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JEE (Main) PAPER-1 (B.E./B. TECH.)

2023

COMPUTER BASED TEST (CBT) Memory Based Questions & Solutions

Date: 25 January, 2023 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)
Duration: 3 Hours | Max. Marks: 300

SUBJECT: MATHEMATICS

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PART : MATHEMATICS

1. Value of $\sum_{k=0}^6 {}^{51-k}C_3$ is

- (1) ${}^{51}C_3 - {}^{45}C_3$ (2) ${}^{51}C_3 - {}^{45}C_4$ (3) ${}^{51}C_4 - {}^{45}C_4$ (4) ${}^{51}C_4$

Ans. (3)

Sol. ${}^{51}C_3 + {}^{50}C_3 + \dots + {}^{45}C_3$
 $\Rightarrow {}^{45}C_4 + {}^{45}C_3 + {}^{45}C_3 + \dots + {}^{51}C_3 - {}^{45}C_4$

$$\Rightarrow {}^{70}C_4 + {}^{70}C_3 + \dots + {}^{70}C_1$$

$$= {}^{51}C_4 + {}^{51}C_3 + \dots + {}^{51}C_1 = {}^{51}C_4 - {}^{45}C_4$$

2. The value of integral is :- $\int_1^2 \frac{dx}{x^3(x^2+2)^2}$

(1) $\frac{11+6\ln 4}{96}$

(2) $\frac{11-3\ln 4}{96}$

(3) $\frac{11+3\ln 4}{96}$

(4) $\frac{11-6\ln 4}{96}$

Ans. (4)

Sol. $\int_1^2 \frac{dx}{x^3 x^4 \left(1 + \frac{2}{x^2}\right)^2}$

Let $1 + \frac{2}{x^2} = t \Rightarrow \frac{-4}{x^3} dx = dt$

$$I = \frac{-1}{4} \int_3^2 \left(\frac{t-1}{2}\right)^2 \frac{dt}{t^2} = -\frac{1}{16} \int_3^2 \frac{(t^2 - 2t + 1)}{t^2} dt$$

$$= -\frac{1}{16} \int_3^2 \left(1 - \frac{2}{t} + \frac{1}{t^2}\right) dt$$

$$= -\frac{1}{16} \left(t - 2 \ln |t| - \frac{1}{t} \right)_3^2$$

$$= -\frac{1}{16} \left(2 - 2 \ln \frac{2}{3} - \frac{3}{2} \right) - \left(3 - 2 \ln 2 - \frac{1}{3} \right)$$

$$= -\frac{1}{16} \left(2 \ln 2 - \ln \frac{3}{2} - \frac{3}{2} - \frac{1}{3} \right)$$

$$= -\frac{1}{16} \left(2 \ln 3 - \frac{11}{6} \right) = \frac{-1}{16} \left(\ln 4 - \frac{11}{6} \right)$$

$$= \frac{11-6\ln 4}{16 \times 6}$$

$$\frac{11-6\ln 4}{96}$$

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3. Remainder when $(2023)^{2023}$ is divided by 35, is

(1) 28

(2) 7

(3) 14

(4) 0

Ans. (2)

Sol. $-7^{2023} = -7 \times 7^{2022}$

$$= \frac{-7^{2022}}{5}$$

$$= \frac{-[50-1]^{2022}}{5}$$

$$= \frac{[5\lambda-1]}{5}$$

remainder = + 1

when divided by 5 now remainder is 7 when divided 35

4. Given, function be $f(x) = 2x^n + \lambda$ for which the value of $f(4) = 133$, $f(5) = 255$, find $[f(3) - f(2)]$

Ans. (38)

Sol. $f(4) = 2(4^n) + \lambda = 133$ $f(5) = 2(5^n) + \lambda = 255$

$$f(5) - f(4) = 2(5^n - 4^n) = 122$$

$$\Rightarrow 5^n - (4^n) = 61$$

$$\Rightarrow n = 3$$

$$\Rightarrow \lambda = 3$$

$$\Rightarrow f(3) - f(2) = 2(3^3 - 2^3) = 2(27 - 8)$$

$$= 2(19) = 38$$

5. If the range of the function $F(x) = \log_2(\sqrt{2}(\sin x - \cos x) + m - 2)$ is $[0, 2]$ then the possible value of m is

5. In the range of the function $f(x) = \log_{\sqrt{3}}(\sqrt{2}(\sin x - \cos x) + m - 2)$ is $[0, 2]$ then the possible value of m is

- (1) 0 (2) 3 (3) 5 (4) 7

Ans. (3)

Sol. $\log_{\sqrt{3}}(\sqrt{2}(\sin x - \cos x) + m - 2) \in [0, 2] \in [\log_{\sqrt{3}} 1, \log_{\sqrt{3}} 5]$

$\Rightarrow \sqrt{2}(\sin x - \cos x) + m - 2 \in [1, m]$ (i)

Range of $(\sin x - \cos x)$ is $[-\sqrt{2}, \sqrt{2}]$

So, from (i)

$[-4 + m, m] \rightarrow [1, m]$

$-4 + m = 1 \Rightarrow m = 5$

6. If $A = \begin{bmatrix} 1 & 3 \\ \sqrt{10} & \sqrt{10} \\ -3 & 1 \\ \sqrt{10} & 10 \end{bmatrix}$ $B = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix}$ and $M = A^T B A$ then $A M^{2023} A^T$ is

- (1) B (2) $-B^{2023}$ (3) B^{2023} (4) $-B$

Ans. (3)

Sol. $M^2 = (A^T B A) (A^T B A)$

$= A^T B (A A^T) B A$

$= A^T B I B A = A^T B^2 A$

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$AA^T = \begin{bmatrix} 1 & 3 \\ \sqrt{10} & \sqrt{10} \\ -3 & 1 \\ \sqrt{10} & 10 \end{bmatrix} \begin{bmatrix} 1 & -3 \\ \sqrt{10} & \sqrt{10} \\ 3 & 1 \\ \sqrt{10} & \sqrt{10} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$M^{2023} = A^T B^{2023} A$

$\therefore B^2 = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix}$

$B^3 = \begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -3 \\ 0 & 1 \end{bmatrix} \Rightarrow B^{2023} = \begin{bmatrix} 1 & -2023 \\ 0 & 1 \end{bmatrix}$

$\therefore M^{2023} = A^T B^{2023} A$

$A^T M^{2023} A^T = A (A^T B^{2023} A) A^T$

$= B^{2023} = \begin{bmatrix} 1 & -2023 \\ 0 & 1 \end{bmatrix}$

7. The number of numbers between 5000 and 10000 by using the digits 1, 3, 5, 7, 9 without repetition is equal to .

- (1) 120 (2) 72 (3) 12 (4) 6

Ans. (2)

Sol. Digit in thousand place must be 5, 7 or 9.

= 3 ways

Now Total numbers between 5000 to 10000

are = $3 \times 4 \times 3 \times 2$

= 72

8. If $\left| \frac{z+2i}{z-1} \right| = 2$ is a circle then centre of circle is

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

Ans. (2)

Sol. $\left| \frac{x+iy+2i}{x+iy-1} \right| = 2 \Rightarrow \frac{x^2 + (y+2)^2}{x^2 + (y-1)^2} = 4$

$\Rightarrow x^2 + y^2 + 4y + 4 = 4x^2 + 4y^2 - 8y + 4$

$\Rightarrow 3x^2 + 3y^2 - 12y = 0$

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

Centre = (0, 2)

9. If roots of $x^2 + (60)^{1/4}x + a = 0$ be α and β and the value of $\alpha^4 + \beta^4 = -30$ then find the product of all

possible values of a
Ans. (45)
Sol. Since, $\alpha^4 + \beta^4 = -30$
 $\Rightarrow [(\alpha + \beta)^2 - 2\alpha\beta]^2 - 2\alpha^2\beta^2 = -30$
 $\Rightarrow [(-60)^2 - 2a]^2 - 2a^2 = -30$

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$$\begin{aligned} &\Rightarrow (\sqrt{60} - 2a)^2 = 2a^2 - 30 \\ &\Rightarrow 60 + 4a^2 - 4a\sqrt{60} = 2a^2 - 30 \\ &\Rightarrow 2a^2 - 4a(\sqrt{60}) + 90 = 0 \\ &\Rightarrow a^2 - 2a(\sqrt{60}) + 45 = 0 \\ &\text{So, product of value of } a = 45 \end{aligned}$$

10. If $(p \rightarrow q) \wedge (p \vee q)$ is a tautology then the ordered pair of Δ, ∇ is

- (1) (\vee, \vee) (2) (\vee, \wedge) (3) (\wedge, \vee) (4) (\wedge, \wedge)

Ans. (1)

Sol. If $\Delta = \nabla = \vee$
 $\Rightarrow (p \rightarrow q) \vee (p \vee q)$
 $\Rightarrow ((\sim p \vee q) \vee p) \vee q$
 $\Rightarrow ((\sim p \vee p) \vee q) \vee q$
 $\Rightarrow (t \vee q) \vee q = t \vee q = t$

11. If $1 + \int_{1/3}^1 nx dx = \frac{m}{n} \ln\left(\frac{n^2}{e}\right)$ Then Value of $m^2 + n^2 - 5$ is equal to

Ans. (20)

Sol. $\int_{1/3}^1 nx dx + \int_{1/3}^1 nx dx$
 $-(x/nx - x)_{1/3}^1 + (x/nx - x)_{1/3}^1$
 $-[(0-1) - (\frac{1}{3} \ln \frac{1}{3} - \frac{1}{3})] + [(3/n3 - 3) - (0-1)]$
 $2 - \frac{1}{3} + 3/n3 - \frac{1}{3} \ln 3 - 3$
 $-\frac{4}{3} + \frac{8}{3} \ln 3 = (2/n3 - 1) \frac{4}{3}$
 $\frac{4}{3} (\ln 9 - \ln e) = \frac{4}{3} \ln \frac{9}{e}$
 $m = 4, n = 3$
 $m^2 + n^2 - 5 = 4^2 + 3^2 - 5 = 20$

12. $\vec{a} = -\hat{i} - \hat{j} + \hat{k}$
 $\vec{a} \times \vec{b} = \hat{i} - \hat{j}$
 $\vec{a} \cdot \vec{b} = 1$

Let $\vec{a} = x\hat{i} + y\hat{j} + z\hat{k}$, then $x + y + z$ equal

Ans. (9)

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Sol. $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & -1 & 1 \\ x & y & z \end{vmatrix}$

$$= (-z - y)\hat{i} - j(-z - x) + k(-y + x) = i - j$$

$$-z - y = 1, z + x = -1, x = y$$

also $(\vec{a} \cdot \vec{b}) = 1$

$$-x - y + z = 1$$

$$-2x + z = 1$$

$$x + z = -1$$

$$-3x = 2$$

$$x = -\frac{2}{3}$$

$$y = -\frac{2}{3}, z = -1 + \frac{2}{3}$$

$$= -\frac{1}{3}$$

now $\vec{a} \cdot 6\vec{b} = (-\hat{i} - \hat{j} + \hat{k}) \cdot 6\left(\frac{-2\hat{i}}{3} - \frac{2\hat{j}}{3} - \frac{\hat{k}}{3}\right)$

$$= 3i + 3j + 3k$$

13. The probability of a smoker to get a lung cancer is 27 times the probability of a normal person getting lung cancer. The probability that the man is smoker given that he is suffering from lung cancer, here it is given

that probability of a person to be smoker is $\frac{1}{4}$, is

(1) $\frac{9}{10}$

(2) $\frac{8}{11}$

(3) $\frac{9}{10}$

(4) $\frac{8}{11}$

Ans. (1)

Sol. $P(S) = \frac{1}{4}, P(N) = \frac{3}{4}$

$$P\left(\frac{C}{S}\right) = 27 P\left(\frac{C}{N}\right)$$

$$P\left(\frac{S}{C}\right) = \frac{P(S)P\left(\frac{C}{S}\right)}{P(S)P\left(\frac{C}{S}\right) + P(N)P\left(\frac{C}{N}\right)}$$

$$= \frac{\frac{1}{4} \times 27 \times P\left(\frac{C}{N}\right)}{\frac{1}{4} \times 27 \times P\left(\frac{C}{N}\right) + \frac{3}{4} \times P\left(\frac{C}{N}\right)}$$

$$= \frac{27}{27+3} = \frac{27}{30} = \frac{9}{10}$$

$$= \frac{27}{27+3} = \frac{27}{30} = \frac{9}{10}$$

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14. If $y = y(x)$ is the solution of equation $\frac{dy}{dx} + \alpha y = \gamma e^{-\beta x}$ where $\alpha, \beta, \gamma > 0$ and $\alpha \neq \beta$ then $\lim_{x \rightarrow \infty} y(x)$ is equal to.

Ans. (0)

Sol. I.F. = $e^{\int \alpha dx} = e^{\alpha x}$

Solution $y \cdot e^{\alpha x} = \int e^{\alpha x} \cdot \gamma e^{-\beta x} dx + c$

$$\Rightarrow y e^{\alpha x} = \gamma \int e^{(\alpha-\beta)x} dx + c$$

$$= \frac{\gamma}{\alpha-\beta} e^{(\alpha-\beta)x} + c$$

$$\Rightarrow y(x) \cdot e^{-\alpha x} = \gamma \frac{e^{-\beta x}}{(\alpha - \beta)} + c$$

$$\Rightarrow y(x) = \gamma \frac{e^{-\beta x}}{(\alpha - \beta)} + ce^{-\alpha x}$$

$$\lim_{x \rightarrow \infty} y(x) = \lim_{x \rightarrow \infty} \left(\frac{\gamma e^{-\beta x}}{(\alpha - \beta)} - ce^{-\alpha x} \right)$$

$$= 0 - 0 = 0$$

15. If $a, b, \frac{1}{18}$ are in G.P. and $\frac{1}{a}, 10, \frac{1}{b}$ are in A.P. also a, b are positive then $12b + 16a =$

Ans. (3)

Sol. $b^2 = \frac{a}{18}$

$$20 = \frac{1}{a} + \frac{1}{b}$$

$$20 = \frac{1}{18b^2} + \frac{1}{b}$$

$$360b^2 = 1 + 18b$$

$$360b^2 - 18b - 1 = 0$$

$$b = \frac{18 + 42}{360 \times 2} = \frac{1}{12}$$

$$\text{and } a = 18b^2 = \frac{18}{144} = \frac{1}{8}$$

$$\text{So, } 12b + 16a = 1 + 2 = 3$$

16. Two dice are rolled If the probability that the Sum of the numbers on dice is n , where $n-2, \sqrt{3n},$

$n+2$ are in geometric progression, is $\frac{x}{48}$, then the value of x is :-

- (1) 4 (2) 12 (3) 7 (4) 3

Ans. (1)

Sol. $n-2, \sqrt{3n}, n+2 \rightarrow$ G.P.

$$(\sqrt{3n})^2 = (n-2)(n+2)$$

$$\Rightarrow 3n = n^2 - 4$$

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$$\Rightarrow n^2 - 3n - 4 = 0$$

$$\Rightarrow (n-4)(n+1) = 0$$

$$\Rightarrow n = 4, n = -1$$

$$\Rightarrow n = 4$$

$$P(S=4) = \frac{3}{36} = \frac{1}{12} = \frac{4}{48}$$

$$\Rightarrow x = 4$$

17. Consider then function $f(x)$

$$\begin{cases} (1 + |\cos x|)^{\frac{\lambda}{|\cos x|}} : x < \frac{\pi}{2} \\ \mu : x = \frac{\pi}{2} \\ e^{\cos 16x} : x > \frac{\pi}{2} \end{cases}$$

If $f(x)$ is continuous at $x = \frac{\pi}{2}$ then (where $\lambda \neq 0$)

(1) $\lambda = \frac{2}{3}, \mu = e^3$

(2) $\lambda = e^3, \mu = \frac{3}{2}$

(3) $\lambda = \frac{3}{2}, \mu = e^2$

(4) $\lambda = e^2, \mu = \frac{3}{2}$

Ans. (1)

Sol. $f\left(\frac{\pi}{2}^+\right) = \lim_{x \rightarrow \frac{\pi}{2}^+} \frac{\cot 6x}{x - \frac{\pi}{2} + e^{\cot 4x}} = \lim_{x \rightarrow \frac{\pi}{2}^+} \frac{\sin 4x \cos 6x}{x - \frac{\pi}{2} + e^{\sin 6x \cos 4x}}$

$= \lim_{x \rightarrow \frac{\pi}{2}^+} \frac{-4 \cos 4x}{6 \cos 6x} = \frac{2}{3} e^3$

LHL $f\left(\frac{\pi}{2}^-\right) = \lim_{x \rightarrow \frac{\pi}{2}^-} (1 + |\cos x|)^{\frac{\lambda}{|\cos x|}} = e^\lambda$

$\Rightarrow \lambda = \frac{2}{3}, \mu = e^3$

18. Let $f(x) = 2x^3 + (2p - 7)x^2 + 3(2p - 9)x - 6$. If maximum value of $f(x)$ occurs at negative x and minimum value of $f(x)$ occurs at positive x , then $p \in \dots$

- (1) $\left(-\infty, \frac{9}{2}\right)$ (2) $\left(-\infty, \frac{1}{2}\right)$ (3) $\left(\frac{9}{2}, \infty\right)$ (4) None of these

Ans. (1)

Sol. $f'(x) = 6x^2 + 2(2p - 7)x + 3(2p - 9)$
 $f'(0) < 0$
 $3(2p - 9) < 0$

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$2p - 9 < 0$

$p < \frac{9}{2}$

$p \in \left(-\infty, \frac{9}{2}\right)$

19. If A is a symmetric matrix and B & C are skew symmetric matrices of same order then

- (1) $A^{13} B^{26} - B^{26} A^{13}$ is symmetric (2) $AC - A$ is symmetric
 (3) $A^{13} B^{26} - B^{26} A^{13}$ is skew symmetric (4) $AC - A$ is skew symmetric

Ans. (3)

Sol. $(A^{13} B^{26} - B^{26} A^{13})^T = (A^{13} B^{26})^T - (B^{26} A^{13})^T$
 $\Rightarrow (B^{26})^T (A^{13})^T - (A^{13})^T (B^{26})^T$
 $\Rightarrow (B^T)^{26} (A^T)^{13} - (A^T)^{13} (B^T)^{26}$
 $\Rightarrow (-B)^{26} A^{13} - A^{13} (-B)^{26}$
 $\Rightarrow -(A^{13} B^{26} - B^{26} A^{13})$

20. If the straight line $3x + 4y = 60$ makes a triangle with co-ordinate axes, then the number of points (a, b) lying inside the triangle such that b is a multiple of a (where $a, b \in \mathbb{N}$), is

Ans. (31)

Sol. $y = \frac{60 - 3x}{4}$

$(1, 1), (1, 2), \dots, (1, 14) \rightarrow 14$

$(2, 2), (2, 4), \dots, (2, 12) \rightarrow 6$

$(3, 3), (3, 6), \dots, (3, 12) \rightarrow 4$

$(4, 4), (4, 8), \dots \rightarrow 2$

$(5, 5), (5, 10), \dots \rightarrow 2$

$(6, 6), (7, 7), (8, 8), \dots \rightarrow 3$

Total number of points lying inside the triangle = 31



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OFFLINE / ONLINE

CLASS
STARTS

6th FEBRUARY
2023

COURSE FEATURES

- Complete Course Coverage
- 25 Chapter wise Test
- Regular Practice through 33 Daily Online Practice Test
- 5 Full Syllabus Test
- 3 Joint Preparatory Test
- Approx 2600 practice Que.
- 113 Teaching hours
- 99 Testing Hours
- Regular Test discussion classes for concept clearance
- Back up support of recorded lectures



RESONites ने फिर लहराया सफलता का परचम

STUDENTS FROM CLASSROOM PROGRAM (OFFLINE/ ONLINE)

AIR
6
KARTHIKEYA
POLISETTY
Roll No.: 21925115

AIR-1
GEN-EWS

AIR
8
DHEERAJ
KURUKUNDA
Roll No.: 21925114

Students
in TOP-100
All India
Ranks
(AIRs)



AIR-11
DEVANSHI MALI
Roll No.: 21910044



AIR-15
ARSHDEEP DHAND
Roll No.: 21922146



AIR-35
SANGHAR SHRIVASTAVA
Roll No.: 21912515



AIR-50
ANSHUL GARG
Roll No.: 21920223



AIR-54
SOUMITRA O. NAYAK
Roll No.: 21920054



AIR-58
KARISHK SHARMA
Roll No.: 21924544

ADMISSIONS OPEN FOR ACADEMIC SESSION 2023-24

TARGET: JEE (Adv.) 2024
for Class XII Passed Student
VISHESH COURSE
MODE: OFFLINE / ONLINE
CLASS STARTS
10th & 17th April

TARGET: JEE (Main) 2024
for Class XII Passed Student
ABHYAAS COURSE
MODE: OFFLINE / ONLINE
CLASS STARTS
10th & 24th April

SCHOLARSHIP ON THE BASIS OF JEE (MAIN) 2023 %ILE / AIR

Resonance Eduventures Limited

REGISTERED & CORPORATE OFFICE: CG Tower, A-46 & 52, IPHA, Near City Mall, Jhalawar Road, Kota (Rajasthan) - 324005
Tel. No.: 0744-2777777, 2777700 | CIN: U80302RJ2007PLC024029

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