# MATHS

## BOOKS - FULL MARKS MATHS (TAMIL ENGLISH)

## SAMPLE PAPER - 17

### Part I

**1.** If A = $\begin{bmatrix} 1 & \tan\frac{\theta}{2} \\ -\tan\frac{\theta}{2} & 1 \end{bmatrix}$ and AB = $I_2$, then B=

A. $\left(\cos^2 . \frac{\theta}{2}\right)A$

B. $\left(\cos^2 . \frac{\theta}{2}\right)A^T$

C. $\left(\cos^2\theta\right)I$

D. $\left(\sin^2 . \frac{\theta}{2}\right)A$

**Answer: B**

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**2.** If $\alpha$ and $\beta$ are the roots of $x^2$ + x + 1 = 0, then $\alpha^{2020}+\beta^{2020}$is

A. $-2$

B. $-1$

C. 1

D. 2

**Answer: B**

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**3.** The value of $e^{I\theta}-e^{-i\theta}$ is .......

A. $\sin\theta$

B. $2\sin\theta$

C. $i\sin\theta$

D. $2i \sin\theta$

**Answer: D**

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**4.** The area of the triangle formed by the complex number z, iz in the Argand's diagram is ........... .

A. $\frac{1}{2}|z^2|$

B. $|z^2|$

C. $\frac{3}{2}|z|^2$

D. $2|z|^2$

**Answer: A**

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**5.** If $\cot^{-1}2$ and $\cot^{-1}3$ are two anges of a triangle, then the third angle is

A. $\frac{\pi}{4}$

B. $\frac{3\pi}{4}$

C. $\frac{\pi}{6}$

D. $\frac{\pi}{3}$

**Answer: B**

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**6.** $\sec^{-1}\left(\frac{2}{3}\right)+\cos ec^{-1}\left(\frac{2}{3}\right)=$ ..........

A. $\frac{-\pi}{2}$

B. $\frac{\pi}{2}$

C. $\pi$

D. $-\pi$

**Answer: A**

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**7.** If the normals of the paralbola y^2=4x drawn at the end points of its latus rectum are tangents to the circle (x-3)^(2) + (y+2)^(2) = r^(2) then the value of r^(2) is

A. 2

B. 3

C. 1

D. 4

**Answer: B**

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**8.** The vertices of the ellipse $16x^2 + 25y^2 = 400$ are ............

A. $(0, \pm 4)$

B. $(\pm 5, 0)$

C. $(\pm 4, 0)$

D. $(0, - \pm 5)$

**Answer: B**

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**9.** If $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \times \vec{b}) \times \vec{c}$, where $\vec{a}, \vec{b}\ \vec{c}$ are any three vectors such that $\vec{b} \cdot \vec{c} \neq 0$ and $\vec{a} \cdot \vec{b} \neq 0$, then $\vec{a}$ and $\vec{c}$ are

A. perpendicular

B. parallel

C. inclined at an angle $\frac{\pi}{3}$

D. inclined at an angle $\frac{\pi}{6}$

**Answer: D**

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**10.** The number given by the Rolle's theorem for the function $x^3 - 3x^2, x \in [0, 3]$ is

A. 1

B. $\sqrt{2}$

C. $\frac{3}{2}$

D. 2

**Answer: D**

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**11.** The function $f(x) = x^3$ has.......... .

A. absolute maximum

B. absolute minimum

C. local maximum

D. no extrema

**Answer: B**

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**12.** Linear approximation for g(x) = cos x at $x = \frac{\pi}{2}$ is

A. $x + \frac{\pi}{2}$

B. $-x + \frac{\pi}{2}$

C. $x - \frac{\pi}{2}$

D. $-x - \frac{\pi}{2}$

**Answer: B**

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**13.** The differnetial of y if y = sin 2x is .........

A. $2\cos 2x$

B. $2\cos 2x.\ dx$

C. $-2\cos 2x dx$

D. $\cos 2x.\ dx$

**Answer: B**

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**14.** The value of $\int_{-1}^{2} |x| dx$

A. $\frac{1}{2}$

B. $\frac{3}{2}$

C. $\frac{5}{2}$

D. $\frac{7}{2}$

**Answer: B**

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15. $\int_0^{2a} f(x)dx = 0$ if ......... .

A. $f(2a - x) = f(x)$

B. $f(2a - x) = - f(x)$

C. $f(x) = - f(x)$

D. $f(x) = f(x)$

**Answer: A**

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**16.** The population P in any year t is such that the rate of increase in the population is proportional to the population. Then

A. $P = ce^{kt}$

B. $P = ce^{-kt}$

C. $P = cKt$

D. $P = c$

**Answer: A**

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**17.** On a multiple-choice exam with 3 possible destructive for each of the 5 questions, the probability that a student will get 4 or more correct answers just by guessing is

A. $\frac{11}{243}$

B. $\frac{3}{8}$

C. $\frac{1}{243}$

D. $\frac{5}{243}$

**Answer: A**

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**18.** Consider a game where the player tosses a six sided fair die. If the face that comes up is 6, the player wins Rs. 36, otherwise he loses Rs. $k^2$, where k is the face that comes up k = {1, 2, 3, 4, 5}.

The expected amount to win at this game in Rs. is

A. $\frac{19}{6}$

B. $-\frac{19}{6}$

C. $\frac{3}{2}$

D. $-\frac{3}{2}$

**Answer: B**

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**19.** A binary operation on a set S is a function from

A. $S \rightarrow S$

B. $(S \times S) \rightarrow S$

C. $S \rightarrow (S \times S)$

D. $(S \times S) \rightarrow (S \times S)$

**Answer: B**

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**20.** If X is a continuous random variable then $p(a < x < b) =$ ________.

A. $P(a \leq X \leq b)$

B. $P(a \leq X \leq b)$

C. $P(a \leq X < b)$

D. all the three above

**Answer: D**

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## Part Ii

**1.** Discuss the maximum possibel number of positive the negative zeros of the polynomials $x^2 - 5x + 6$ and $x^2 - 5x + 16$. Also draw rough sketch of the graphs.

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**2.** Show that $\cot\left(\sin^{-1} x\right)\frac{\sqrt{1-x^2}}{x}, \ -1 \leq x \leq 1 \text{ and } x \neq 0$

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**3.** Find the distance between the parallel planes $\overrightarrow{r}.\left(2\hat{i}-\hat{j}-2\hat{k}\right)=6$ and $\overrightarrow{r}.\left(6\hat{i}-3\hat{j}-6\hat{k}\right)=27$

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**4.** If the mass m(x) (in kilograms) of a thin rod of length x(in metres) is given by, $m(x)=\sqrt{3x}$ then what is the rate of change of mass with respect to the length when it is x = 27 meters.

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**5.** In each of the following cases , determine whether the following function is homogeneous or not. If it is so , find the degree. (i) $f(x,y)=x^2y+6x^3+7$ (ii) $h(x,y)=\dfrac{6x^2y^3-\pi y^5+9x^4y}{2020x^2+2019y^2}$ (iii) $g(x,y,z)=\dfrac{\sqrt{3x^2+5y^2+z^2}}{4x+7y}$ (iv) $U(x,y,z)=xy+\sin\left(\dfrac{y^2-2z^2}{xy}\right)$

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**6.** Evaluate $\int_0^{\frac{\pi}{3}} \frac{\sec x \tan x}{1+\sec^2}$x dx

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**7.** $y = e^{2x}(a+bx)$

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**8.** For the probabilty density function $f(x)\begin{bmatrix} cx(1-x)^3 & 0 < x < 1 \\ 0 & \text{elsewhere} \end{bmatrix}$

find the constant c.

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**9.** Verify the

Associative property

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10. If $y=2\sqrt{2}x+c$ is a tangent to the circle $x^2+y^2=16$, find the value of c.

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## Part Iii

1. Verify $(AB)^{-1}=B^{-1}A^{-1}$ with $A=\begin{bmatrix}0 & -3\\ 1 & 4\end{bmatrix}, B=\begin{bmatrix}-2 & -3\\ 0 & -1\end{bmatrix}$

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2. Simplify : $\left(\sin\frac{\pi}{6}+i\cos\frac{\pi}{6}\right)^{08}$.

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**3.** Solve the equation $9x^3 - 36x^2 + 44x - 16 = 0$ if the roots form an arithmetic progression.

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**4.** Prove that $\tan^{-1} x + \tan^{-1} \frac{2x}{1 - x^2} = \tan^{-1}\left(\frac{3x - x^3}{1 - 3x^2}\right) |x| < \frac{1}{\sqrt{3}}.$

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**5.** Find the equaiton of the tangent at $t = 2$ to the parabola $y^2 = 8x$ . (Hint use parametic from)

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**6.** If a plane meets the coordinate axes at A,B,C such that the centroid of the triangle ABC is the point $(u, v, w)$, find the eqution of the plane.

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**7.** Compute the value of 'c' satisfied by the Rolle's theorem for the function . $f(x) = \log\left(\frac{x^2+6}{5x}\right)$ in the interval [2,3].

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**8.** If $w(x, y, z) = \log\left(\frac{5x^3y^4 + 7y^2xz^4 - 75y^3z^4}{x^2+y^2}\right)$, find $x\frac{\partial w}{\partial x} + y\frac{\partial w}{\partial y} + z\frac{\partial w}{\partial z}$,

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**9.** Find the area of the region bounded by the curve $y = x^2$ and the line y = 4.

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**10.** A random variable X has a probability density function $f(x) = \begin{cases} k & 0 < x < 2\pi \\ 0 & \text{elesewhere} \end{cases}$ find (i) k , (ii) $P(0 < X < \pi/2)$ (iii) $P(\pi/2 < X < 3\pi/2)$

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## Part Iv

**1.** Investigate for what values of $\lambda$ and $\mu$ the system of linear equations.

$x + 2y + z = 7, x + y + \lambda z = \mu, x + 3y - 5z = 5.$ Has (i) no solution (ii) a unique solution (iii) an infinte number of solutions.

(b) P prpresents the variable complex number z. Find the locus of P , if $Re\left(\frac{z+1}{z+i}\right) = 1$ .

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**2.** Assume that water issuing from the end of a horizontal pipe. 7.5 m above the ground describes a parabolic path. The vertex of the parabolic path . The vertex of the parabolic path is at the end of the pipe. At a position 2.5 m below the line of the pipe . At a position 2.5 m below the line of the pipe , the flow of water has curved outward 3m beyond the vertical line through the end of the pipe. How far beyond this vertical line will the water strike the ground ?

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**3.** If $V(x, y) = e^x(x\cos y - y\sin y)$, then prove that $\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} = 0$

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**4.** If the curve $y^2 = x$ and $xy = k$ are orthogonal then prove that $8k^2 = 1$

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**5.** If

$\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}, \vec{b} = 2\hat{i} - \hat{j} + \hat{k}, \vec{c} = 3\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{a} \times \left(\vec{b} \times \vec{c}\right.$

find the values fo l,m,n.

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**6.** Find the probability mass function and cumculative distribution function of number of girl child in families with 4 children, assuming equal probabilities for boys and girls.

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**7.** A steel plant is capable of producing x tonnes per day of a low-grade steel and y tonnes per day of a high-grade steel, where $y = \frac{40 - 5x}{10 - x}$. If the fixed market price of low-grade steel is half that of high-grade steel, then what should be optimal productions in low-grade steel and high-grade steel in order to have maximum receipts.

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