

# JEE Main 2023 (Memory Based Paper)

29 January (Evening Shift) - Mathematics



Q1 if  $z \neq 0$  be a complex number such that  $|z - \frac{1}{z}| = 2$  then find the maximum value of  $|z|$   
 $\sqrt{2+1}$

Q2 find the value of  $\int_2^{1/2} \frac{\tan^{-1} x}{x} dx$   
 $\frac{\pi}{4} (\ln \frac{1}{2} - \ln 2)$

Q3 if  $(\cos^2 2x - 2\sin^4 x - \sin^2 x) = \lambda$  then find the interval in which  $\lambda$  lies

(a)  $[-1, 0]$  (b)  $[0, 1]$  ~~(c)  $[-2, 1]$~~  (d)  $(-\infty, 1)$

Q4 find the number of 3 digit nos. which are divisible by 3 or 4 but not by 48  
(432)

Q5 if  $f(1) = 1$ ,  $f(1) + 2f(2) + 3f(3) + \dots + n f(n) = n(n+1)f(n+1)$   
 $\forall n \in \mathbb{N}$  then find  $\frac{1}{f(2022)} + \frac{1}{f(2028)}$   
(4050)

Q6 find the rank of the word "TOUGH" if letters of the word are arranged in a dictionary  
(89)

Q7 find  $\int_{1/2}^2 \frac{t^6+1}{t^4+1} dt$   
 $2 \tan^{-1} 2 + \frac{2}{3} \tan^{-1} 8 - \frac{2\pi}{3}$

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Q8  $R = \{ (a, b) : 2a + 3b \text{ is divisible by } 5 \ \& \ a, b \in \mathbb{N} \}$  is

- (a) Transitive & symmetric
- (b) Symmetric but not transitive
- (c) Transitive but not symmetric
- (d) Equivalence Relation

Q9 Area of the region  $|\cos x - \sin x| \leq y \leq \sin x \ \forall x \in (0, \frac{\pi}{2})$

$$1 + \sqrt{5} - 2\sqrt{2}$$

Q10 find the shortest distance b/w the lines

$$\frac{x-1}{2} = \frac{2y-2}{3} = \frac{z-3}{1} \ \& \ \frac{x-2}{3} = \frac{y-1}{2} = \frac{z+2}{4}$$

$$\frac{13}{\sqrt{165}}$$

Q11 A line  $x+y=3$  cuts a circle having centre  $(2,3)$  and radius 4 at two points A & B. If the tangents at A and B are drawn which intersect at a point  $S(\alpha, \beta)$  then find the value of  $4\alpha - 7\beta$  (11)

Q12 Given a differential eq<sup>n</sup>  $x \ln x \frac{dy}{dx} + y = x^2 \ln x$   
&  $y(2) = 2$  then find  $y(e)$

$$1 + e^2/4$$

Q13 let  $f(x) = x^2 + 2x + 5$  &  $\alpha, \beta$  be roots of  $f(\frac{1}{t}) = 0$   
then  $\alpha + \beta =$

$$-2/5$$



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Q14

let  $x = 11, 12 \dots 40, 41$

&  $y = 61, 62 \dots 91$

here  $\sigma^2$  is the variance of  $(x \cup y)$  Then find the value of  $\sigma^2 - \bar{x} - \bar{y}$

(603)

Q15

if the lines  $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z+3}{1}$  &  $\frac{x-11}{4} = \frac{y-9}{2} = \frac{z-4}{3}$

intersects at point P then the perpendicular distance of P from the plane  $3x + 2y + 6z = 10$

3/7

Q16

Number of 4 digit nos. 'n' such that  $\gcd(n, 52) = 2$

2077

Q17

$\vec{a} = 9\hat{i} + 2\hat{k}$ ,  $\vec{b} = \hat{i} + \hat{j} + \hat{k}$  &  $\vec{c} = 7\hat{i} - 3\hat{j} + 2\hat{k}$

Are 3 vectors let there be a vector  $\vec{r}$  such that

$\vec{r} \times \vec{b} + \vec{b} \times \vec{c} = 0$  and  $\vec{r} \cdot \vec{a} = 0$  then  $\vec{r} \cdot \vec{c}$  is

280/11

Q18

let  $k =$  sum of odd coefficients of  $(1+x)^{99}$

$a =$  middle term of  $(2 + \frac{1}{\sqrt{2}})^{200}$

and if  ${}^{200}C_{99} \frac{k}{a} = \frac{2^l m}{n}$  where  $m, n$  are odd numbers

then find  $(l, n)$

(50, 101)

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Q19 if the curve given by  $y = \frac{(x-a)}{(x-3)(x-2)}$  passes through  $(1, -3)$  then the equation of normal at  $(1, -3)$  to the curve is given by

(a)  $2x + 3y = -7$  (b)  $3x - 2y = 9$

~~(c)~~  $x - 4y = 13$  (d)  $3x - 4y = 21$

Q20 Two matrices A and B are such that  $|A| = 2$

$$B = \begin{bmatrix} 2 & 1 \\ 3 & 3/2 \end{bmatrix} \quad BA = \begin{bmatrix} 2 & 1 \\ \alpha & \beta \end{bmatrix} \quad \& \quad A^T = A$$

and  $\text{Tr}(A) = S$  then  $\frac{\beta \times S}{\alpha}$  3/2

Q21 Consider a sequence  $a_1, a_2, \dots, a_n$  given by

$a_n = a_{n+1} + 2^{n+1}$   $a_1 = 1$  and another sequence given by  $b_n = b_{n+1} + a_{n+1}$  where  $b_1 = 1$  Also  $P = \sum_{n=1}^{10} \frac{b_n}{2^n}$

and  $Q_n = \sum_{n=1}^{10} \frac{1}{2^{n-1}}$  then  $2^7 (P - 2Q)$  7.5

Q22  $b \rightarrow (\sim a \vee b)$  is equivalent to