JEE (MAIN) 2026

MEMORY BASED QUESTIONS & TEXT SOLUTION

SHIFT-1

DATE & DAY: 05th April 2026 & Sunday

PAPER-1

Duration: 3 Hrs.
Time: 09:00 – 12:00 IST

SUBJECT: MATHEMATICS

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PART : MATHEMATICS

1. If $\vec{r}\times\vec{a}+\vec{a}\times\vec{b}=\vec{0}, \vec{a}=\sqrt{7}\hat{\imath}+\hat{\jmath}+\hat{k}, \vec{b}=\hat{\jmath}-2\hat{k}$ and $\vec{r}.\vec{a}=0$, then the value of $|3\vec{r}|^2$ is

(1) 46 (2) 40 (3) 42 (4) 44

Ans. **(4)**

Sol. $\vec{r}\times\vec{a}-\vec{b}\times\vec{a}=\vec{0}$

$(\vec{r}-\vec{b})\times\vec{a}=\vec{0}$

$\vec{r}-\vec{b}=\lambda\vec{a}$

$\vec{r}=\vec{b}+\lambda\vec{a}$

$\vec{r}\cdot\vec{a}=0\Rightarrow\vec{a}\cdot\vec{b}+\lambda|\vec{a}|^2=0$

$$\lambda=-\frac{\vec{a}\cdot\vec{b}}{|\vec{a}|^2}=-\frac{(1-2)}{9}=\frac{1}{9}$$

$$\vec{r}=\vec{b}+\frac{\vec{a}}{9}$$

$$|3\vec{r}|^2=9|\vec{r}|^2=9\left(b^2+\frac{a^2}{81}+\frac{2(\vec{a}\cdot\vec{b})}{9}\right)=44$$

2. Let S_n is the sum of first n terms of an A.P. If $S_n=3n^2+5n$, then the sum of square of first 10 terms of the given A.P. is

(1) 15220 (2) 14220 (3) 15320 (4) 15110

Ans. **(1)**

Sol. $S_n=3n^2+5n$

$T_n=S_n-S_{n-1}$

$=3(n^2-(n-1)^2)+5(n-(n-1))$

$=3(2n-1)+5$

$=6n+2$

$$\sum_{n=1}^{10}(6n+2)^2=\sum 36n^2+\sum 4+\sum 24n$$

$$=36\times\frac{10\times11\times21}{6}+4\times10+24\frac{10\times11}{2}$$

$=15220$

3. A and B play a tennis match which will not result in a draw. The player who wins 5 rounds first, will be the winner of the match then the number of ways such that A can win the match is

(1) 126 (2) 252 (3) 63 (4) 216

Ans. **(1)**

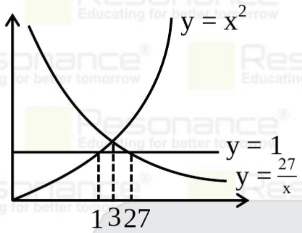
Sol. required ways = ${}^9C_5=126$

4. The area enclosed between the region given by $xy \le 27$ & $1 \le y \le x^2$ is

(1) $54\ln 3 - \frac{52}{3}$ (2) $52\ln 3 - \frac{52}{3}$ (3) $54\ln 2 - \frac{54}{3}$ (4) $52\ln 2 - \frac{52}{3}$

Ans. **(1)**

Sol.



Area $= \int_1^3 (x^2-1)dx + \int_3^{27}\left(\frac{27}{x}-1\right)dx$

$= \left[\frac{x^3}{3} - x\right]_1^3 + [27\ell nx - x]_3^{27}$

$= \frac{26}{3} - 2 + 27\ln 9 - 24$

$= 27\ln 9 - \frac{26\times 2}{3}$

$= 54\ln 3 - \frac{52}{3}$

5. Consider

x_i	5	6	8	11	13
f_i	4	8	2	3	9

then mean deviation about mean is

(1) 4.23 (2) 5.23 (3) 2.32 (4) 3.23

Ans. **(4)**

Sol. M.D. $= \frac{\sum f_i|x_i - \bar{x}|}{\sum f_i}$

$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$

$= \frac{20+48+16+33+117}{26}$

$= \frac{234}{26} = 9$

M.D. $= \frac{4(4)+8(3)+2(1)+3(2)+9(4)}{26}$

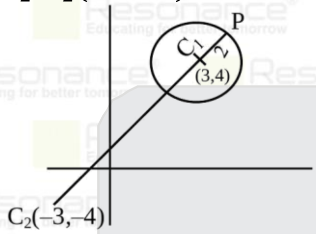
$= \frac{16+24+2+6+36}{26}$

$= \frac{84}{26} = 3.23$

6. If $S_1 : x^2 + y^2 - 6x - 8y + 21 = 0$ and
$S_2 : x^2 + y^2 + 6x + 8y + \lambda = 0$
then the distance of centre of S_2 to the farthest point on S_1 is
(1) 10 (2) 11 (3) 12 (4) 13

Ans. (3)

Sol. $S_1 : C_1(3,4) r = 2$
$S_2 : C_2(-3,-4)$



$C_1C_2 = 10$
So $C_2P = 12$

7. If α, β are the roots of quadratic equation $ax^2 + bx + c = 0$ and $|\alpha - \beta| = \sqrt{11}, \alpha + \beta = 3i$, then the value of $(\alpha^3 - \beta^3)^2$ is
(1) 167 (2) 176 (3) 716 (4) 617

Ans. (2)

Sol. $|\alpha - \beta| = \sqrt{11}$
$\Rightarrow \alpha^2 + \beta^2 - 2\alpha\beta = 11$
$\alpha + \beta = 3i \Rightarrow \alpha^2 + \beta^2 + 2\alpha\beta = -9$
$\Rightarrow \alpha\beta = -5$
Now, $E = (\alpha^3 - \beta^3)^2$
$= (\alpha - \beta)^2(\alpha^2 + \beta^2 + \alpha\beta)^2$
$= (\sqrt{11})^2((\alpha + \beta)^2 - 2\alpha\beta + \alpha\beta)^2$
$= 11(-9 - (-5))^2$
$= 176$

8. If f(x) satisfy the relation $f\left(\frac{x+y}{3}\right) = \frac{f(x)+f(y)}{3}$ & $f'(0) = 3$, then the minimum value of $g(x) = 3 + e^x f(x)$ is
(1) $\frac{3(e-1)}{e}$ (2) $\frac{(e-1)}{e}$ (3) $\frac{(e-1)}{3}$ (4) $\frac{e(e-1)}{3}$

Ans. (1)

Sol. $f\left(\frac{x+y}{3}\right) = \frac{f(x)+f(y)}{3}$, put $x = y = 0$
$f(0) = \frac{2f(0)}{3}$
$\Rightarrow f(0) = 0$ ... (1)
$f'\left(\frac{x+y}{3}\right) \cdot \frac{1}{3} = \frac{1}{3} f'(x)$
put $x = 0$
$f'\left(\frac{y}{3}\right) \frac{1}{3} = \frac{1}{3} \times 3$
$f'\left(\frac{y}{3}\right) = 3$
put $y = 3x$
$f'(x) = 3$

integrate both sides

$f(x) = 3x + c$

from eq. (1)

$f(0) = 0$

$\Rightarrow f(x) = 3x$

Now

$g(x) = 3 + e^x \cdot 3x$

$g'(x) = 3[e^x + x \cdot e^x]$

$= 3e^x(x+1)$

$g'(x) = 0$, at $x = -1$

$(g(x))_{min} = 3 + e^{-1}(-3)$

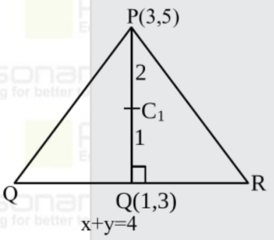
$= 3\left[1 - \frac{1}{e}\right] = \frac{3(e-1)}{e}$

9. Consider an equilateral $\triangle$ PQR, where P(3,5) and QR is $x + y = 4$. If the orthocentre of $\triangle$ PQR is (α, β), then $9(\alpha + \beta)$ is equal to

(1) 46 (2) 48 (3) 50 (4) 52

Ans. **(2)**

Sol.



$Q: \frac{x-3}{1} = \frac{y-5}{1} = -\frac{(3+5-4)}{1+1}$

Q(1, 3)

So orthocentre is $\left(\frac{2+3}{3}, \frac{6+5}{3}\right)$

$\left(\frac{5}{3}, \frac{11}{3}\right)$

So $9(\alpha + \beta) = 3(16) = 48$

10. If $\alpha = \frac{\pi}{4} + \sum_{p=1}^{11} \tan^{-1}\left(\frac{2^{p-1}}{1+2^{2p-1}}\right)$ then the value of $\tan(\alpha)$ is

(1) 2^9 (2) 2^{10} (3) 2^{11} (4) 2^{12}

Ans. **(3)**

Sol. $\alpha = \frac{\pi}{4} + \sum_{p=1}^{11} \tan^{-1}\left(\frac{2^{p-1}}{1+2^{2p-1}}\right)$

$= \frac{\pi}{4} + \sum_{p=1}^{11} \tan^{-1}\left(\frac{2^p - 2^{p-1}}{1 + 2^p 2^{p-1}}\right)$

$= \frac{\pi}{4} + \sum_{p=1}^{11} \left(\tan^{-1}(2^p) - \tan^{-1}(2^{p-1})\right)$

$= \frac{\pi}{4} + \tan^{-1}(2^{11}) - \tan^{-1}(2^0) = 2^{11}$

11. If $\lim_{x\to 0}\frac{1-\cos(\alpha x)\cos((\alpha+1)x)\cos((\alpha+2)x)}{\sin((\alpha+1)x)^2}=2$

Then the product of all possible values of α is

(1) 1 (2) –1 (3) 2 (4) –2

Ans. **(2)**

Sol. $\lim_{x\to 0}\frac{1-\cos\alpha x\cdot\cos((\alpha+1)x)\cos((\alpha+2)x)}{(\alpha+1)^2x^2}$

By using L.H. Rule we get

$\Rightarrow \frac{1}{2}(\alpha+1)^2[\alpha^2+(\alpha+1)^2+(\alpha+2)^2]=2$

$\alpha^2+(\alpha+1)^2+(\alpha+2)^2=4(\alpha+1)^2$

$\alpha^2+(\alpha+2)^2=3(\alpha+1)^2$

$\Rightarrow \alpha^2+2\alpha-1=0$

Product $=-1$

12. On a postcard one of the two words either KANPUR or ANANTPUR is written. If only two consecutive letters AN are visible on the postcard, then the probability that the written word is ANANTPUR, is

(1) $\frac{3}{17}$ (2) $\frac{10}{17}$ (3) $\frac{2}{17}$ (4) $\frac{4}{17}$

Ans. **(2)**

Sol. $P(I):\frac{1}{2}P\left(\frac{A}{I}\right)\to\frac{1}{5}$

$P(II):\frac{1}{2}P\left(\frac{A}{II}\right)\to\frac{2}{7}$

$\therefore$ Reqd. Prob $=\frac{\frac{1}{2}\times\frac{2}{7}}{\frac{1}{2}\times\frac{1}{5}+\frac{1}{2}\times\frac{2}{7}}=\frac{\frac{2}{7}\times 5}{\frac{17}{7}}=\frac{10}{17}$

13. Consider differential equation

$\sin\left(\frac{y}{x}\right)\frac{dy}{dx}+1=\frac{y}{x}\sin\left(\frac{y}{x}\right), y(1)=\frac{\pi}{2}$

and $\alpha=\cos\left(\frac{y(e^{12})}{e^{12}}\right)$. Let r be the radius of the circle $x^2+y^2-2px+2py+\alpha+2=0$ (where ≤ 6) then the number of integral values of 'p' is

(1) 11 (2) 12 (3) 13 (4) 15

Ans. **(1)**

Sol. $\sin\frac{y}{x}\frac{dy}{dx}=\frac{y}{x}\sin\frac{y}{x}-1$

put $y=tx\Rightarrow\frac{dy}{dx}=t+x\frac{dt}{dx}$

$\sin t\left(t+x\frac{dt}{dx}\right)=t\sin t-1$

$x\sin t\frac{dt}{dx}+1=0$

$\sin t\,dt+\frac{dx}{x}=0$

$\Rightarrow -\cos t+\ln x=C$

$\Rightarrow -\cos\left(\frac{y}{x}\right)+\ell nx=C$

$y(1)=\frac{\pi}{2}\Rightarrow C=0$

$\Rightarrow \cos\left(\frac{y}{x}\right) = \ell nx$

$\cos\left(\frac{y(e^{12})}{e^{12}}\right) = 12 \Rightarrow \alpha = 12$

$x^2 + y^2 - 2px + 2py + 14 = 0$

$r = \sqrt{p^2 + p^2 - 14}$

$\Rightarrow r \le 6 \Rightarrow r^2 \le 36$

$2p^2 - 14 \le 36$

$p^2 \le 25$

$p \in [-5,5]$

14. The value of $\int_0^\infty \frac{\ell nx}{x^2+4} dx$ is equal to

(1) $\frac{\pi\ell n2}{4}$ (2) $\frac{\pi\ell n2}{2}$ (3) $\frac{\pi\ell n4}{3}$ (4) $\frac{3\pi\ell n2}{4}$

Ans. **(1)**

Sol. Put $x = 2t \Rightarrow dx = 2dt$

$I = \int_0^\infty \frac{\ell n2t}{4t^2+4}(2dt) = \frac{1}{2}\int_0^\infty \frac{\ell n2 + \ell nt}{t^2+1}dt$

$= \frac{1}{2}\int_0^\infty \frac{\ell n2}{t^2+1}dt + \frac{1}{2}\int_0^\infty \frac{\ell nt}{t^2+1}dt$

$\left[\frac{\ln 2}{2}\tan^{-1} t\right]_0^\infty + I_1$

$= \frac{\ell n2}{2}\cdot\frac{\pi}{2} + I_1$

$I_2 = \frac{1}{2}\int_0^\infty \frac{\ell nt}{t^2+1}dt \; t = \frac{1}{u} \Rightarrow dt = -\frac{du}{u^2}$

$= \frac{1}{2}\int_\infty^0 \frac{\ell n(1/u)}{\frac{1}{u^2}+1}\left(-\frac{du}{u^2}\right)$

Add $\Rightarrow I_1 = 0$

$I = \frac{\pi\ell n2}{4}$

15. If tan A and tan B are roots of equation $x^2 - 2x - 5 = 0$, then the value of $10\left(\sin^2\left(\frac{A+B}{2}\right)\right)$ is

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

Ans. **(3)**

Sol. $x^2 - 2x - 5 = 0$

$\tan A + \tan B = 2; \tan A \tan B = -5$

$\therefore \tan(A+B) = \frac{2}{1-(-5)} = \frac{1}{3}$

$\Rightarrow \cos(A+B) = \frac{3}{\sqrt{10}}$

$\therefore 10\left(\sin^2\left(\frac{A+B}{2}\right)\right) = \frac{10}{2}(1-\cos(A+B))$

$= 5\left(1 - \frac{3}{\sqrt{10}}\right)$

16. If system of equations (in variable x, y, z):

$x - 2y + tz = 0$

$3x + 5y + t^2 z = 0$

$6x + ty + f(t)z = 0$

have infinitely many solutions (where $f(t)$ represents real function) then

(1) $y = f(t)$ is strictly increasing (2) $y = f(t)$ is strictly decreasing

(3) $y = f(t)$ is decreasing (4) $y = f(t)$ is increasing

Ans. **(1)**

Sol. $$\begin{vmatrix} 1 & -2 & t \\ 3 & 5 & t^2 \\ 6 & t & f(t) \end{vmatrix} = 0$$

$$1(5f(t) - t^3) + 2(3f(t) - 6t^2) + t(3t - 30) = 0$$

$$f(t) = \frac{t^3 + 9t^2 + 30t}{11}$$

$$f'(t) = \frac{1}{11}(3t^2 + 18t + 30)$$

$D < 0$

So function is strictly increasing.

17. The value of $\sum_{n=1}^{10} \frac{528}{n(n+1)(n+2)}$ is equal to

(1) 130 (2) 260 (3) 65 (4) 120

Ans. **(1)**

Sol. Let $T_n = \frac{1}{n(n+1)(n+2)} = \frac{1}{2}\left[\frac{(n+2)-n}{n(n+1)(n+2)}\right]$

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

$$T_1 = \frac{1}{2}\left[\frac{1}{1.2} - \frac{1}{2.3}\right]$$

$$T_2 = \frac{1}{2}\left[\frac{1}{2.3} - \frac{1}{3.4}\right]$$

$\vdots$

$$T_{10} = \frac{1}{2}\left[\frac{1}{10.11} - \frac{1}{11.12}\right]$$

$$S = \frac{1}{2}\left[\frac{1}{2} - \frac{1}{11.12}\right]$$

$$\text{Final sum } = \frac{528}{2}\left[\frac{1}{2} - \frac{1}{11.12}\right]$$

$$= 132 - 2 = 130$$

18. Let f: A → A be function, where
$A = \{1,2,3,4,5,6\}$. The number of one-one functions such that
$f(1) \leq 3, f(3) \leq 4$ and $f(2) + f(3) = 5$, is

(1) 20 (2) 18 (3) 36 (4) 24

Ans. (3)

Sol. $f(1) = 1,2,3$ $f(3) = 1,2,3,4$

$f(1) = 1$

$f(3) = 2, f(2) = 3 \rightarrow 6$

$f(3) = 3, f(2) = 2 \rightarrow 6$

$f(1) = 2$ $f(3) = 1, f(2) = 4 \rightarrow 6$

$f(3) = 4, f(2) = 1 \rightarrow 6$

$f(1) = 3$ $f(3) = 1, f(2) = 4 \rightarrow 6$

$f(3) = 4, f(2) = 1 \rightarrow 6$

Total $= 36$

19. Let $p(x, y)$ is a variable point on the circle $x^2 + y^2 - 6x - 8y + 21 = 0$, then the maximum possible distance of p from the vertex of $y^2 + 6y + x + 13 = 0$ is

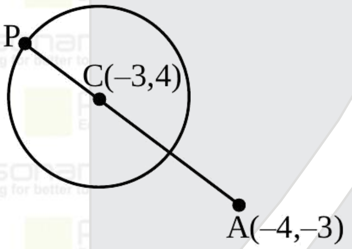
(1) $7 + 2\sqrt{2}$ (2) $2 + 7\sqrt{2}$ (3) $4 + 7\sqrt{2}$ (4) $3 + 2\sqrt{2}$

Ans. (2)

Sol. Centre : $C(3,4)$ & $r = 2$

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

Vertex is $A(-4, -3)$



$AP_{max} = AC + r = \sqrt{49 + 49} + 2 = \sqrt{98} + 2$

$= 2 + 7\sqrt{2}$

20. If $3\sin^2 t - 12\sin t - 3 = p$, then the sum of all integral values of 'p' such that the equation has at least one real root, is

(1) – 75 (2) – 60 (3) – 65 (4) – 72

Ans. (1)

Sol. $3\sin^2 t - 12\cos t - 3 = p$

$\Rightarrow -3\cos^2 t - 12\cos t = p$

$\Rightarrow 3\cos^2 t + 12\cos t + p = 0$

$\Rightarrow \cos t = \dfrac{-12 \pm \sqrt{144 - 12p}}{6}$

$\Rightarrow \cos t = -2 \pm \sqrt{4 - p/3}$

But $-1 \leq \cos t \leq 1$

$\Rightarrow -1 \le -2 + \sqrt{4 - p/3} \le 1$

$1 \le \sqrt{4 - \frac{p}{3}} \le 3$

$1 \le 4 - \frac{p}{3} \le 9$

$-3 \le -\frac{p}{3} \le 5$

$-15 \le p \le 9$

Sum $= -15 - 14 \ldots\ldots\ldots. + 9$

$= -10 - 11 - 12 \ldots\ldots\ldots - 15$

$= -75$

21. The value of $I = \int_{\pi/6}^{\pi/3} \frac{4 - \operatorname{cosec}^2 x}{\cos^4 x} dx$ is

(1) $\frac{32\sqrt{3}}{3}$ (2) $\frac{32\sqrt{3}}{9}$ (3) $\frac{64\sqrt{3}}{3}$ (4) $\frac{64\sqrt{3}}{9}$

Ans. (2)

Sol. $= \int_{\pi/6}^{\pi/3} \frac{4}{\cos^4 x} dx - \int_{\pi/6}^{\pi/3} \frac{\operatorname{cosec}^2 x}{\cos^4 x} dx$

$= \int_{\pi/6}^{\pi/3} \frac{4}{\cos^4 x} dx - \left[-\frac{\cot x}{\cos^4 x} - \int_{\pi/6}^{\pi/3} (-\cot x) \frac{-4}{\cos^5 x} (-\sin x) dx \right]$

$= \left. \frac{\cot x}{\cos^4 x} \right|_{\frac{\pi}{6}}^{\frac{\pi}{3}}$

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

$= \frac{16}{\sqrt{3}} - \frac{\sqrt{3}.16}{9} = \frac{16}{\sqrt{13}} - \frac{16}{3\sqrt{3}} = \frac{16}{\sqrt{13}} \left(1 - \frac{1}{3}\right)$

$\frac{32}{3\sqrt{3}} = \frac{32\sqrt{3}}{9}$

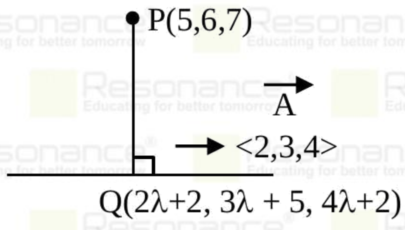
22. Find square of the distance of the point (5, 6, 7) from the line $\frac{x-2}{2} = \frac{y-5}{3} = \frac{z-2}{4}$

Ans. (6)

Sol. $\overrightarrow{PQ} \cdot \vec{A} = 0$

$\Rightarrow (2\lambda - 3)2 + (3\lambda - 1)3 + (4\lambda - 5)4 = 0$

$\Rightarrow \lambda = 1$



Point Q = (4,8,6)

$PQ^2 = 6$

23. In the expansion of $\left(\frac{1}{x^3} - x^4\right)^n$, if sum of coefficient of x^7&x^{14} is zero, then find n .

Ans. **(21)**

Sol. General term = ${}^nC_r\left(\frac{1}{x^3}\right)^{n-r}(-x^4)^r$

$= {}^nC_r(-1)^r X^{7r-3n}$

Coeff. of $x^7 \Rightarrow 7r_1 - 3n = 7 \Rightarrow r_1 = \frac{7+3n}{7}$

Coeff. of $x^{14} \Rightarrow 7r_2 - 3n = 14 \Rightarrow r_2 = \frac{14+3n}{7}$

Now, ${}^nC_{\frac{7+3n}{7}}(-1)^{\frac{7+3n}{7}} + {}^nC_{\frac{14+3n}{7}}(-1)^{\frac{7+3n}{7}} = 0$

Possible if $\left(\frac{7+3n}{7}\right) + \left(\frac{14+3n}{7}\right) = n$

$\frac{21+6n}{7} = n \Rightarrow n = 21$