

Step Academy official

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STUDENT NAME	
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CLASS	New 1st Year (FSC/ICS)
SUBJECT	Mathematics
TOTAL MARKS	100
Paper Type	

Q1. Choose the correct answer.

20X1=20

1. $1 + \omega^4 = \dots$

- (A) ω (B) $-\omega$ (C) ω^2 (D) $-\omega^2$

2. Far table of graph we required minimum values of each function:

- (A) 1 (B) 2 (C) 3 (D) 4

3. What are the distinct roots of the equation $x^2 + x^2 - 2 = 0$:

- (A) $\pm 1, \pm i$ (B) $\pm i$ (C) ± 2 (D) ± 1

4. If each element of a matrix is zero, then it is called

- (A) Null matrix (B) Identity matrix (C) Scalar matrix (D) Diagonal matrix

5. The conditional equation $5x+4$ is true if $x=$:

- (A) 4 (B) 5 (C) $5/4$ (D) $4/5$

6. Partial fraction of $\frac{x+4}{(x-1)(x^2+2)}$ will be:

- (A) $\frac{A}{x-1} + \frac{Bx+C}{x^2-x+1}$ (B) $\frac{A}{x-1} + \frac{B}{x^2+2}$ (C) $\frac{Ax}{x-1} + \frac{Bx+C}{x^2+2}$ (D) $\frac{Ax}{x-1} + \frac{Bx}{x^2+2}$

7. For sequence a_n represents

- (A) nth term (B) General term (C) Tenth term (D) Last term

8. In an arithmetic series S_n equals to

- (A) $S_{n-1} + a_n$ (B) $S_{n-1} - a_n$ (C) $S_{n-1} \times a_n$ (D) None of these

9. The next term of G.P 1,2,4,8,16,.... is:

- (A) 15 (B) 19 (C) 21 (D) 32

10. A geometric mean between a and b is

- (A) $\frac{a+b}{2}$ (B) $\frac{2}{a+b}$ (C) \sqrt{ab} (D) $\frac{2ab}{a+b}$

11. The series $1 + \frac{x}{2} + \frac{x^2}{4} + \frac{x^3}{8} + \dots$ if 0

- (A) Arithmetic (B) Harmonic (C) Convergent (D) Divergent

12. If $\sin 2\theta = 1$ then value of θ is

- (A) 30° (B) 45° (C) 60° (D) 90°
13. Trigonometric function are:
- (A) discontinuous (B) No circular function (C) Periodic (D) Not periodic
14. Range of $y = \cos x$:
- (A) \mathbb{R} (B) $-1 \leq y \leq 1$ (C) $y \geq 1$ or $y \leq -1$ (D) -1
15. The period of $\sin 2x$ is:
- (A) $\frac{\pi}{10}$ (B) π (C) $\frac{\pi}{2}$ (D) None
16. The period of $\operatorname{cosec} 10x$ is:
- (A) $\frac{\pi}{10}$ (B) $\frac{2\pi}{5}$ (C) $\frac{\pi}{5}$ (D) None
17. $\lim_{x \rightarrow \infty} \left(1 + \frac{x}{2}\right)^{\frac{1}{x}} =$
- (A) e (B) e^{-1} (C) e^2 (D) None
18. If $f(x) = a + x$ then which of the following options is correct?
- (A) $f(0) = f(1)$ (B) $f'(1) < f'(0)$ (C) $f(0)f'(1)$ (D) $f(0) = f'(1)$
19. $\vec{k} \cdot \vec{k}$ is equal to.....:
- (A) -1 (B) 0 (C) 1 (D) -2
20. The angle between the vectors $2\hat{i} + 3\hat{j} + \hat{k}$ and $2\hat{i} - \hat{j} - \hat{k}$ is:
- (A) 30° (B) 40° (C) 60° (D) 90°

Q2. write the answers of following questions. Any 8

8X2=16

1. Factorize the following: $z^2 - 2z - 1$
2. Factorize the following polynomials into its linear factors: $z^3 + 8$
3. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = \frac{2x - 3}{x + 1}$. Prove that $f(x)$ is one-to-one.
4. Find the point of intersection of the coordinate axes and the following linear function graphically: $y = 2x - 1$
5. Find the maximum and minimum value of the following quadratic function by completing squares: $f(x) = 3x^2 + 6x - 13$
6. Solve the following absolute value quadratic equation and inequalities: $|x^2 + 1| = 5$
7. If $A = \begin{bmatrix} 1 & 0 & -1 & 2 \\ 3 & 1 & 2 & 5 \\ 0 & -2 & 1 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & -1 & 3 & 1 \\ 1 & 3 & -1 & 4 \\ 3 & 1 & 2 & -1 \end{bmatrix}$, then show that $(A+B)^t = A^t + B^t$
8. Evaluate the following determinant: $\begin{vmatrix} 1 & -2 & -4 \\ 3 & -1 & -3 \\ -2 & 3 & 2 \end{vmatrix}$
- 9.

Find the values of λ and B are singular: $A = \begin{bmatrix} 4 & 2 & 3 \\ 7 & \lambda & 6 \\ 2 & 3 & 1 \end{bmatrix}$, $B = \begin{bmatrix} -2 & 4 & 5 \\ 1 & -2 & 1 \\ 2 & \lambda & 0 \end{bmatrix}$

10 .

Solve the following system by homogeneous linear equation by using Gaussian elimination method:

$$\begin{cases} x_1 + 4x_2 + 2x_3 = 0 \\ 2x_1 + x_2 - 3x_3 = 0 \\ 3x_1 + 2x_2 - 4x_3 = 0 \end{cases}$$

11 . Solve the following: $\sqrt{x+5} - \sqrt{x-3} = 2$

12 .

Find the value of x if:
$$\begin{vmatrix} 2 & 1 & x \\ -1 & -4 & -3 \\ x & 1 & 0 \end{vmatrix} = 5$$

Q3. write the answers of following questions. Any 8

8X2=16

1 .

Resolve the following into partial fraction: $\frac{x^2 + 1}{(x + 1)(x - 1)}$

2 .

Resolve into partial fractions: $\frac{2x^2 + 3x + 3}{(x + 1)(x^2 + 1)}$

3 . Write down the n^{th} term of the following sequence: $a_1b_1, a_2b_2, a_3b_3, \dots$

4 . Find the first three terms of an arithmetic series in which $a_1=9$, $a_n=105$ and $S_n=741$.

5 . If $a, 2a+2, 3z+3, \dots$ are in G.P then find the fifth term.

6 . If a, b, c are in G.P., show that $\log_a x, \log_b x, \log_c x$ are in H.P.

7 . Find the number of the diagonals of a 6-sided figure.

8 . Use the factor theorem to determine the first polynomial is a factor of the second polynomial: $x-3$, $x^4-3x^3+x^2-x+1$

9 . Use synthetic division to find the quotient and the remainder when the polynomial x^4-10x^2-2x+4 is divided by $x+3$.

10 . Write down the n^{th} term of the following sequence: $1, 4, 9, \dots$

11 . Find a_{n+1} and a_n if $a_n=4+3n$.

12 .

Insert five A.Ms. between $\sqrt{2}$ and $\frac{15}{\sqrt{2}}$.

Q4. write the answers of following questions. Any 9

9X2=18

1 . Without using the table, find the value of: $\cos(-240^\circ)$.

2 .

Prove the following: $\frac{\operatorname{cosec} \theta + 2 \operatorname{cosec} 2\theta}{\sec \theta} = \cot \frac{\theta}{2}$

3 . Express the following sums and differences as products: $\sin 8\theta - \sin 4\theta$

4 . Express the following sums and differences as products: $\cos 12^\circ + \cos 48^\circ$

5 .

Find the periods of the following function: $-5 - 3 \sec\left(7\pi x + \frac{\pi}{4}\right)$

6 .

Discuss continuity of $f(x)$ at $x=3$, when $f(x) = \begin{cases} x-1, & x < 3 \\ 2x+1, & x \geq 3 \end{cases}$.

7. Calculate $\frac{d}{dx} \left(3x^{\frac{4}{3}} \right) = 3 \frac{d}{dx} \left(x^{\frac{4}{3}} \right)$.

8. Is the following triple can be the direction angles of a single vector? $30^\circ, 45^\circ, 60^\circ$

9. If $\underline{u}=2\mathbf{i}+3\mathbf{j}+\mathbf{k}$, $\underline{v}=4\mathbf{i}+6\mathbf{j}+2\mathbf{k}$ and $\underline{w}=-6\mathbf{i}-9\mathbf{j}-3\mathbf{k}$, then show that \underline{u} , \underline{v} and \underline{w} are parallel to each other.

10. If $|\underline{a}+\underline{b}|=|\underline{a}-\underline{b}|$, then show that \underline{a} and \underline{b} are perpendicular.

11. If $\underline{u}=2\mathbf{i}-\mathbf{j}+\mathbf{k}$ and $\underline{v}=4\mathbf{i}+2\mathbf{j}-\mathbf{k}$, find by determinant formula: $\underline{v} \times \underline{u}$

12. Prove that: $\frac{\sin \theta - \cos \theta \tan \frac{\theta}{2}}{\cos \theta + \sin \theta \tan \frac{\theta}{2}} = \tan \frac{\theta}{2}$

13. Evaluate: $\lim_{x \rightarrow 3} \frac{x-3}{\sqrt{x}-\sqrt{3}}$

Q5. write the answers of following questions. Any 6

3X10=30

1a. Show that: $(1-\omega+\omega^2)(1-\omega^2+\omega^4)(1-\omega^4+\omega^8)(1-\omega^8+\omega^{16})\dots$ to $2n$ factors $= 2^{2n}$

b. If z_1 and z_2 are two complex numbers, show that: $\text{Arg} \left(\frac{z_1}{z_2} \right) = \text{Arg } z_1 - \text{Arg } z_2$

2a. If $A = [a_{ij}]_{3 \times 4}$, then show that, $I_3 A = A$

b. Without expansion show that: $\begin{vmatrix} bc & a & a^2 \\ ca & b & b^2 \\ ab & c & c^2 \end{vmatrix} = \begin{vmatrix} 1 & a^2 & a^3 \\ 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \end{vmatrix}$

3a. Solve the following systems of linear equation by Cramer's rule: $\left. \begin{aligned} x_1 + 2x_2 - 3x_3 &= 0 \\ 4x_1 - x_2 + x_3 &= 5 \\ -2x_1 + 3x_2 + 2x_3 &= 3 \end{aligned} \right\}$

b. Resolve the following into partial fraction: $\frac{1}{x(x+1)^3}$

4a. Prove that: $\frac{(2n+1)!}{n!} = [1.3.5..(2n-1)(2n+1)]2^n$

b. Prove that: $\frac{1 - \tan \theta \tan \phi}{1 + \tan \theta \tan \phi} = \frac{\cos(\theta + \phi)}{\cos(\theta - \phi)}$

5a. Find the direction cosines for the given vector: $\underline{v}=4\mathbf{i}+2\mathbf{j}-5\mathbf{k}$

b. If $\underline{u}=2\mathbf{i}-\mathbf{j}+\mathbf{k}$ and $\underline{v}=4\mathbf{i}+2\mathbf{j}-\mathbf{k}$, find by determinant formula: $\underline{v} \times \underline{u}$