JEE Main 2020 Paper

Date : 2nd September 2020

Time : 09 : 00 am - 12 : 00 pm

Subject : Maths

Q.1 A line parallel to the straight line 2x-y=0 is tangent to the hyperbola $\frac{x^2}{4}-\frac{y^2}{2}=1$ at the point (x_1,y_1). Then $x_1^2+5y_1^2$ is equal to :

(1) 6 (2) 10 (3) 8 (4) 5

Sol. **1**

$T: \frac{xx_1}{4}-\frac{yy_1}{2}=1 \quad ....(1)$

t : 2x — y = 0 is parallel to T

$\Rightarrow T: 2x - y = \lambda \quad ....(2)$

Now compare (1) & (2)

$$\frac{\frac{x_1}{4}}{2}=\frac{\frac{y_1}{2}}{1}=\frac{1}{\lambda}$$

$x_1=8/\lambda$ & $y_1 = 2/\lambda$

(x_1,y_1) lies on hyperbola $\Rightarrow \frac{64}{4\lambda^2}-\frac{4}{2\lambda^2}=1$

$\Rightarrow 14 = \lambda^2$

Now

$x_1^2+5y_1^2$

$=\frac{64}{\lambda^2}+5\frac{4}{\lambda^2}$

$=\frac{84}{14}$

= 6 Ans.

Q.2 The domain of the function $f(x)=\sin^{-1}\left(\frac{|x|+5}{x^2+1}\right)$ is $(-\infty,-a]\cup[a,\infty)$. Then a is equal to :

(1) $\frac{\sqrt{17}-1}{2}$ (2) $\frac{\sqrt{17}}{2}$ (3) $\frac{1+\sqrt{17}}{2}$ (4) $\frac{\sqrt{17}}{2}+1$

Sol. **3**

$-1 \le \frac{|x|+5}{x^2+1} \le 1$

$-x^2-1 \le |x|+5 \le x^2+1$

case - I

$-x^2-1 \le |x|+5$

this inequality is always right $\forall\ x \in R$

case - II

$|x|+5 \leq x^2+1$

$x^2 - |x| \geq 4$

$|x|^2-|x|-4 \geq 0$

$$\left(|x|-\left(\frac{1+\sqrt{17}}{2}\right)\right)\left(|x|-\left(\frac{1-\sqrt{17}}{2}\right)\right) \geq 0$$

$|x| \leq \frac{1-\sqrt{17}}{2}$ (Not possible)

or

$|x| \geq \frac{1+\sqrt{17}}{2}$

$$x \in \left(-\infty, \frac{-1-\sqrt{17}}{2}\right] \cup \left[\frac{1+\sqrt{17}}{2}, \infty\right)$$

$a = \frac{1+\sqrt{17}}{2}$

Q.3 If a function f(x) defined by $f(x) = \begin{cases} ae^x + be^{-x}, & -1 \leq x < 1 \\ cx^2, & 1 \leq x \leq 3 \\ ax^2 + 2cx, & 3 < x \leq 4 \end{cases}$ be continuous for some a, $b, c \in R$ and $f'(0)+f'(2) = e$, then the value of a is :

(1) $\frac{1}{e^2 - 3e + 13}$ (2) $\frac{e}{e^2 - 3e - 13}$ (3) $\frac{e}{e^2 + 3e + 13}$

(4) $\frac{e}{e^2 - 3e + 13}$

Sol. **4**

f(x) is continuous

at x=1 $\Rightarrow$

at x=3 $\Rightarrow$ 9c = 9a + 6c $\Rightarrow$ c=3a

Now $f'(0) + f'(2) = e$

$\Rightarrow$ a – b + 4c = e

$\Rightarrow$ a – e (3a–ae) + 4.3a = e

$\Rightarrow$ a – 3ae + ae^2 + 12a = e

$\Rightarrow$ 13a – 3ae + ae^2=e

$$\Rightarrow \boxed{a = \frac{e}{13 - 3e + e^2}}$$

Q.4 The sum of the first three terms of a G.P. is S and their product is 27. Then all such S lie in :

(1) $(-\infty,-9] \cup [3,\infty)$ (2) $[-3,\infty)$ (3) $(-\infty, 9]$ (4) $(-\infty,-3] \cup [9,\infty)$

Sol. **4**

$\frac{a}{r}.a.ar = 27 \Rightarrow a = 3$

$\frac{a}{r} + a + ar = S$

$\frac{1}{r} + 1 + r = \frac{S}{3}$

$r + \frac{1}{r} = \frac{S}{3} - 1$

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

$\frac{S}{3} \geq 3$ or $\frac{S}{3} \leq -1$

$S \geq 9$ or $S \leq -3$

$S \in (-\infty, -3] \cup [9, \infty)$

Q.5 If $R = \{(x, y) : x, y \in Z, x^2 + 3y^2 \leq 8\}$ is a relation on the set of integers Z, then the domain of R^{-1} is :

(1) $\{-1, 0, 1\}$ (2) $\{-2, -1, 1, 2\}$ (3) $\{0, 1\}$ (4) $\{-2, -1, 0, 1, 2\}$

Sol. **1**

$3y^2 \leq 8 - x^2$

R : {(0,1), (0,–1), (1,0),(–1,0), (1,1), (1,-1)
(-1,1), (-1,-1), (2,0), (-2,0),(-2,0),(2,1),(2,-1), (-2,1),(-2,-1)}

$\Rightarrow$ R : {-2,-1,0,1,2}→{-1,0,-1}

Hence R^{-1} : {-1,0,1}→{-2,-1,0,1,2}

Q.6 The value of $\left(\dfrac{1 + \sin\frac{2\pi}{9} + i\cos\frac{2\pi}{9}}{1 + \sin\frac{2\pi}{9} - i\cos\frac{2\pi}{9}}\right)^3$ is :

(1) $-\frac{1}{2}\left(1 - i\sqrt{3}\right)$ (2) $\frac{1}{2}\left(1 - i\sqrt{3}\right)$ (3) $-\frac{1}{2}\left(\sqrt{3} - i\right)$ (4) $\frac{1}{2}\left(\sqrt{3} - i\right)$

Sol. **3**

$$\left(\frac{1 + \sin\frac{2\pi}{9} + i\cos\frac{2\pi}{9}}{1 + \sin\frac{2\pi}{9} - i\cos\frac{2\pi}{9}}\right)^3$$

$$= \left(\frac{1 + \cos\left(\frac{\pi}{2} - \frac{2\pi}{9}\right) + i\sin\left(\frac{\pi}{2} - \frac{2\pi}{9}\right)}{1 + \cos\left(\frac{\pi}{2} - \frac{2\pi}{9}\right) - i\sin\left(\frac{\pi}{2} - \frac{2\pi}{9}\right)}\right)^3$$

$$= \left(\frac{1 + \cos\frac{5\pi}{18} + i\sin\frac{5\pi}{18}}{1 + \cos\frac{5\pi}{18} - i\sin\frac{5\pi}{18}} \right)^3$$

$$= \left(\frac{2\cos\frac{5\pi}{36}\left\{\cos\frac{5\pi}{36} + i\sin\frac{5\pi}{36}\right\}}{2\cos\frac{5\pi}{36}\left\{\cos\frac{5\pi}{36} - i\sin\frac{5\pi}{36}\right\}} \right)^3$$

$$= \left(\frac{\text{cis}\left(\frac{5\pi}{36}\right)}{\text{cis}\left(\frac{-5\pi}{36}\right)} \right)^3$$

$$= \left(\frac{e^{i\left(\frac{5\pi}{36}\right)}}{e^{-i\left(\frac{5\pi}{36}\right)}} \right)^3$$

$$= \left(e^{i\left(\frac{5\pi}{36}\right)+i\left(\frac{5\pi}{36}\right)} \right)^3$$

$$= \left(e^{2i\left(\frac{5\pi}{36}\right)} \right)^3$$

$$= e^{i\left(\frac{30\pi}{36}\right)}$$

$$= e^{i\left(\frac{5\pi}{6}\right)}$$

$$= \text{cis}\left(\frac{5\pi}{6}\right) = \boxed{-\frac{\sqrt{3}}{2} + \frac{i}{2}}$$

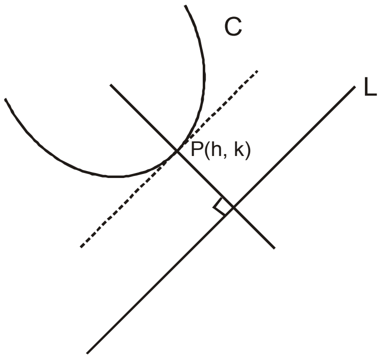
Q.7 Let P(h,k) be a point on the curve $y=x^2+7x+2$, nearest to the line, $y=3x-3$. Then the equation of the normal to the curve at P is:

(1) $x+3y-62=0$ (2) $x-3y-11=0$ (3) $x-3y+22=0$ (4) $x+3y+26=0$

Sol. **4**

C : $y = x^2 + 7x + 2$

Let P : (h, k) lies on



Curve $k = h^2 + 7h + 2$ ....(1)

Now for shortest distance

Slope of tangent line at point P = slope of line L

$$\left.\frac{dy}{dx}\right|_{\text{at } P(h,k)} = m_L$$

$$\left.\frac{d}{dx}\left(x^2 + 7x + 2\right)\right|_{\text{at } P(h,k)} = 3$$

$$\left.(2x + 7)\right|_{\text{at } P(h,k)} = 3$$

$2h + 7 = 3$

$h = -2$

from equation (1)

$k = -8$

P : (-2,-8)

equation of normal to the curve is perpendicular to L : $3x - y = 3$

N : $x + 3y = \lambda$

$\downarrow$ Pass (-2,-8)

$\lambda = -26$

N : $x + 3y + 26 = 0$

Q.8 Let A be a 2×2 real matrix with entries from $\{0,1\}$ and $|A| \neq 0$. Consider the following two statements:

(P) If $A \neq I_2$, then $|A| = -1$

(Q) If $|A| = 1$, then tr(A) = 2,

where I_2 denotes 2×2 identity matrix and tr(A) denotes the sum of the diagonal entries of A. Then:

(1) Both (P) and (Q) are false
(2) (P) is true and (Q) is false
(3) Both (P) and (Q) are true
(4) (P) is false and (Q) is true

Sol. **4**

P : $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \neq I_2$ & $|A| \neq 0$ & $|A| = 1$(false)

Q : $|A| = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} = 1$ then Tr(A) = 2 (true)

Q.9 Box I contains 30 cards numbered 1 to 30 and Box II contains 20 cards numbered 31 to 50. A box is selected at random and a card is drawn from it. The number on the card is found to be a non-prime number. The probability that the card was drawn from Box I is:

(1) $\frac{4}{17}$ (2) $\frac{8}{17}$ (3) $\frac{2}{5}$ (4) $\frac{2}{3}$

Sol. **2**

$\boxed{1 \text{ to } 30}$

box I

Prime on I
$\{2,3,5,7,11,13,17,19,23,29\}$

$\boxed{31 \text{ to } 50}$

box II

Prime on II
$\{31,37,41,43,47\}$
A : selected number on card is non - prime
P(A) = P(I).P(A/I) + P(II). P(A/II)

$$= \frac{1}{2} \times \frac{20}{30} + \frac{1}{2} \cdot \frac{15}{20}$$

$$\text{Now, } P(I/A) = \frac{P(II).P(A/I)}{P(A)}$$

$$= \frac{\frac{1}{2} \cdot \frac{20}{30}}{\frac{1}{2} \cdot \frac{20}{30} + \frac{1}{2} \cdot \frac{15}{20}} = \frac{\frac{2}{3}}{\frac{2}{3} + \frac{3}{4}} = \frac{8}{17}$$

Q.10 If p(x) be a polynomial of degree three that has a local maximum value 8 at x=1 and a local minimum value 4 at x=2; then p(0) is equal to :
(1) 12 (2) -12 (3) -24 (4) 6

Sol. **2**
$p'(1) = 0$ & $p'(2) = 0$
$p'(x) = a(x-1)(x-2)$

$$p(x) = a\left(\frac{x^3}{3} - \frac{3x^2}{2} + 2x\right) + b$$

$$p(1) = 8 \Rightarrow a\left(\frac{1}{3} - \frac{3}{2} + 2\right) + b = 8 \qquad \ldots(i)$$

$$p(2) = 4 \Rightarrow a\left(\frac{8}{3} - \frac{3.4}{2} + 2.2\right) + b = 4 \qquad \ldots\ldots(ii)$$

from equation (i) and (ii)
$a = 24$ & $b = -12$
$p(0) = b = -12$

Q.11 The contrapositive of the statement "If I reach the station in time, then I will catch the train" is:
(1) If I will catch the train, then I reach the station in time.
(2) If I do not reach the station in time, then I will catch the train.
(3) If I do not reach the station in time, then I will not catch the train.
(4) If I will not catch the train, then I do not reach the station in time.

Sol. 4
Statement p and q are true
Statement, then the contra positive of the implication
$p \to q = (\sim q) \to (\sim p)$
hence correct Ans. is 4

Q.12 Let α and β be the roots of the equation, $5x^2+6x-2=0$. If $S_n = \alpha^n + \beta^n$, n=1,2,3,....., then:
(1) $5S_6+6S_5+2S_4=0$ (2) $6S_6+5S_5=2S_4$
(3) $6S_6+5S_5+2S_4=0$ (4) $5S_6+6S_5=2S_4$

Sol. 4

$5x^2 + 6x - 2 = 0 <^{\alpha}_{\beta} = 5\alpha^2 + 6\alpha = 2$
$6\alpha - 2 = -5\alpha^2$
Simillarly
$6\beta - 2 = -5\beta^2$
$S_6 = \alpha^6 + \beta^6$
$S_5 = \alpha^5 + \beta^5$
$S_4 = \alpha^4 + \beta^4$
Now $6S_5 - 2S_4$
$= 6\alpha^5 - 2\alpha^4 + 6\beta^5 - 2\beta^4$
$= a^4(6\alpha-2) + \beta^4(6\beta-2)$
$= \alpha^4(-5\alpha^2) + \beta^4(-5\beta^2)$
$= -5(\alpha^6 + \beta^6)$
$= -5S_6$
$= 6S_5 + 5S_6 = 2S_4$

Q.13 If the tangent to the curve y=x+siny at a point (a,b) is parallel to the line joining $\left(0,\frac{3}{2}\right)$ and $\left(\frac{1}{2},2\right)$, then:

(1) $b = \frac{\pi}{2} + a$ (2) |a+b|=1 (3) |b-a|=1 (4) b=a

Sol. 3

$$\left.\frac{dy}{dx}\right|_{p(a,b)}^{c} = \frac{2-\frac{3}{2}}{\frac{1}{2}-0}$$

$1 + \cos b = 1$ | p : (a,b) lies on curve
$\cos b = 0$ | $b = a + \sin b$

$\boxed{b = a \pm 1}$

$b - a = \pm 1$

$\boxed{|b - a| = 1}$

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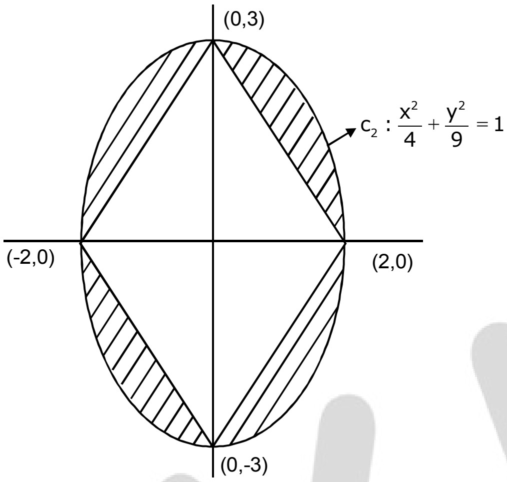
Q.14 Area (in sq. units) of the region outside $\frac{|x|}{2}+\frac{|y|}{3}=1$ and inside the ellipse $\frac{x^2}{4}+\frac{y^2}{9}=1$ is:

(1) $3(\pi-2)$ (2) $6(\pi-2)$ (3) $6(4-\pi)$ (4) $3(4-\pi)$

Sol. **2**

$c_1 : \frac{|x|}{2}+\frac{|y|}{3}=1$



$A = 4\left(\frac{\pi ab}{4}-\frac{1}{2}.2.3\right)$

$A = \pi . 2. 3 - 12$

$A = 6(\pi-2)$

Q.15 If $|x|<1, |y|<1$ and $x \neq y$, then the sum to infinity of the following series $(x+y)+(x^2+xy+y^2)+(x^3+x^2y+xy^2+y^3)+....$ is:

(1) $\frac{x+y+xy}{(1-x)(1-y)}$ (2) $\frac{x+y-xy}{(1-x)(1-y)}$ (3) $\frac{x+y+xy}{(1+x)(1+y)}$ (4) $\frac{x+y-xy}{(1+x)(1+y)}$

Sol. **2**

$(x+y)+(x^2+xy+y^2)+(x^3+x^2y+xy^2+y^3)+.... \infty$

$$= \frac{1}{(x-y)}\left\{\left(x^2-y^2\right)+\left(x^3-y^3\right)+\left(x^4-y^4\right)+...\infty\right\}$$

$$= \frac{\frac{x^2}{1-x}-\frac{y^2}{1-y}}{x-y}$$

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

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

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

Q.16 Let $\alpha > 0, \beta > 0$ be such that $\alpha^3 + \beta^2 = 4$. If the maximum value of the term independent of x in the binomial expansion of $\left(\alpha x^{\frac{1}{9}} + \beta x^{-\frac{1}{6}}\right)^{10}$ is 10k, then k is equal to:

(1) 176 (2) 336 (3) 352 (4) 84

Sol. **2**

For term independent of x

$$T_{r+1} = {}^{10}C_r \left(\alpha x^{\frac{1}{9}}\right)^{10-r} . \left(\beta x^{-\frac{1}{6}}\right)^r$$

$$T_{r+1} = {}^{10}C_r \alpha^{10-r} \beta^r . x^{\frac{10-r}{9}} . x^{-\frac{r}{6}}$$

$$\because \frac{10-r}{9} - \frac{r}{6} = 0 \Rightarrow r = 4$$

$$T_5 = {}^{10}C_r \alpha^6 . \beta^4$$

$\because$ AM $\geq$ GM

Now $$\frac{\left(\frac{\alpha^3}{2} + \frac{\alpha^3}{2} + \frac{\beta^2}{2} + \frac{\beta^2}{2}\right)}{4} \geq \sqrt[4]{\frac{\alpha^6 . \beta^4}{2^4}} \qquad \because \left(\alpha^3 + \beta^2 = 4\right)$$

Take 4th power

$$\left(\frac{4}{4}\right)^4 \geq \frac{\alpha^6 \beta^4}{2^4}$$

$$\alpha^6 . \beta^4 \leq 2^4$$

$${}^{10}C_4 . \alpha^6 . \beta^4 \leq {}^{10}C_4 2^4$$

$$T_5 \leq {}^{10}C_4 2^4$$

$$T_5 \leq \frac{10!}{6!4!} . 2^4$$

$$T_5 \leq \frac{10.9.8.7.2^4}{4.3.2.1}$$

maximum value of T_5 = 10. 3.7. 16 = 10k

k = 16.7.3

k = 336

Q.17 Let S be the set of all $\lambda \in R$ for which the system of linear equations

2x-y+2z=2

x-2y+λz=-4

x+λy+z=4

has no solution. Then the set S

(1) is an empty set. (2) is a singleton.

(3) contains more than two elements. (4) contains exactly two elements.

Sol. **4**

For no solution

$\Delta = 0 \ \& \ \Delta_1|\Delta_2|\Delta_3 \neq 0$

$$\Delta = \begin{vmatrix} 2 & -1 & 2 \\ 1 & -2 & \lambda \\ 1 & \lambda & 1 \end{vmatrix} = 0$$

$2(-2-\lambda^2) + 1(1-\lambda) + 2(\lambda+2) = 0$

$-4 - 2\lambda^2 + 1 - \lambda + 2\lambda + 4 = 0$

$-2\lambda^2 + \lambda + 1 = 0$

$2\lambda^2 - \lambda - 1 = 0 \Rightarrow \lambda = 1, -1/2$

For two values of λ equations has no solution

Q.18 Let $X = \{x \in N : 1 \leq x \leq 17\}$ and $Y = \{ax + b : x \in X \text{ and } a, b \in R, a > 0\}$. If mean and variance of elements of Y are 17 and 216 respectively then a+b is equal to:

(1)-27 (2) 7 (3)-7 (4) 9

Sol. **3**

X : {1,2,.....17}

Y : {ax+b : x∈X & a, $b \in R$, a>o}

Given Var(Y) = 216

$$\frac{\sum y_1^2}{n} - (\text{mean})^2 = 216$$

$$\frac{\sum y_1^2}{17} - 289 = 216$$

$\sum y_1^2 = 8585$

$(a+b)^2 + (2a+b)^2 + \ldots + (17a+b)^2 = 8585$

$105a^2 + b^2 + 18ab = 505$ ....(1)

Now $\sum y_1 = 17\times17$

$a(17\times9) + 17.b = 17 \times 17$

$9a + b = 17$ ....(2)

from equation (1) & (2)

a = 3 & b = -10

a+b = −7

Q.19 Let y=y(x) be the solution of the differential equation, $\frac{2+\sin x}{y+1}.\frac{dy}{dx} = -\cos x, y > 0, y(0) = 1.$ If $y(\pi) = a$, and $\frac{dy}{dx}$ at $x = \pi$ is b, then the ordered pair (a,b) is equal to:

(1) $\left(2, \frac{3}{2}\right)$ (2) (1,1) (3) (2,1) (4) (1,-1)

Sol. **2**

$$\int \frac{dy}{y+1} = \int \frac{-\cos x \ dx}{2+\sin x}$$

ln |y+1| = -ln |2+sin x| + k

$\downarrow (0,1)$

k = ln 4

Now C : (y+1) (2+sin x) = 4

$y(\pi)=a \Rightarrow (a+1)(2+0)=4 \Rightarrow (a=1)$

$$\left.\frac{dy}{dx}\right|_{x=\pi} = b \Rightarrow b = -(-1)\left(\frac{2+0}{1+1}\right)$$

$\Rightarrow b = 1$

(a,b) = (1,1)

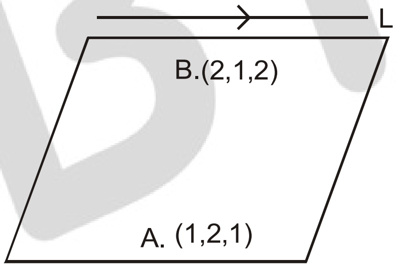
Q.20 The plane passing through the points (1,2,1), (2,1,2) and parallel to the line, 2x=3y, z=1 also passes through the point:

(1) (0,-6,2) (2) (0,6,-2) (3) (-2,0,1) (4) (2,0,-1)

Sol. **3**

$$L : \begin{cases} 2x = 3y \\ z = 1 \end{cases} < \begin{matrix} P:(0,0,1) \\ Q:(3,2,1) \end{matrix}$$

$\vec{V}_L$ Dr of line (3,2,0)



$\vec{n}_p = \overrightarrow{AB} \times \vec{V}_L$

$\vec{n}_p = \langle 1,-1,1 \rangle \times \langle 3,2,0 \rangle$

$\vec{n}_p = \langle -2,+3,5 \rangle$

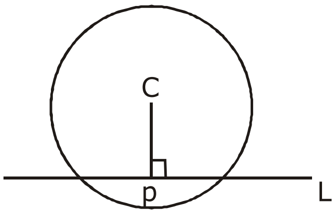
Plane : −2(x-1)+3(y-2)+5(z -1)=0

Plane : -2x+3y+5z+2−6-5=0

Plane : 2x − 3y - 5z = -9

Q.21 The number of integral values of k for which the line, $3x+4y=k$ intersects the circle, $x^2+y^2-2x-4y+4=0$ at two distinct points is...............

Sol. **9**



c : (1,2) & r = 1

$|cp| < r$

$$\left|\frac{3.1+4.2-k}{5}\right| < 1$$

$|11-k|<5$

$-5<k-11<5$

$6<k<16$

$k = 7, 8, 9, \ldots\ldots., 15 \Rightarrow$ total 9 value of k

Q.22 Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that $\left|\vec{a}-\vec{b}\right|^2+\left|\vec{a}-\vec{c}\right|^2=8$. Then $\left|\vec{a}+2\vec{b}\right|^2+\left|\vec{a}+2\vec{c}\right|^2$ is equal to :

Sol. **2**

$$\left|\vec{a}-\vec{b}\right|^2+\left|\vec{a}-\vec{c}\right|^2=8$$

$$\left(\vec{a}-\vec{b}\right).\left(\vec{a}-\vec{b}\right)+\left(\vec{a}-\vec{c}\right)\left(\vec{a}-\vec{c}\right)=8$$

$a^2+b^2-2a.b+a^2+c^2-2a.c=8$

$2a^2+b^2+c^2-2a.b-2a.c=8$

$a.b+a.c=-2$

Now $|\vec{a}+2\vec{b}|^2+|\vec{a}+2\vec{c}|^2$

$= 2a^2+4b^2+4c^1+4\bar{a}.\bar{b}+4\bar{a}.\bar{c}$

$= 2+4+4+4(-2)$

$= 2$

Q.23 If the letters of the word 'MOTHER' be permuted and all the words so formed (with or without meaning) be listed as in a dictionary, then the position of the word 'MOTHER' is.........

Sol. **309**

E H M O R T

E - - - - -	= 5!
H - - - - -	= 5!
M E - - - -	= 4!
M H - - - -	= 4!
M O E - - -	= 3!
M O H - - -	= 3!
M O R - - -	= 3!
M O T E - -	= 2!
M O T H E R	= 1
	309

Q.24. If $\lim_{x\to1}\frac{x+x^2+x^3+\dots+x^n-n}{x-1}=820,(n\in N)$ then the value of n is equal to :

Sol. **40**

$$\lim_{x\to1}\frac{(x-1)}{x-1}+\frac{(x^2-1)}{x-1}+\dots+\frac{(x^n-1)}{x-1}=820$$

$\Rightarrow$ 1 + 2 + 3 + ...+n = 820

$\Rightarrow \sum n=820$

$\Rightarrow \frac{n(n+1)}{2}=820$

$\Rightarrow$ n = 40

Q.25 The integral $\int_0^2 ||x-1|-x|\,dx$ is equal to :

Sol. **1.5**

$$\int_0^2 ||x-1|-x|\,dx$$

$$=\int_0^1 |1-x-x|\,dx+\int_1^2 |x-1-x|\,dx$$

$$=\int_0^1 |2x-1|\,dx+\int_1^2 1\,dx$$

$$=\int_0^{\frac{1}{2}}(1-2x)\,dx+\int_{\frac{1}{2}}^1(2x-1)\,dx+\int_1^2 1\,dx$$

$$=\left[\left(\frac{1}{2}-0\right)-\left(\frac{1}{4}-0\right)\right]+\left(1-\frac{1}{4}\right)-\left(1-\frac{1}{2}\right)+1$$

$$=\frac{1}{2}-\frac{1}{4}+\frac{3}{4}-\frac{1}{2}+1=\frac{3}{2}$$