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JEE (MAIN) 2026

MEMORY BASED QUESTIONS & TEXT SOLUTION

SHIFT-2

DATE & DAY: 02nd April 2026 & Thursday

PAPER-1

Duration: 3 Hrs.
Time: 03:00 PM – 06:00 PM

SUBJECT: MATHEMATICS

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Rajasthan) - 324005
0744-2777777 | 73400 10345 | contact@resonance.ac.in | www.resonance.ac.in | Follow Us: @ResonanceEdu | @Resonance_Edu

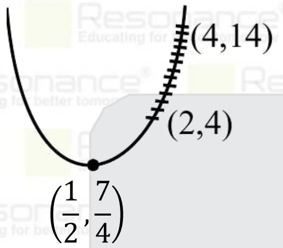
PART : MATHEMATICS

1. Find number of points of discontinuity of the function $f(x) = [x^2 - x + 2]$ in $x \in [2,4]$ (where $[\cdot]$ denotes greatest integer function).

(1) 10 (2) 8 (3) 9 (4) 11

Ans. **(1)**

Sol. In the interval $x \in [2,4]$ range of $x^2 - x + 2$ is $[4,14]$ GIF is discontinuous at integers



Checking at $x = 4$

$f(4) = [4^2 - 4 + 2] = 14$

$f(4^-) = \lim_{h\to 0}[(4-h)^2 - (4-h) + 2]$

$= \lim_{h\to 0}[16 + h^2 - 8h - 4 + h + 2]$

$= \lim_{h\to 0}[14 + h(h-7)]$

$= 13$

Discontinuous at $x = 4$ and 9 other points.

Total 10 points.

2. A regular polygon with n sides is given. P_n denotes no. of triangles formed by joining any three points of given regular polygon. If $P_{n+1} - P_n = 66$, then the sum of all prime divisors of n is

(1) 5 (2) 23 (3) 9 (4) 11

Ans. **(1)**

Sol. $P_n = {}^nC_3$

$P_{n+1} - P_n = 66$

${}^{n+1}C_3 - {}^nC_3 = 66$

$\Rightarrow \frac{(n+1)n(n-1)}{6} - \frac{n(n-1)(n-2)}{6} = 66$

$\Rightarrow \frac{n(n-1)}{6}[n+1-n+2] = 66$

$\Rightarrow n(n-1) = 132$

$n = 12$

Prime divisors of 12 are 2 & 3

sum $= 2 + 3 = 5$

3. If the system of equations $x + 5y + 6z = 4$, $2x + 2y + 4z = 1$ and $x + y + az = b$ has infinite numbers of solutions then point (a, b) lies on-

(1) $y - x = 3$ (2) $x + y = 2$

(3) $x - y = 3$ (4) $x - 2y = 1$

Ans. **(4)**

Sol. $x + 5y + 6z = 4$

$2x + 2y + 4z = 1$

$x + y + az = b$

$$D = \begin{vmatrix} 1 & 5 & 6 \\ 2 & 2 & 4 \\ 1 & 1 & a \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} 1 & 5 & 6 \\ 1 & 1 & 2 \\ 1 & 1 & a \end{vmatrix} = 0 \Rightarrow a = 2$$

$$D_z = \begin{vmatrix} 1 & 5 & 4 \\ 2 & 2 & 1 \\ 1 & 1 & b \end{vmatrix} = 0 \Rightarrow b = \frac{1}{2}$$

$a - 2b = 1$

4. Parabola $y = x^2 + px + q$ is passing through $(1, -1)$ and vertex of parabola is at minimum distance from x -axis then $p^2 + q^2$ is

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

Ans. **(1)**

Sol. Parabola passes through $(1, -1)$ so

$-1 = 1 + p + q$

$p + q = -2$

$q = -2 - p$ (1)

Distance from x -axis

$$\frac{-D}{4a} = \frac{-(p^2 - 4q)}{4(1)} = \frac{4q - p^2}{4}$$

$$= \frac{4(-2-p)-p^2}{4} \quad \text{from (1)}$$

$$= \frac{-8 - 4p - p^2}{4} = \frac{-(p^2 + 4p + 8)}{4} = \frac{-((p+2)^2 + 4)}{4}$$

Minimum at $p = -2 \Rightarrow q = 0$

$p^2 + q^2 = 4 + 0 = 4$

5. Let $\overrightarrow{PS} = \hat{\imath} + \hat{\jmath}$ and $\overrightarrow{PQ} = -\hat{\jmath} + \hat{k}$. If $\overrightarrow{PS}$ must be rotated by an angle α such that $\overrightarrow{PS}$ is perpendicular to $\overrightarrow{PQ}$ then $\left(\sin^2 \frac{5\alpha}{2} - \sin^2 \frac{\alpha}{2}\right)$ equals

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

Ans. **(4)**

Sol. $\overrightarrow{PS} = \hat{\imath} + \hat{\jmath}$ $\quad \theta = \left(\overrightarrow{PS} \wedge \overrightarrow{PQ}\right)$

$\overrightarrow{PQ} = -\hat{\jmath} + \hat{k}$

$$\cos\theta = \frac{\overrightarrow{PS} \cdot \overrightarrow{PQ}}{|\overrightarrow{PS}||\overrightarrow{PQ}|} = -\frac{1}{2} \Rightarrow \theta = \frac{2\pi}{3}$$

$\alpha = 30°$

$$\text{Sin}^2 75° - \sin^2 15° = \sin 60° = \frac{\sqrt{3}}{2}$$

6. Let $x_1, x_2, x_3, \ldots, x_n$ be 'n' observations such that $\sum_{i=1}^{n-1} x_i = 48$ and $\sum_{i=1}^{n-1} x_i^2 = 496$. If mean and variance of the distribution are 8 and 16 respectively then value of n is :-

(1) 8 (2) 9 (3) 7 (4) 12

Ans. (3)

Sol. $x_1 + x_2 + \cdots + x_{n-1} + x_n = 8n$

$48 + x_n = 8n$

$\Rightarrow x_n = 8n - 48$ (1)

$\Rightarrow 16 = \dfrac{496 + x_n^2}{n} - (8)^2$

$\Rightarrow 80n = 496 + x_n^2$

$\Rightarrow x_n^2 = 80n - 496$ (2)

$\Rightarrow (8n - 48)^2 = 80n - 496$

$\Rightarrow 64(n - 6)^2 = 8(10n - 62)$

$\Rightarrow 8(n - 6)^2 = 10n - 62$

$\Rightarrow 4(n - 6)^2 = 5n - 31$

$\Rightarrow 4(n^2 - 36 - 12n) = 5n - 31$

$\Rightarrow 4n^2 + 144 - 48n = 5n - 31$

$\Rightarrow 4n^2 - 53n + 175 = 0$

$\Rightarrow 4n^2 - 28n - 25n + 175 = 0$

$\Rightarrow 4n(n - 7) - 25(n - 7) = 0$

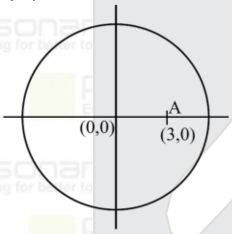
$n = 7$

7. Let 'C' be a circle with radius '6' units centred at origin. Let A(3,0) be a point. If B is a variable point in xy-plane such that circle drawn taking AB as diameter touches the circle C then eccentricity of the locus of point 'B' is

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

Ans. (2)

Sol.



Let B(h, k)

Equation of circle with AB as diameter

$(x - h)(x - 3) + (y - k)(y - 0) = 0$

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

Centre $\left(\frac{h+3}{2}, \frac{k}{2}\right)$

Circle touches internally

$\therefore C_1C_2 = |R - r|$

$\sqrt{\left(\frac{h+3}{2}\right)^2 + \left(\frac{k}{2}\right)^2} = \left|6 - \frac{1}{2}\left(\sqrt{(h-3)^2 + k^2}\right)\right|$

$\sqrt{(x+3)^2 + y^2} + \sqrt{(x-3)^2 + y^2} = 12$

$2a = 12 \therefore a = 6$

$(-3, 0)$ and $(3, 0)$ are foci

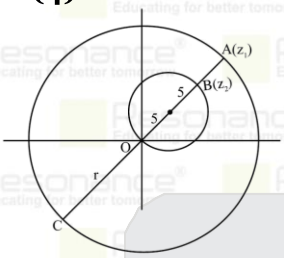
$2ae = 6 \quad \Rightarrow \quad 12e = 6 \quad \Rightarrow \quad e = \frac{1}{2}$

8. If z_1 lies on curve $|z| = r$ and z_2 lies on curve $|z - 3 - 4i| = 5$ if minimum of $|z_1 - z_2| = 2$, then the maximum of $|z_1 - z_2|$ is

(1) 12 (2) 18 (3) 20 (4) 22

Ans. **(4)**

Sol.



$|z| = r$

$OA = r$

minimum $|z_1 - z_2| = 2$

$\Rightarrow r - 10 = 2 \Rightarrow r = 12$

maximum value of CB

$|z_1 - z_2| = r + 10 = 12 + 10 = 22$

9. If the lines $x + (k-1)y + 3 = 0$ & $2x + k^2y - 4 = 0$ are perpendicular and their point of intersection is the centre of a circle which passes through origin. If chord $x - y + 2 = 0$ intersects this circle at A & B then $(AB)^2 = ?$

(1) 18 (2) 20 (3) 9 (4) 36

Ans. **(1)**

Sol. $x + (k-1)y + 3 = 0$

$2x + k^2y - 4 = 0$

$\left(\frac{1}{1-k}\right)\left(\frac{2}{k^2}\right) = 1$

$2 = k^2 - k^3$

$k^3 - k^2 + 2 = 0$

$k = -1$

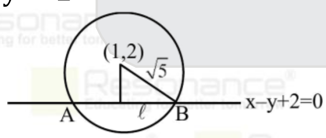
Solving :

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

$2x + y - 4 = 0$

$-5y + 10 = 0$

$y = 2$



$x = 1$

Centre (1,2)

$r = \sqrt{5}$

So circle is $(x-1)^2 + (y-2)^2 = 5$

Chord $x - y + 2 = 0$

$p = \frac{1}{\sqrt{2}}$

$\ell = \sqrt{5 - \frac{1}{2}} = \frac{3}{\sqrt{2}} \quad \Rightarrow \quad AB = \frac{6}{\sqrt{2}} \therefore AB^2 = 18$

10. Find sum up to 8 terms of the series $\frac{1^3}{1}+\frac{1^3+2^3}{1+3}+\frac{1^3+2^3+3^3}{1+3+5}+\cdots$.

(1) 84 (2) 71 (3) 61 (4) 100

Ans. **(2)**

Sol. $T_r=\frac{1^3+2^3+3^3+\cdots\ldots r^3}{1+3+5+\cdots\ldots+(2r-1)}=\frac{\left(\frac{r(r+1)}{2}\right)^2}{r^2}$

$=\frac{r^2+2r+1}{4}$

$S_n=\sum_{r=1}^{n}T_r$

$S_n=\frac{1}{4}\sum(r^2+2r+1)$

$=\frac{1}{4}\left[\frac{n(n+1)(2n+1)}{6}+2\frac{n(n+1)}{2}+n\right]$

$S_8=\frac{1}{4}\left[\frac{8\times9\times17}{6}+8\times9+8\right]=\frac{1}{4}[204+72+8]=71$

11. Let $f(x)$ be a polynomial of degree 5 having extreme values at $x=1$ and $x=-1$. If $\lim_{x\to0}\frac{f(x)}{x^3}=-5$, then the value of $f(2)-f(-2)$ is

(1) 110 (2) 112 (3) 115 (4) 118

Ans. **(2)**

Sol. Given f(x) is a polynomial of degree 5

Also, $f'(1)=0\,;f'(-1)=0$.

Also $\because\lim_{x\to0}\frac{f(x)}{x^3}=-5$ (fixed and finite)

$\therefore f(0)=0; f'(0)=0; f''(0)=0$

$\frac{f'''(0)}{6}=-5\Rightarrow f'''(0)=-30$

Hence, let $f'(x)=(ax+b)(x-0)(x-1)(x+1)$

$\Rightarrow f'(x)=ax^4+bx^3-ax^2-bx$

$f''(x)=4ax^3+3bx^2-2ax-b$

$\because f''(0)=0\Rightarrow\ b=0$

$f'''(x)=12ax^2+6bx-2a$

$\because f''(0)=-2a=-30\quad\Rightarrow\quad a=15$

$\therefore f'(x)=15x.x.(x-1)(x+1)$

$\Rightarrow f'(x)=15x^4-15x^2\quad\Rightarrow\quad f(x)=3x^5-5x^3+C$

$\because f(0)=0\Rightarrow C=0$

$\therefore f(x)=3x^5-5x^3$

$\therefore f(2)-f(-2)=112$

12. The value of $\int_0^{20\pi}(\sin^4 x + \cos^4 x)\cdot dx$ is equal to

(1) 15π (2) $15\pi/2$ (3) 25π (4) $\frac{25\pi}{2}$

Ans. (1)

Sol. $I = \int_0^{20\pi}(1 - 2\sin^2 x\cos^2 x)\cdot dx$

$= 20\pi - \frac{1}{2}\int_0^{20\pi}\sin^2 2x dx$

$20\pi - \frac{1}{2}(40)\int_0^{\frac{\pi}{2}}\sin^2 2x$

$20\pi - \frac{20}{2}\left(x - \frac{\sin 2x}{2}\right)_0^{\frac{\pi}{2}}$

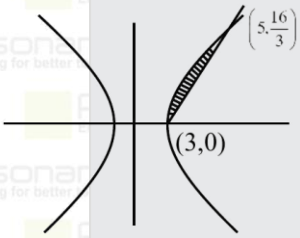
$20\pi - 10\left(\frac{\pi}{2}\right) = 15\pi$

13. If the area bounded by two curves $\frac{x^2}{9} - \frac{y^2}{16} = 1$ and $8x - 3y = 24$ is $A - 6\log_e 3$, then A is equal to

(1) 5 (2) 6 (3) 7 (4) 8

Ans. (4)

Sol.



$16x^2 - 9y^2 = 144$

$16x^2 - (8x - 24)^2 = 144$

$16x^2 - 64(x-3)^2 = 144 \Rightarrow x^2 - 4(x-3)^2 = 9$

$3x^2 - 24x + 45 \Rightarrow x^2 - 8x + 15 = 0$

$x = 3,5$

Area $= \int_3^5 \sqrt{\frac{16x^2 - 144}{9}} - \frac{1}{2}\cdot 2\cdot\frac{16}{3}$

$= \frac{4}{3}\int_3^5 \sqrt{x^2 - 9} - \frac{16}{3}$

$= \frac{4}{3}\left(\frac{x}{2}\sqrt{x^2 - 9} - \frac{9}{2}\log_e\left(x + \sqrt{x^2 - 9}\right)\right)_3^5 - \frac{16}{3}$

$= \frac{4}{3}\left(\frac{5}{2}\cdot 4 - \frac{9}{2}\log_e 9 - \frac{3}{2}\cdot 0 + \frac{9}{2}\log_e 3\right) - \frac{16}{3}$

Area $= 8 - 6\log_e 3 = A - 6\log_e 3$

$\Rightarrow A = 8$

14. Let $A = \{2,3,4,5,6\}$ be a set. Consider R be a relation of $A \times A$ such that $(x, y)R(a, b)$ implies x divides 'a' and $y \le b$ then total number of elements in R is :

(1) 24 (2) 120 (3) 720 (4) 144

Ans. **(2)**

Sol. For

$x = 2,\quad a = 2,4,6$

$x = 3 \quad a = 3,6$

$x = 4 \quad a = 4$

$x = 5 \quad a = 5$

$x = 6 \quad a = 6$

Total case = 8

and no. of combination of y and b satisfying $y \le b = 1 + 2 + 3 + 4 + 5 = 15$

No. of relations satisfying $(x, y)R(a, b)$ is $8 \times 15 = 120$.

15. If $I(x) = \int \frac{16x+24}{x^2+2x-15} dx, I(4) = 14\ln 3$ and $I(7) = \ln(2^\alpha \cdot 3^\beta)$, then $(\alpha + \beta)$ is equal to

(1) 39 (2) 33 (3) 36 (4) 42

Ans. **(1)**

Sol. $I(x) = \int \frac{8(2x+2)+8}{x^2+2x-15} dx$

$$I(x) = 8\ln|x^2 + 2x - 15| + \ln\left|\frac{x-3}{x+5}\right| + C$$

$I(4) = 14\ln 3 + C$

$C = 0$

$I(7) = 8\ln 48 - \ln 3$

$= \ln\left(\frac{(48)^8}{3}\right)$

$I(7) = \ln(2^{32} \times 3^7)$

$\alpha = 32, \beta = 7 \Rightarrow \alpha + \beta = 39$

16. Let $x(y)$ be the solution of the given differential equation $2y^2 \frac{dx}{dy} - 2xy + x^2 = 0$. If $x(e) = e$, then $\frac{3x(e^2)}{e^2}$ equals.

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

Ans. **(2)**

Sol. $2y(ydx - xdy) + x^2dy = 0$

$-2yx^2\, d\left(\frac{y}{x}\right) + x^2dy = 0$

$-2y\ d\left(\frac{y}{x}\right) + dy = 0$

$\frac{-2y}{x} + \log_e y = C$

Given $x(e) = e$

$C = -1$

$\frac{-2y}{x} + \log_e y = -1$

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

$\frac{2e^2}{x} - 2 = 1 \Rightarrow \frac{2e^2}{x} = 3 \Rightarrow x = \frac{2e^2}{3}$

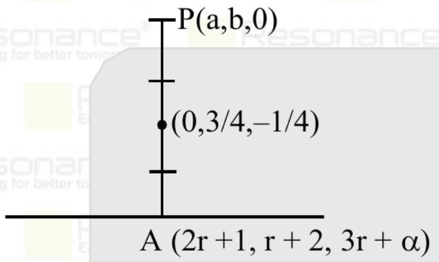
$x(e^2) = \frac{2e^2}{3}$

17. If foot of the perpendicular from a point $P(a,b,0)$ on the line $\frac{x-1}{2}=\frac{y-2}{1}=\frac{z-\alpha}{3}$ is A and mid-point of AP is $(0,3/4,-1/4)$, then the value of $(a^2+b^2+\alpha^2)$ is -

Ans. **(1)**

Sol. $\frac{2r+1+a}{2}=0 \Rightarrow 2r+a=-1$

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



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

$$2\cdot a+1\cdot(b-3/4)+3\cdot\frac{1}{4}=0 \Rightarrow a+b=0$$

$\Rightarrow 2(-1-2r)+(-r-1/2)=0$

$\Rightarrow -3/2=3r=1 \Rightarrow r=-1/2, a=0, b=0, \alpha=1$

$\therefore a^2+b^2+\alpha^2=1$

18. Ram is tossing a coin if head comes then 10 points will be given and if tail comes then 5 points will be given . If the probability of getting exactly 30 point is $\frac{m}{n}$ then $(m+n)$ equals (Where m & n are co-prime numbers).

Ans. **(107)**

Sol. P = (6 tail) + (4 tail +1 head) + (2 tail +2 head) + (3 head)

$$P=\left(\frac{1}{2}\right)^6+\frac{5!}{1!\,4!}\left(\frac{1}{2}\right)^5+\frac{4!}{2!\,2!}\left(\frac{1}{2}\right)^4+\left(\frac{1}{2}\right)^3$$

$$P=\frac{1}{64}+\frac{5}{32}+\frac{3}{8}+\frac{1}{8}$$

$$P=\frac{1+10+24+8}{64}=\frac{43}{64}=\frac{m}{n}$$

$m+n=107$

19. If ${}^{30}C_{30-r}+3\cdot{}^{30}C_{31-2}+3\cdot{}^{30}C_{32-r}+{}^{30}C_{33-r}={}^{n}C_r$ then value of n is

Ans. **(33)**

Sol. ${}^{3}C_3\cdot{}^{30}C_{30-r}+{}^{3}C_2\cdot{}^{30}C_{31-r}+{}^{3}C_1\cdot{}^{30}C_{32-r}+{}^{3}C_0\cdot{}^{30}C_{33-r}$

$={}^{33}C_{33-r}\equiv{}^{n}C_r\equiv{}^{n}C_{n-r}$

$n=33$

20. If matrices $A = \begin{bmatrix} 2 & -2 \\ 4 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 3 \\ 3 & 9 \end{bmatrix}$ are such that PA = B and AQ = B then tr(2(P + Q)) is -

Ans. **(10)**

Sol. $A^{-1} = \frac{1}{4}\begin{bmatrix} -2 & 2 \\ -4 & 2 \end{bmatrix} = \frac{1}{2}\begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix}$

$P = BA^{-1} = \frac{1}{2}\begin{bmatrix} 1 & 3 \\ 3 & 9 \end{bmatrix}\begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix} = \frac{1}{2}\begin{bmatrix} -7 & 4 \\ -21 & 12 \end{bmatrix}$

$Q = A^{-1}B = \frac{1}{2}\begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix}\begin{bmatrix} 1 & 3 \\ 3 & 9 \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 2 & 6 \\ 1 & 3 \end{bmatrix}$

$\therefore \text{tr}(2(P + Q)) = 10$

21. Let $P = \{\theta \in [0,4\pi], \tan^2\theta \neq 1\}$

$S = \{a \in z: (\cos^2\theta - \sin^2\theta)\sec 2\theta = a^2, \theta \in P\}$ then n(S) equals

Ans. **(2.00)**

Sol. $a^2 = \cos 2\theta \cdot \sec 2\theta = 1 \Rightarrow a = 1, -1 n(S) = 2$