JEE Main September 2020

Question Paper With Text Solution

5 September| Shift-1

MATHEMATICS

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

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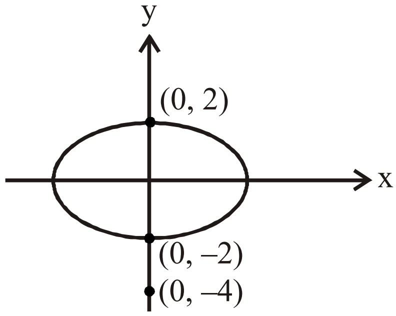
JEE MAIN SEP 2020 | 5 SEP SHIFT-1

1. If the point P on the curve, $4x^2 + 5y^2 = 20$ is farthest from the point Q(0, –4), then PQ^2 is equal to :

(1) 36 (2) 21 (3) 48 (4) 29

Ans. (1)

Sol. The longest distance of point Q from the curve will be along the normal.



Equation of normal is

$$\frac{\sqrt{5}x}{\cos\theta} - \frac{2y}{\sin\theta} = 5 - 4 = 1$$

$\Rightarrow \sqrt{5}x\sin\theta - 2y\cos\theta = \sin\theta\cos\theta$

passes through (0, –4)

$\Rightarrow 0 - 2\times(-4)\cos\theta = \sin\theta\cos\theta$

$\Rightarrow \cos\theta = 0$ or $\sin\theta = 8$ (Not possible)

So the normal will be x = 0.

The farthest point P will be (0, 2).

$PQ_{max} = 6$ units $(PQ)^2 = 36$

2. If S is the sum of the first 10 terms of the series : $\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{13}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{21}\right) + ...$, then tan(S) is equal to :

(1) $\frac{5}{6}$ (2) $\frac{10}{11}$ (3) $-\frac{6}{5}$ (4) $\frac{5}{11}$

Ans. (1)

Sol. $\text{Sum} = \sum_{n=1}^{10} \tan^{-1} \frac{1}{1+n(n+1)} = \sum_{n=1}^{10} \tan^{-1} \frac{(n+1)-(n)}{1+n(n+1)}$

$= \sum_{n=1}^{10} \left[\tan^{-1}(n+1) - \tan^{-1}(n) \right]$

$= \left(\tan^{-1}2 - \tan^{-1}1\right) + \left(\tan^{-1}3 - \tan^{-1}2\right) + ...\left(\tan^{-1}11 - \tan^{-1}10\right)$

$= \tan^{-1}11 - \tan^{-1}1$

$== \tan^{-1}\left(\frac{11-1}{11+1}\right)$

$S = \tan^{-1}\frac{5}{6}$

$\Rightarrow \tan S = \frac{5}{6}$

3. The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{1}{1+e^{\sin x}}$ is :

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

Ans. (1)

Sol. $I = \int_{-\pi/2}^{\pi/2} \frac{1}{1+e^{\sin x}} dx$ ....(1)

Using $I(a+b-x) = I(x)$;

$I = \int_{-\pi/2}^{\pi/2} \frac{dx}{1+e^{-\sin x}} = \int_{-\pi/2}^{\pi/2} \frac{e^{\sin x}}{1+e^{\sin x}} dx$ ....(2)

(1) + (2)

$\Rightarrow 2I = \int_{-\pi/2}^{\pi/2} \frac{1+e^{\sin x}}{1+e^{\sin x}} dx$

$\Rightarrow 2I = \int_{-\pi/2}^{\pi/2} dx = \pi$

$\Rightarrow I = \frac{\pi}{2}$

4. The negation of the Boolean expression $x \leftrightarrow \sim y$ is equivalent to :

(1) $(x \wedge \sim y) \vee (\sim x \wedge y)$ (2) $(\sim x \wedge y) \vee (\sim x \wedge \sim y)$

(3) $(x \wedge y) \wedge (\sim x \vee \sim y)$ (4) $(x \wedge y) \vee (\sim x \wedge \sim y)$

Ans. (4)

Sol. $x \leftrightarrow \sim y = (x \Rightarrow \sim y) \wedge (\sim y \Rightarrow x)$

$= (\sim x \vee \sim y) \wedge (\sim(\sim y) \vee x)$

$= (\sim x \vee \sim y) \wedge (y \vee x)$

Using De-Morgan's law

Its negation will be $(x \wedge y) \vee (\sim x \wedge \sim y)$

5. Let $\lambda \in R$. The system of linear equations

$2x_1 - 4x_2 + \lambda x_3 = 1$

$x_1 - 6x_2 + x_3 = 2$

$\lambda x_1 - 10x_2 + 4x_3 = 3$

is inconsistent for :

(1) every value of λ (2) exactly two values of λ

(3) exctly one negative value of λ (4) exctly one positive value of λ

Ans. (3)

Sol. $\Delta = 0 \Rightarrow \begin{vmatrix} 2 & -4 & \lambda \\ 1 & -6 & 1 \\ \lambda & -10 & 4 \end{vmatrix} = 0$

$\Rightarrow \lambda = 3$ or $-\frac{2}{3}$

for $\lambda = 3,\ \Delta_1 = 0 = \Delta_2 = \Delta_3$

$\Rightarrow$ Infinite solutions

for $\lambda = -\frac{2}{3}$

$\Delta_1 \neq 0 \Rightarrow$ Inconsistent

$\Rightarrow$ exactly one negative value of λ.

6. If the volume of a parallelopiped, whose coterminus edges are given by the vectors $\vec{a} = \hat{i} + \hat{j} + n\hat{k}$, $\vec{b} = 2\hat{i} + 4\hat{j} - n\hat{k}$ and $\vec{c} = \hat{i} + n\hat{j} + 3\hat{k}$ $(n \geq 0)$, is 158 cu. units, then :

(1) $\vec{a}.\vec{c} = 17$ (2) $n = 9$ (3) $\vec{b}.\vec{c} = 10$ (4) $n = 7$

Ans. (3)

Sol. Volume of parallelopiped $= \begin{vmatrix} 1 & 1 & n \\ 2 & 4 & -n \\ 1 & n & 3 \end{vmatrix} = 158$.

$\Rightarrow |1\,(12 + n^2) - 1(6 + n) + n(2n - 4)| = 158$

$\Rightarrow |3n^2 - 5n + 6| = 158$

$\Rightarrow 3n^2 - 5n + 6 = 158$ or -158

$\Rightarrow 3n^2 - 5n - 152 = 0$ or $3n^2 - 5n + 164 = 0$

The second equation has no real roots.

$3n^2 - 24n + 19n - 152 = 0$

$\Rightarrow 3n\,(n - 8) + 19\,(n - 8) = 0$

$\Rightarrow (3n + 19)\,(n - 8) = 0$

$\Rightarrow n = 8$ or $-\frac{19}{3}$

Since $n \geq 0$, so $n = 8$

$\vec{a} = \hat{i} + \hat{j} + 8\hat{k}$, $\vec{b} = 2\hat{i} + 4\hat{j} - 8\hat{k}$ and $\vec{c} = \hat{i} + 8\hat{j} + 3\hat{k}$

So $\vec{b}.\vec{c} = 10$

7. The mean and variance of 7 observations are 8 and 16, respectively. If five observations are 2, 4, 10, 12, 14, then the absolute difference of the remaining two observations is :

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

Ans. (4)

Sol. Let the remaining observations are x and y.

Mean $= \frac{2 + 4 + 10 + 12 + 14 + x + y}{7} = 8$

$\Rightarrow 42 + x + y = 56 \;\; \Rightarrow x + y = 14$ .... (1)

$$\text{Variance} = \frac{\sum_{i=1}^{7} x_i^2}{7} - \left(\bar{x}\right)^2 = 16$$

$$\Rightarrow \frac{2^2+4^2+10^2+12^2+14^2+x^2+y^2}{7} - (8)^2 = 16$$

$\Rightarrow 460 + x^2 + y^2 = 560 \quad \Rightarrow x^2 + y^2 = 100$ .... (2)

$(1)^2 - 2 \qquad \Rightarrow 2xy = 196 - 100 = 96$

$\Rightarrow xy = 48$ .... (3)

From (1) and (3)

$$x + \frac{48}{x} = 14 \Rightarrow x^2 - 14x + 48 = 0$$

$\Rightarrow x = 6$ and $y = 8$ or $x = 8$ and $y = 6$

$\Rightarrow |x - y| = 2$

8. If α is the positive root of the equation, $p(x) = x^2 - x - 2 = 0$, then $\lim\limits_{x\to\alpha^+} \dfrac{\sqrt{1-\cos(p(x))}}{x+\alpha-4}$ is equal to :

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

Ans. (4)

Sol. $x^2 - x - 2 = 0$

$\Rightarrow (x-2)(x+1) = 0$

$\Rightarrow x = 2$ or -1

Out of which 2 is the positive root

$\Rightarrow \alpha = 2$

$$\text{Limit } L = \lim_{x\to 2^+} \frac{\sqrt{1-\cos(x-2)(x+1)}}{x-2}$$

$$= \lim_{x\to 2^+} \frac{\sqrt{2\sin^2\left(\frac{(x-2)(x+1)}{2}\right)}}{x-2}$$

$$= \lim_{x\to 2^+} \frac{\sqrt{2}\left|\sin\frac{(x-2)(x+1)}{2}\right|}{x-2}$$

For $x \to 2^+$; $x^2 - x - 2 \to 0^+$.

So Mod will open with a positive sign

$$\text{So } L = \lim_{x\to 2^+} \frac{\sqrt{2}\sin\frac{(x-2)(x+1)}{2}}{(x-2)\frac{(x+1)}{2}} \times \frac{(x+1)}{2}$$

$$= \sqrt{2} \times \frac{2+1}{2} = \frac{3}{2}\sqrt{2} = \frac{3}{\sqrt{2}}$$

9. If the function

$f(x) = \begin{cases} k_1(x-\pi)^2, & x \le \pi \\ k_2 \cos x, & x > \pi \end{cases}$ is twice differentiable, then the ordered pair (k_1, k_2) is equal to :

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

Ans. (3)

Sol. Function must be continuous at $x = \pi$.

$\Rightarrow f(\pi^-) = f(\pi^+)$

$\Rightarrow -1 = -k_2 \Rightarrow k_2 = 1$

$$f'(x) = \begin{cases} 2k_1(x-\pi) & , x \le \pi \\ -k_2 \sin x = -\sin x & , x > \pi \end{cases}$$

For f'(x) to exist, $f'(\pi^-) = f'(\pi^+) = 0$

$$f''(x) = \begin{cases} 2k_1 & , x \le \pi \\ -k_2 \cos x & , x > \pi \end{cases}$$

$f''(\pi^-) = f''(\pi^+) \Rightarrow 2k_1 = k_2$

$\Rightarrow k_1 = \dfrac{1}{2}$

10. If y(x) is the solution of the differential equation $\dfrac{5+e^y}{2+y}\cdot\dfrac{dy}{dx}+e^x=0$ satisfying $y(0)=1$, then a value of $y(\log_e 13)$ is :

(1) 1 (2) –1 (3) 0 (4) 2

Ans. (2)

Sol. $\int \dfrac{dy}{y+2} = -\int \dfrac{e^x}{e^x+5}dx$

$= ln(y+2) = -ln(e^x+5)+C$

$x=0,\ y=1 \Rightarrow ln\,3 = -ln\,6 + C \Rightarrow C = ln\,18$

So $y+2 = \dfrac{18}{e^x+5}$

$y(ln13) = -1$

11. A survey that 73% of the persons working in an office like coffee, whereas 65% like tea,. If x denotes the percentage of them, who like both coffee and tea, then x cannot be :

(1) 38 (2) 63 (3) 36 (4) 54

Ans. (3)

Sol. $n(C) = 73\%$

$n(T) = 65\%$

Maximum value of $n(T \cap C) = 65\%$ (when set T lies completely inside set C)

Maximum value of $n(T \cup C) = 100\%$

$n(T \cap C)_{min} = n(C) + n(T) - n(C \cup T)$

$= 73\% + 65\% - 100\%$

$= 38\ \%$

$\Rightarrow 38 \le x \le 65$

So x cannot be 36.

12. If $\int \left(e^{2x}+2e^x-e^{-x}-1\right)e^{\left(e^x+e^{-x}\right)}dx = g(x)\,e^{\left(e^x+e^{-x}\right)}+c$, where c is a constant of integration, then g(0) is equal to:

(1) 2 (2) e (3) e^2 (4) 1

Ans. (1)

Sol. $\int\left(e^{2x}+2e^{x}-e^{-x}-1\right)\left(e^{e^{x}+e^{-x}}\right)dx$

$=\int\left(e^{x}-e^{-x}\right)e^{e^{x}+e^{-x}}dx+\int\left(e^{2x}-e^{x}-1\right)e^{e^{x}+e^{-x}}dx=I_1+I_2$

For I_1, $e^{x}+e^{-x}=t$; $\left(e^{x}-e^{-x}\right)dx=dt$

$I_1=\int e^{t}dt=e^{t}+C=e^{e^{x}+e^{-x}}+C$

$I_2=\int e^{x}\left(e^{x}-e^{-x}+1\right)e^{e^{x}+e^{-x}}dx$

$\int\left(e^{x}-e^{-x}+1\right)e^{e^{x}+e^{-x}+x}dx$

Let $e^{x}+e^{-x}+x=u;\left(e^{x}-e^{-x}+1\right)dx=du$

So, $I_2=\int e^{u}du=e^{u}+C=e^{e^{x}+e^{-x}+x}+C$

$I=I_1+I_2=e^{e^{x}+e^{-x}}\left(e^{x}+1\right)+C$

$g(x)=e^{x}+1$

$g(0)=2$

13. If the co-ordinates of two points A and B are $\left(\sqrt{7},0\right)$ and $\left(-\sqrt{7},0\right)$ respectively and P is any point on the conic, $9x^2+16y^2=144$, then PA + PB is equal to :

(1) 6 (2) 16 (3) 9 (4) 8

Ans. (4)

Sol. Eccentricity $=\sqrt{1-\frac{b^2}{a^2}}=\sqrt{1-\frac{9}{16}}=\frac{\sqrt{7}}{4}$

Foci $(\pm a e, 0)=\left(\pm 4\times\frac{\sqrt{7}}{4},0\right)=\left(\sqrt{7},0\right)$ and $\left(-\sqrt{7},0\right)$

So PA + PB = 2a = 2 × 4 = 8

14. If $3^{2\sin 2\alpha-1}$, 14 and $3^{4-2\sin 2\alpha}$ are first 3 terms of an artihmetic progression, then 6^{th} term of the A.P. is :

(1) 78 (2) 66 (3) 65 (4) 81

Ans. (2)

Sol. Let $\sin 2\alpha = x$

$$\frac{3^{2x-1}+3^{4-2x}}{2}=14$$

Let $3^{2x} = y$

$$\frac{y}{3}+\frac{81}{y}=28$$

$\Rightarrow y^2-84y+243=0$

$\Rightarrow y^2-81y-3y+243=0$

$\Rightarrow (y-81)(y-3)=0$

$\Rightarrow y = 81$ or $y = 3$

$\Rightarrow 3^{2x} = 81$ or $3^{2x} = 3$

$\Rightarrow 2x = 4$ or $2x = 1$

$\Rightarrow x = 2$ or $x=\frac{1}{2}$

$\Rightarrow \sin 2\alpha = 2$ (Not possible) or $\sin 2\alpha=\frac{1}{2}$

First term $a = 3^{1-1} = 1$

Common difference $d = 14 - 1 = 13$

6^{th} term $= a + 5d = 1 + 5 \times 13 = 66$

15. If the four complex numbers $z, \bar{z}, \bar{z}-2\operatorname{Re}(\bar{z})$ and $z-2\operatorname{Re}(z)$ represent the vertices of a square of side 4 units in the Argand plane, then $|z|$ is equal to :

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

Ans. (1)

Sol. Let $z = x + iy$, $\bar{z} = x - iy$

$\bar{z}-2\operatorname{Re}(\bar{z}) = x-iy-2x=-x-iy$

$z-2\operatorname{Re}(z) = x+iy-2x=-x+iy$

$|z-\bar{z}|=|2y|=4$

$\Rightarrow y=\pm 2$

$\left|z-\left(z-2\operatorname{Re}(z)\right)\right|=4$

$\Rightarrow |2x|=4 \Rightarrow x=\pm 2$

$|z|=\sqrt{x^2+y^2}=\sqrt{4+4}=2\sqrt{2}$

16. If the minimum and the maximum values of the function $f:\left[\frac{\pi}{4},\frac{\pi}{2}\right]\rightarrow R$, defined by

$f(\theta)=\begin{vmatrix}-\sin^2\theta & -1-\sin^2\theta & 1\\ -\cos^2\theta & -1-\cos^2\theta & 1\\ 12 & 10 & -2\end{vmatrix}$ are m and M respectively, then the ordered pair (m, M) is equal to :

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

Ans. (4)

Sol. $C_2 \rightarrow C_2 - C_1 + C_3$

$f(\theta)=\begin{vmatrix}-\sin^2\theta & 0 & 1\\ -\cos^2\theta & 0 & 1\\ 12 & -4 & -2\end{vmatrix}=4\cos 2\theta$

$\theta \in \left[\frac{\pi}{4},\frac{\pi}{2}\right]$

$\Rightarrow 4\cos 2\theta \in [-4, 0]$

17. The product of the roots of the equation $9x^2 - 18|x| + 5 = 0$, is :

(1) $\frac{25}{9}$ (2) $\frac{5}{27}$ (3) $\frac{5}{9}$ (4) $\frac{25}{81}$

Ans. (4)

Sol. Let $|x| = t$

$\Rightarrow 9t^2 - 18t + 5 = 0$

$\Rightarrow 9t^2 - 15t - 3t + 5 = 0$

$\Rightarrow (3t - 5)(3t - 1) = 0$

$\Rightarrow t = \frac{1}{3}$ or $\frac{5}{3} = |x|$

$\Rightarrow x = \pm\frac{1}{3}$ or $\pm\frac{5}{3}$

Product $= \left(\frac{1}{3}\right)\left(-\frac{1}{3}\right)\left(\frac{5}{3}\right)\left(-\frac{5}{3}\right) = \frac{25}{81}$

18. If the common tangent to the parabolas, $y^2 = 4x$ and $x^2 = 4y$ also touches the circle, $x^2 + y^2 = c^2$, then c is equal to :

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

Ans. (2)

Sol. Tangent to $y^2 = 4x$ will be

$y = mx + \frac{a}{m} = mx + \frac{1}{m}$

Tangent to $x^2 = 4y$ will be

$y = mx - am^2 = mx - m^2$

Comparing constant term

$\frac{1}{m} = -m^2 \Rightarrow m = -1$

Tangent : $y = -x - 1$

If this is tangent to $x^2 + y^2 = c^2$, distance of tangent from center will be equal to radius.

$\Rightarrow c = \frac{1}{\sqrt{2}}$

19. If (a, b, c) is the image of the point (1, 2, –3) in the line, $\frac{x+1}{2} = \frac{y-3}{-2} = \frac{z}{-1}$, then a + b + c is equal to :

(1) 1 (2) 2 (3) –1 (4) 3

Ans. (2)

Sol. Let Q be the foot of perpendicular from P(1, 2, –3) on the line is Q (2k – 1, –2k + 3, –k).

$\overrightarrow{PQ}.\vec{b} = 0$

$\Rightarrow (2k-2).2 + (-2k+1).(-2) + (-k+3).(-1) = 0$

$\Rightarrow 9k = 9 \Rightarrow k = 1$

So Q is (1, 1, –1)

If R is the image, coordinates of R are $(2 \times (1) - 1, 2 \times (1) - 2, 2 \times (-1) + 3) = (1, 0, 1)$

$a + b + c = 2$

20. If $2^{10} + 2^9.3^1 + 2^8.3^2 + ... + 2.3^9 + 3^{10} = S - 2^{11}$, then S is equal to :

(1) $3^{11} - 2^{12}$ (2) 3^{11} (3) 2.3^{11} (4) $\frac{3^{11}}{2} + 2^{10}$

Ans (2)

Sol. This is a G.P. with First Term $a = 2^{10}$

and $r = \frac{2^9.3}{2^{10}} = \frac{3}{2}$

sum of 11 terms $= \frac{a(r^n - 1)}{r - 1}$

$= 2^{10} \times \frac{\left(\left(\frac{3}{2}\right)^{11} - 1\right)}{\frac{3}{2} - 1}$

$= 2^{11} \times \left(\frac{3^{11} - 2^{11}}{2^{11}}\right)$

$= 3^{11} - 2^{11}$

21. If the line, $2x - y + 3 = 0$ is at a distance $\frac{1}{\sqrt{5}}$ and $\frac{2}{\sqrt{5}}$ from the lines $4x - 2y + \alpha = 0$ and $6x - 3y + \beta = 0$, respectively, then the sum of all possible values of α and β is ____.

Ans. 30

Sol. Distance between $2x - y + 3 = 0$ and $2x - y + \frac{\alpha}{2} = 0$ is

$$\left|\frac{\frac{\alpha}{2} - 3}{\sqrt{5}}\right| = \frac{1}{\sqrt{5}}$$

$\Rightarrow \alpha - 6 = \pm 2$

$\Rightarrow \alpha = 4$ or 8.

Distance between $2x - y + 1 = 0$ and $2x - y + \frac{\beta}{3} = 0$ is

$$\left|\frac{\frac{\beta}{3} - 3}{\sqrt{5}}\right| = \frac{2}{\sqrt{5}}$$

$\Rightarrow \beta - 9 = \pm 6$

$\Rightarrow \beta = 3$ or 15

Sum of all possible values of α and β $= 4 + 8 + 3 + 15 = 30$.

22. The number of words, with or without meaning, that can be formed by taking 4 letters at a time from the letters of the word 'SYLLABUS' such that two letters are distinct and two letters are alike, is ____.

Ans 240

Sol. A B L L S S O Y

2 alike can be chosen in ${}^2C_1 = 2$ ways

Rest 2 different letters can be chosen in ${}^5C_2 = 10$ ways

Permutations of 2 alike and 2 different letters $= \frac{4!}{2!} = 12$ ways

Total number of ways $= 2 \times 10 \times 12 = 240$

23. The natural number m, for which the coefficient of x in the binomial expansion of $\left(x^m + \frac{1}{x^2}\right)^{22}$ is 1540, is ____.

Ans. 13

Sol. General term $T_{r+1} = {}^{22}C_r \left(x^m\right)^{22-r} . \left(\frac{1}{x^2}\right)^r$

$= {}^{22}C_r \, x^{22m - mr - 2r}$

$22m - mr - 2r = 1$ .... (1)

and ${}^{22}C_r = 1540$

$${}^{22}C_3 = \frac{22 \times 21 \times 20}{3 \times 2 \times 1} = 1540$$

So r = 3 or 19.

If r = 3, 22m – 3m – 6 = 1

$\Rightarrow m = \frac{7}{19}$ (not an integer)

If r = 19, 22m – 19m – 38 = 1

$\Rightarrow$ m = 13

24. Four fair dice are thrown independently 27 times. Then the expected number of times, at least two dice show up a three or a five, is ____.

Ans. 11

Sol. P (at least two are 3 or 5) = 1 – P(No 3 or 5) – P(Exactly one 3 or 5)

$$=1-\left(\frac{4}{6}\right)^4-{}^4C_1\frac{2}{6}\left(\frac{4}{6}\right)^3$$

$$=1-\frac{16}{81}-\frac{32}{81}=\frac{11}{27}$$

In binomial distribution, $n=27,\ p=\frac{11}{27}, q=\frac{16}{27}$

Expected value $= np$

$$=27\times\frac{11}{27}=11$$

25. Let f(x) = $x.\left[\frac{x}{2}\right]$, for $-10 < x < 10$, where [t] denotes the greatest integer function. Then the number of points of discontinuity of f is equal to _____.

Ans. 8

Sol. Possible points of discontinuity are (–8, –6, –4, –2, 0, 2, 4, 6, 8)

checking $f(a^-) = f(a) = f(a^+)$, it is continuous at 0, discontinuous at rest.

Hence discontinuous at 8 points.