplets are coalesced and formed a larger drop، the new terminal velocity will be .... cm/s.

Ans. (٤٠)

Sol. m = mass of small drop

M = mass of bigger drop

$V_t = \frac{٢}{٩} \frac{R^٢(\rho - \sigma)g}{\eta}$

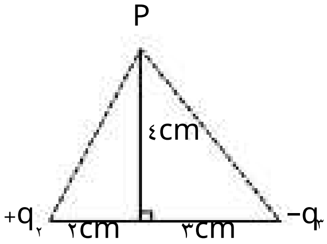
٨ × m = M

٨r^٣ = R^٣ $\Rightarrow$ R = ٢R

as Vt ∝ R^٢ $\Rightarrow$ Radius double so Vt becomes ٤ time

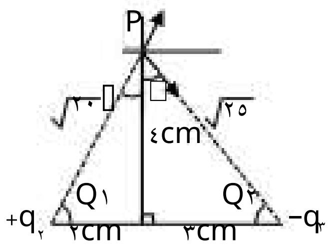
$\Rightarrow$ ٤ × ١٠ = ٤٠ cm/s

٥٣. If the net electric field at point P along Y axis is zero, then the ratio $\left|\frac{q_٢}{q_٣}\right|$ is $\frac{٨}{٥\sqrt{x}}$, where x = …………..



Ans. (٥)

Sol.



$\frac{Kq_٢}{٢٠}\cos\theta = \frac{Kq_٣}{٢٥}\cos\theta$

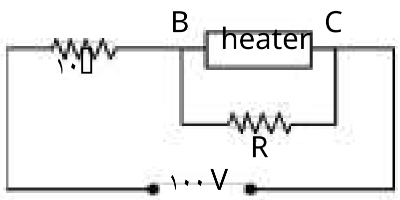
$\frac{Kq_٢}{٢٠}\frac{٤}{\sqrt{٢٠}} = \frac{Kq_٣}{٢٥}\frac{٤}{\sqrt{٢٥}}$

$\frac{q_٢}{q_٣} = \frac{٢٠}{٢٥}\sqrt{\frac{٢٠}{٢٥}} = \frac{٨}{٥\sqrt{x}}$

$\Rightarrow \sqrt{x} = \frac{٨\times٢٥\sqrt{٢٥}}{٥\times٢٠\sqrt{٢٠}}$

x = ٥

٥٤. A heater is designed to operate with a power of ١٠٠٠ W in a ١٠٠ V line. It is connected in combination with a resistance of ١٠ Ω and a resistance R, to a ١٠٠ V mains as shown in figure. For the heater to operate at ٦٢.٥ W, the value of R should be ……………. Ω.



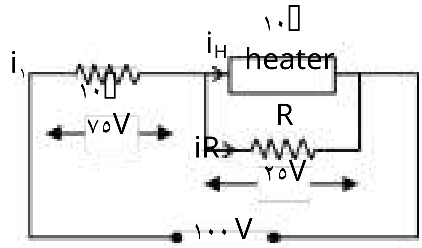
Ans. (٥)

Sol. $R_{heater} = \frac{V^٢}{P} = \frac{(١٠٠)^٢}{١٠٠٠} = ١٠\Omega$

For heater $P = \frac{V^٢}{R} \Rightarrow V = \sqrt{PR}$

$V = \sqrt{٦٢.٥\times١٠}$

V = ٢٥ V



$i_١ = \frac{٧٥}{١٠} = ٧.٥A$, $i_H = \frac{٢٥}{١٠} = ٢.٥A$.

$i_R = i_١ - i_H = ٥$

V = IR

$R = \frac{٢٥}{٥} = 5\Omega$

٥٥. An alternating emf $E = ١١٠\sqrt{٢}\sin(١٠٠t)$ is applied to a capacitor of ٢μF, the rms value of current in the circuit is ……… mA.

Ans. (٢٢)

Sol. C = ٢μf ; $E = ١١٠\sqrt{٢}\sin(١٠٠t)$

$X_C = \frac{١}{\omega C} = \frac{١}{١٠٠\times٢\times١٠^{-٦}}$

$= \frac{١٠٠٠٠}{٢} = ٥٠٠٠\ \Omega$

$i_o = \frac{١١٠\sqrt{٢}}{٥٠٠٠}$

$i_{rms} = \frac{١١٠\sqrt{٢}}{٥٠٠٠\sqrt{٢}}$

$= \frac{١١٠}{٥}$ mA

= ٢٢ mA

٥٦. Two slits are ١ mm apart and the screen is located ١ m away from the slits. A light wavelength ٥٠٠ nm is used. The width of each slit to obtain ١٠ maxima of the double slit pattern within the central maximum of the single slit pattern is ……… × ١٠^{-٤} m.

Ans. (٢)

Sol. d = ١ mm, D = ١ m, λ = ٥٠٠ nm

$$10\left(\frac{\lambda D}{d}\right) = \frac{2\lambda D}{a}$$

$$a = \frac{d}{5}$$

$$= \frac{10^{-3}\,m}{5}$$

$$= 2 \times 10^{-4}$$

٥٧. An object of mass ٠.٢ kg executes simple harmonic motion along x axis with frequency of $\left(\frac{25}{\pi}\right)$ Hz. At the position x = ٠.٠٤ m the object has kinetic energy ٠.٥ J and potential energy ٠.٤ J. The amplitude of oscillation is ……… cm.

Ans. (٦)

Sol. Total energy = K.E. + P.E.

at x = ٠.٠٤ m, T.E. = ٠.٥ + ٠.٤ = ٠.٩ J

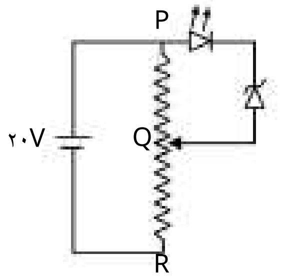
$T.E = \frac{1}{2} m\omega^2 A^2 = 0.9$

$$= \frac{1}{2}(0.2)\left(2\pi \times \frac{25}{\pi}\right)^2 A^2 = 0.9$$

$\therefore A = 0.06$ m

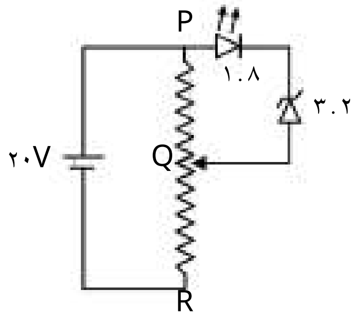
A = ٦ cm

٥٨. A potential divider circuit is connected with a dc source of ٢٠ V, a light emitting diode of glow in voltage ١.٨ V and a zener diode of breakdown voltage of ٣.٢ V. The length (PR) of the resistive wire is ٢٠ cm. The minimum length of PQ to just glow the LED is ……… cm.



Ans. (٥)

Sol.



PR = ٢٠ cm

$$V_{PQ} = \frac{1}{4} \times R_{PR}$$

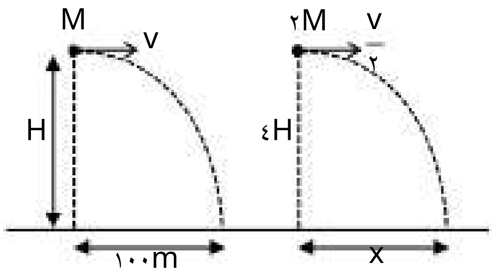
$$\therefore \min(PQ) = \frac{1}{4} \times 20$$

= ٥ cm

٥٩. A body of mass M thrown horizontally with velocity v from the top of the tower of height H touches the ground at a distance of ١٠٠m from the foot of the tower. A body of mass ٢M thrown at velocity $\frac{v}{2}$ from the top of the tower of height ٤H will touch the ground at a distance of ……… m.

Ans. (١٠٠)

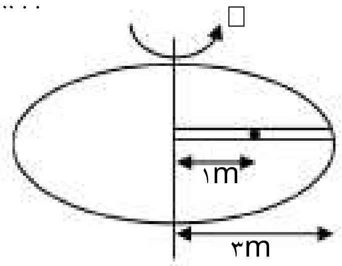
Sol.



$$100 = v\sqrt{\frac{2H}{g}}, \quad x = \frac{v}{2}\sqrt{\frac{2(4H)}{g}} = v\sqrt{\frac{2H}{g}}$$

$\therefore x = 100$ m

٦٠. A circular table is rotating with an angular velocity of ω rad/s about its axis (see figure). There is a smooth groove along a radial direction on the table. A steel ball is gently placed at a distance of ١m on the groove. All the surface are smooth. If the radius of the table is ٣ m, the radial velocity of the ball w.r.t. the table at the time ball leaves the table is $x\sqrt{2}\omega$ m/s, where the value of x is.........



Ans. (٢)

Sol. $a_c = \omega^2 x$

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

$\int_0^v v\,dv = \omega^2 \int_1^3 x\,dx$

$\frac{v^2}{2} = \omega^2\left[\frac{x^2}{2}\right]_1^3$

$\frac{v^2}{2} = \frac{\omega^2}{2}\left(3^2 - 1^2\right)$

$v = 2\sqrt{2}\omega$

$x = 2$

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION–A

٦١. In qualitative test for identification of presence of phosphorous، the compound is heated with an oxidising agent. Which is further treated with nitric acid and ammonium molybdate respectively. The yellow coloured precipitate obtained is :

(١) NaPO ٣ . ٤ ١٢MoO ٣

(٢) NH4 PO ٤ . ١٢NH ٤ MoO ٤

(٣) NH ٤ ٣ PO ٤ . ١٢MoO

(٤) MoPO ٤ . ٢١NHNO ٤ ٣

Ans. (٣)

Sol. PO٤ ٣− + (NH)MoO ٤ —H+→ (NH٤)٣PO٤ . ١٢MoO٣
Or HPO٤ − Ammonium Molybdate
Canary yellow ppt. (Ammonium phospho molybdate)

٦٢. For a reaction A → B → C (K١, K٢)

If the rate of formation of B is set to be zero then the concentration of B is given by :

(١) K١K٢[A] (٢) (K١ – K٢)[A]

(٣) (K١ + K٢)[A] (٤) (K١ /K٢)[A]

Ans. (٤)

Sol. Rate of formation of B is

$$\frac{d[B]}{dt} = k_1[A] - k_2[B]$$

٠ = k١[A] – k٢[B]

٦٣. $\left(\frac{k}{k2}\right)$ [A] [B]

When ψA and ψB are the wave functions of atomic orbitals، then σ* is represented by :

(١) ψA – ٢ψB (٢) ψA – ψB

(٣) ψA + ٢ψB (٤) ψA + ψB

Ans. (٢)

Sol. Antibonding molecular orbitals are formed by destructive interference of wave functions.

(ABMO) ψ* = ψA – ψB

٦٤. Which one the following compounds will readily react with dilute NaOH؟

(١) C٦H٥CH٢OH (٢) C٢H٥OH

(٣) (CH٣)٣COH (٤) C٦H٥OH

Ans. (٤)

Sol.
OH + NaOH → ONa + H٢O

Stronger ACID than H٢O

٦٥. The shape of carbocation is :

(١) trigonal planar (٢) diagonal pyramidal

(٣) tetrahedral (٤) diagonal

Ans. (١)

Sol. Carbocation

H
C⊕
H H

Trigonal planar

٦٦. Given below are two statements : Statement (I) : SN٢ reactions are 'stereospecific'، indicating that they result in the formation of only one stereo-isomers as the product.

Statement (II) : SN١ reactions generally result in formation of product as racemic mixtures. In the light of the above statements، choose the correct answer from the options given below :

(١) Statement I is true but Statement II is false

(٢) Statement I is false but Statement II is true

(٣) Both Statement I and Statement II is true

(٤) Both Statement I and Statement II is false

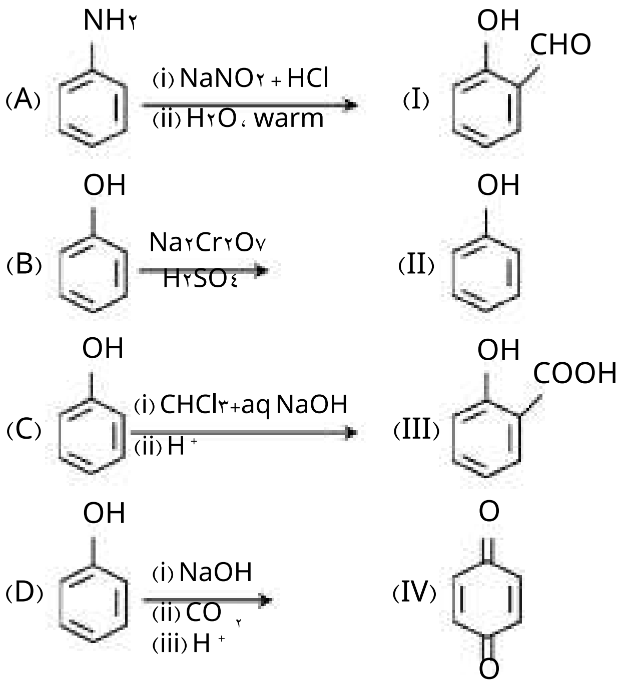
Ans. (٣)

Sol. SN٢ Inversion

SN١ Racemisation

٦٧. Match List-I with List-II.

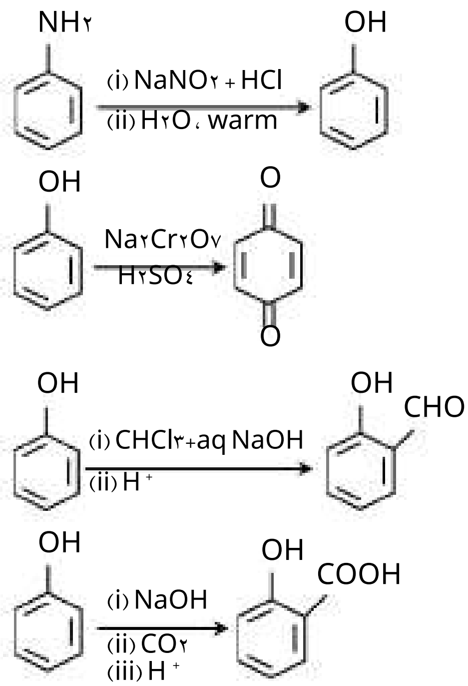
List-I (Reactions) | List-II (Products)



Choose the correct answer from the options given below : (١) (A)-(III), (B)-(II), (C)-(I), (D)-(IV) (٢) (A)-(IV), (B)-(II), (C)-(III), (D)-(I) (٣) (A)-(I), (B)-(IV), (C)-(II), (D)-(III) (٤) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

Ans. (٤)

Sol.



٦٨. Match List-I with List-II.

List-I (Test)	List-II (Identification)
(A) Bayer's test	(I) Phenol
(B) Ceric ammonium nitrate test	(II) Aldehyde
(C) Phthalein dye test	(III) Alcoholic-OH group
(D) Schiff's test	(IV) Unsaturation

Choose the correct answer from the options given below : (١) (A)-(III), (B)-(I), (C)-(IV), (D)-(II) (٢) (A)-(II), (B)-(III), (C)-(IV), (D)-(I) (٣) (A)-(IV), (B)-(I), (C)-(II), (D)-(III) (٤) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

Ans. (٤)

Sol. (A) Bayer's test → Unsaturation

(B) Ceric ammonium nitrate test → Alcoholic-OH group

(C) Phthalein dye test → Phenol

(D) Schiff's test → Aldehyde

٦٩. Identify the incorrect statements about group ١٥ elements :

(A) Dinitrogen is a diatomic gas which acts like an inert gas at room temperature.

(B) The common oxidation states of these elements are -٣, +٣ and +٥.

(C) Nitrogen has unique ability to form pπ–pπ multiple bonds.

(D) The stability of +٥ oxidation states increases down the group.

(E) Nitrogen shows a maximum covalency of ٦.

Choose the correct answer from the options given below.

(١) (A), (B), (D) only (٢) (A), (C), (E) only

(٣) (B), (D), (E) only (٤) (D) and (E) only

Ans. (٤)

Sol. (D) Due to inert pair effect lower oxidation state is more stable.

(E) Nitrogen belongs to ٢nd period and cannot expand its octet.

٧٠. IUPAC name of following hydrocarbon (X) is :

CH٣ – CH – CH٢ – CH٢ – CH – CH – CH٢ – CH٣
with CH٣ on C-2, CH٣ on C-5 and CH٣ on C-6 (X)

(١) ٢-Ethyl-٣،٦-dimethylheptane
(٢) ٢-Ethyl-٢،٦-diethylheptane
(٣) ٢،٥،٦-Trimethyloctane
(٤) ٣،٤،٧-Trimethyloctane

Ans. (٣)

Sol. (carbons numbered ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨)
CH٣ – CH – CH – CH – CH – CH – CH٢ – CH٣
with CH٣ on C-2, CH٣ on C-5 and CH٣ on C-6

٢،٥،٦-Trimethyloctane

٧١. The equilibrium $Cr_{٢}O_{٧}^{2-} \rightleftharpoons ٢CrO_{٤}^{2-}$ is shifted to the right in :
(١) an acidic medium
(٢) a basic medium
(٣) a weakly acidic medium
(٤) a neutral medium

Ans. (٢)

Sol. $Cr_{٢}O_{٧}^{2-} \underset{H^{+}}{\overset{OH^{-}}{\rightleftharpoons}} ٢CrO_{٤}^{2-}$

٧٢. Given below are two statements :

Statement (I) : A Buffer solution is the mixture of a salt and an acid or a base mixed in any particular quantities.

Statement (II) : Blood is naturally occurring buffer solution whose pH is maintained by $H_{٢}CO_{٣}/HCO_{٣}^{-}$ concentrations.

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

(١) Statement I is false but Statement II is true
(٢) Both Statement I and Statement II is true
(٣) Both Statement I and Statement II is false
(٤) Statement I is true but Statement II is false

Ans. (١)

Sol. Buffer solution is a mixture of either weak acid / weak base and its respective conjugate.

Blood is a buffer solution of carbonic acid $H_{٢}CO_{٣}$ and bicarbonate $HCO_{٣}^{-}$

Statement ١ is false but Statement II is true.

٧٣. The correct sequence of acidic strength of the following aliphatic acids in their decreasing order is :

CH٣CH٢COOH, CH٣COOH, CH٣CH٢CH٢COOH, HCOOH

(١) HCOOH > CH٣COOH > CH٣CH٢COOH > CH٣CH٢CH٢COOH
(٢) HCOOH > CH٣CH٢CH٢COOH > CH٣CH٢COOH > CH٣COOH
(٣) CH٣CH٢CH٢COOH > CH٣CH٢COOH > CH٣COOH > HCOOH
(٤) CH٣COOH > CH٣CH٢COOH > CH٣CH٢CH٢COOH > HCOOH

Ans. (١)

Sol. CH٣CH٢COOH, CH٣COOH, CH٣CH٢CH٢COOH, HCOOH

The correct order is :

HCOOH > CH٣COOH > CH٣CH٢COOH > CH٣CH٢CH٢COOH

٧٤. Given below are two statements :

Statement (I) : All the following compounds react with p-toluenesulfonyl chloride.

C٦H٥NH٢ (C٦H٥)٢NH (C٦H٥)٣N

Statement (II) : Their products in the above reaction are soluble in aqueous NaOH.

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

(١) Both Statement I and Statement II is false
(٢) Statement I is true but Statement II is false
(٣) Statement I is false but Statement II is true
(٤) Both Statement I and Statement II is true

Ans. (١)

Sol. Hinsberg test given by ١° amine only.

٧٥. The emf of cell $Tl|Tl^{+}(٠.٠٠١M)||Cu^{٢+}(٠.٠١M)|Cu$ is ٠.٨٣ V at ٢٩٨ K. It could be increased by :

(١) increasing concentration of Tl^{+} ions
(٢) increasing concentration of both Tl^{+} and $Cu^{٢+}$ ions
(٣) decreasing concentration of both Tl^{+} and $Cu^{٢+}$ ions
(٤) increasing concentration of $Cu^{٢+}$ ions

Ans. (٤)

Sol.

Anodic Reaction $Tl_{(s)} \rightarrow Tl^{+}_{(aq)} + e^{-}$ ×٢

Cathodic Reaction $Cu^{2+}_{(aq)} + ٢e^{-} \rightarrow Cu_{(s)}$

Overall Redox Reaction $٢Tl_{(s)} + Cu^{2+}_{(aq)} \rightarrow ٢Tl^{+}_{(aq)} + Cu_{(s)}$

$$E_{cell} = E^{o}_{cell} - \frac{٠.٠٥٩١}{٢}\log\frac{[Tl^{+}]^{٢}}{[Cu^{2+}]}$$

Ecell increases by increasing concentration of Cu^{2+} ions.

٧٦. Identify the correct statements about p-block elements and their compounds.

(A) Non metals have higher electronegativity than metals.

(B) Non metals have lower ionisation enthalpy than metals.

(C) Compounds formed between highly reactive nonmetals and highly reactive metals are generally ionic.

(D) The non-metal oxides are generally basic in nature.

(E) The metal oxides are generally acidic or neutral in nature.

(١) (D) and (E) only (٢) (A) and (C) only

(٣) (B) and (E) only (٤) (B) and (D) only

Ans. (٢)

Sol. As electronegativity increases non-metallic nature increases.

Along the period ionisation energy increases.

High electronegativity difference results in ionic bond formation.

Oxides of metals are generally basic and that of non-metals are acidic in nature.

٧٧. Given below are two statements : Statement (I) : Kjeldahl method is applicable to estimate nitrogen in pyridine. Statement (II) : The nitrogen present in pyridine can easily be converted into ammonium sulphate in Kjeldahl method. In the light of the above statements, choose the correct answer from the options given below. (١) Both Statement I and Statement II is false (٢) Statement I is false but Statement II is true (٣) Both Statement I and Statement II is true (٤) Statement I is true but Statement II is false

Ans. (١) Sol. Nitrogen present in pyridine can not be estimated by Kjeldahl method as the nitrogen present in pyridine can not be easily converted into ammonium sulphate.

٧٨. The reaction :

$$\frac{١}{٢}H_{٢(g)} + AgCl_{(s)} \rightarrow H^{+}_{(aq)} + Cl^{-}_{(aq)} + Ag_{(s)}$$

occurs in which of the following galvanic cell :

(١) $Pt|H_{٢(g)}|HCl_{(soln.)}|AgCl_{(s)}|Ag$

(٢) $Pt|H_{٢(g)}|HCl_{(soln.)}|AgNO_{٣(aq)}|Ag$

(٣) $Pt|H_{٢(g)}|KCl_{(soln.)}|AgCl_{(s)}|Ag$

(٤) $Ag|AgCl_{(s)}|KCl_{(soln.)}|AgNO_{٣(aq.)}|Ag$

Ans. (٣)

Sol. Anodic half cell

Gas – gas ion electrode

$$\frac{١}{2}H_{2(g)} \rightarrow H^{+}_{(aq)} + e^{-}$$

Cathodic Reaction

Metal-metal insoluble salt anion electrode

$Ag^{+}_{(aq)} + e^{-} \rightarrow Ag_{(s)}$

$AgCl_{(s)} \rightleftharpoons Ag^{+}_{(aq)} + Cl^{-}_{(aq)}$

$AgCl_{(s)} + e^{-} \rightarrow Ag_{(s)} + Cl^{-}_{(aq)}$

Overall redox reaction

$\frac{1}{2} H_{2(g)} + AgCl_{(s)} \rightarrow H^{+}_{(aq)} + Cl^{-}_{(aq)} + Ag_{(s)}$

Cell Representation

$Pt | H_{2(g)} | KCl_{(sol)} | AgCl_{(s)} | Ag$

٧٩. Given below are two statements :

Statement (I) : Fusion of MnO_2 with KOH and an oxidising agent gives dark green K_2MnO_4.

Statement (II) : Manganate ion on electrolytic oxidation in alkaline medium gives permanganate ion.

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

(١) Both Statement I and Statement II is true
(٢) Both Statement I and Statement II is false
(٣) Statement I is true but Statement II is false
(٤) Statement I is false but Statement II is true

Ans. (١)

Sol. $MnO_2 + 4KOH + O_2 \xrightarrow{fused} 2K_2MnO_4 + 2H_2O$

Dark green

Electrolytic oxidation in alkaline medium :

At anode :

$MnO_4^{2-} \rightarrow MnO_4^{-} + e^{-}$

٨٠. Match List-I with List-II.

List-I (Complex ion)	List-II (Spin only magnetic moment in B.M.)
(A) $[Cr(NH_3)_6]^{3+}$	(I) ٤.٩٠
(B) $[NiCl_4]^{2-}$	(II) ٣.٨٧
(C) $[CoF_6]^{3-}$	(III) ٠.٠
(D) $[Ni(CN)_4]^{2-}$	(IV) ٢.٨٣

Choose the correct answer from the options given below :

(١) (A)-(I), (B)-(IV), (C)-(II), (D)-(III)
(٢) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
(٣) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
(٤) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Ans. (٣)

Sol. (A) $[Cr(NH_3)_6]^{3+}$

Cr^{3+} : $3d^3$

n = ٣ (unpaired electrons)

$\mu \simeq$ ٣.٨٧ B.M. (II)

(B) $[NiCl_4]^{2-}$

Ni^{2+} : $3d^8$

n = ٢

$\mu \simeq$ ٢.٨٣ B.M. (IV)

(C) $[CoF_6]^{3-}$

Co^{3+} : $3d^6$

n = ٤

$\mu \simeq$ ٤.٩٠ B.M. (I)

(D) $[Ni(CN)_4]^{2-}$

Ni^{2+} : $3d^8$

n = ٠

μ = ٠ B.M. (III)

SECTION-B

٨١. ΔvapH for water is +٤٠.٤٩ kJ mol at ١ bar and ١٠٠°C. Change in internal energy for this vapourisation under same condition is ________ kJ mol⁻¹ (Integer answer)

(Given R = ٨.٣ JK⁻¹ mol⁻¹)

Ans. (٣٨)

Sol. $H_2O(\ell) \rightleftharpoons H_2O(g)$ ΔH°vap = ٤٠.٧٩ kJ/mole

ΔH°vap = ΔU°vap + Δn$_g$RT

٤٠.٧٩ = ΔU°vap + $\frac{١ \times ٨.٣ \times ٣٧٣.١٥}{١٠٠٠}$

ΔU°vap = ٤٠.٧٩ − ٣.٠٩٧١

= ٣٧.٦٩٢٩

ΔU°vap ≃ ٣٨

٨٢. Number of molecules having bond order ٢ from the following molecule is __________.

C٢, O٢, Be٢, Li٢, Ne٢, N٢, He٢

Ans. (٢)

Sol. C٢

(١٢e) : σ١s², σ*١s², σ٢s², σ*٢s² [π٢px² = π٢py²]

B.O. = $\frac{٨ - ٤}{٢}$ = ٢

O٢

(١٦e) : σ١s, σ*١s, σ٢s, σ*٢s, σ٢pz²

[π٢px² = π٢py²] [π*٢px¹ = π*٢py¹]

B.O. = $\frac{١٠ - ٦}{٢}$ = ٢

Be٢

(٨e) : σ١s, σ*١s, σ٢s, σ*٢s²

B.O. = $\frac{٤ - ٤}{٢}$ = ٠

Li٢

(٦e) : σ١s, σ*١s, σ٢s²

B.O. = $\frac{٤ - ٢}{٢}$ = ١

Ne٢

(٢٠e) : σ١s, σ*١s², σ٢s², σ*٢s², σ٢pz²

[π٢px² = π٢py²] [π*٢px² = π*٢py²] σ*٢pz²

B.O. = $\frac{١٠ - ١٠}{٢}$ = ٠

N٢

(١٤e) : σ١s, σ*١s, σ٢s, σ*٢s² [π٢px² = π٢py²] σ٢pz²

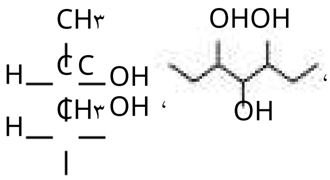
B.O. = $\frac{١٠ - ٤}{٢}$ = ٦

He٢

(٤e) : σ١s, σ*١s²

B.O. = $\frac{٢ - ٢}{٢}$ = ٠

٨٣. Total number of optically active compounds from the following is __________.



CH٣ – CH٢ – CH٢ – CH٢ – OH,
CH٣ – CH٢ – CH – CH٣ (with Cl on CH)
CH٣ – CH٢ – CH – CH – Cl,
(CH٣)٢CH – CH – CH – Cl

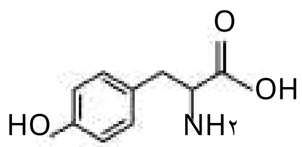
Ans. (١)

Sol. CH٣ – CH٢ – CH – CH٣ (with Cl on CH)

٨٤. The total number of carbon atoms present in tyrosine, an amino acid, is __________.

Ans. (٩)

Sol. Tyrosine

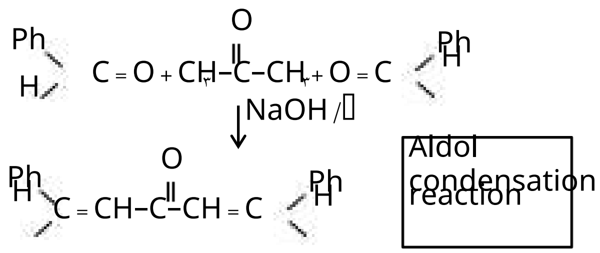


Number of carbon atoms = ٩

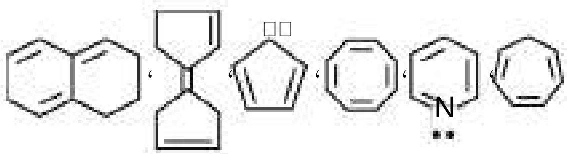
٨٥. Two moles of benzaldehyde and one mole of acetone under alkaline conditions using aqueous NaOH after heating gives x as the major product. The number of □ bonds in the product x is

Ans. (٩)

Sol.

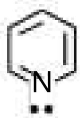


٨٦. Total number of aromatic compounds among the following compounds is ___________.



Ans. (١)

Sol.



٨٧. Molality of an aqueous solution of urea is ٤.٤٤ m. Mole fraction of urea in solution is x × ١٠⁻٣. Value of x is ___________. (integer answer)

Ans. (٧٤)

Sol. Molality of urea is ٤.٤٤ m, that means ٤.٤٤ moles of urea present in ١٠٠٠ gm of water.

$$\square X_{urea} \square \frac{٤.٤٤}{٤.٤٤ \square \frac{١٠٠٠}{١٨}}$$

= ٠.٠٧٤٠

OR

٧٤ □ ١٠ □ ٣

X = ٧٤

٨٨. Total number of unpaired electrons in the complex ion $[Co(NH_3)_6]^{3+}$ and $[NiCl_4]^{2-}$ is

Ans. (٢)

Sol. Co^{+3} : ٣d⁶ t٢g⁶, e g⁰, ٠

Unpaired e⁻ = ٠

Ni^{+2} : ٣d ٨ e٢, ٢t٢, ١, ١

Unpaired e⁻ = ٢

٨٩. Wavenumber for a radiation having ٥٨٠٠ Å wavelength is x × ١٠ cm⁻¹. The value of x is _______.

Ans. (١٧٢٤)

Sol. □ (wave no.) = $\frac{١}{\square}$ □ $\frac{١}{٥٨٠٠ \square ١٠ \square ٨ \text{ cm}}$ = ١٧٢٤١

OR

١٧٢٤ □ ١٠ cm □ ١ □□ x = ١٧٢٤

٩٠. A solution is prepared by adding ١ mole ethyl alcohol in ٩ mole water. The mass percent of solute in the solution is ___________ (Integer Answ (Given : Molar mass in g mol⁻¹ Ethyl alcohol : ٤٦, water : ١٨)

Ans. (٢٢)

Sol. Mass percent of Alcohol

$$= \frac{\text{Mass of ethyl alcohol}}{\text{Total mass of solution}} \square ١٠٠$$

$$= \frac{١ \square ٤٦}{١ \square ٤٦ \square ٩ \square ١٨} \square ١٠٠ = \frac{٤٦٠٠}{٢٠٨}$$

= ٢٢.١١ Or ٢٢