

# 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. Dividend = (divisor)(quotient)+ .....

- (A) Zero (B) Remainder (C) Divisor (D) None of these

2. Of one root of the equation  $x^2+ax+2=0$  is 2 then a is equal to .....

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

3.  $\sin\left(\frac{3\pi}{2} + -\theta\right) = \dots$

- (A)  $\cos \theta$  (B)  $\sin \theta$  (C)  $-\cos \theta$  (D)  $-\sin \theta$

4.  $\cos^2 \theta = \dots$

- (A)  $\frac{1 + \cos \theta}{2}$  (B)  $\frac{1 + \cos 2\theta}{2}$  (C)  $\frac{1 - \cos 2\theta}{2}$  (D)  $\frac{\cos 2\theta - 1}{2}$

5.  $(\cos 2\theta)^2 + (\sin 2\theta)^2 = ?$

- (A) 0 (B) 2 (C) 4 (D) 1

6.  $\sin 3\theta - \sin 5\theta$  equals .....

- (A)  $2\sin 4\theta \cdot \cos 2\theta$  (B)  $2\cos 4\theta \cdot \sin \theta$  (C)  $-2\cos 4\theta \cdot \sin \theta$  (D)  $2\sin 4\theta \cdot \cos \theta$

7. Range of  $\tan x$  is .....

- (A)  $-\infty$  (B)  $-\infty$  (C)  $-\infty$  (D) None

8. Maximum value of function is  $m=|a|-|b|$  whenever  $\sin \theta = ?$

- (A) 1 (B) -1 (C) 0 (D) None

9.  $\lim_{x \rightarrow 0} \frac{1 - \cos \theta}{\theta}$  equal to .....

- (A) zero (B) -1 (C) 1 (D) None

10.  $\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^{2n} = ?$

- (A)  $e^{-1}$  (B)  $e^{-1/2}$  (C)  $e^2$  (D)  $e^3$

11. The function  $f(x) = \frac{x^2 - 1}{x - 1}$  is discontinuous at .....

- (A)  $x=-1$  (B)  $x=1$  (C)  $x=2$  (D)  $x=0$

12.

The notation used by Leibniz for derivative is:

- (A)  $\frac{dy}{dx}$  (B)  $f(x)$  (C)  $f'(x)$  (D)  $Df(x)$

13. Differentiate  $(x-1)(x+2)^2$ :

- (A)  $2x(x+2)$  (B)  $2(x-1)(x+2)$  (C)  $2(x-1)$  (D)  $3x(x+2)$

14.  $\frac{d}{dx} \left[ \frac{1}{g(x)} \right] = \dots\dots$

- (A)  $\frac{1}{g^2(x)}$  (B)  $\frac{-g(x)}{g(x)}$  (C)  $\frac{1}{[g(x)]^2}$  (D)  $\frac{-g'(x)}{[g(x)]^2}$

15. A physical quantity that can be specified by a number along with unit is called a:

- (A) Vector (B) Scalar (C) Constant (D) Constant vector

16. The magnitude of the vector  $v = a\hat{i} + b\hat{j} + c\hat{k}$  is:

- (A)  $a^2 + b^2 + c^2$  (B)  $a + b + c$  (C)  $a^3 + b^3 + c^3$  (D)  $\sqrt{a^2 + b^2 + c^2}$

17. The dot product of vectors  $\underline{u}$  and  $\underline{v}$  is .....:

- (A)  $\cos \theta \sin \theta$  (B)  $|\underline{u}||\underline{v}| = \cos \theta$  (C)  $uv \cos \theta$  (D) None

18. If any two vectors of scalar product are equal then its value is:

- (A) 1 (B) 2 (C) -1 (D) 0

19.  $\hat{i} \times \hat{k} = :$

- (A) 0 (B)  $\hat{j}$  (C)  $-\hat{j}$  (D) 1

20. What is the volume of parallel piped if its edges are  $[2, -4, 5], [2, -3, 6], [0, -1, -1]$ :

- (A) 16 (B) 0 (C) 5 (D) 24

**Q2. write the answers of following questions. Any 8**

8X2=16

1. Use the remainder theorem to find the remainder when the first polynomial is divided by the second polynomial:  $x^4 + x^3 + x^2 + x + 1$ ,  $x - 1$

2. Divide the cube polynomial  $3x^3 - 10x^2 + 13x - 6$  by the linear polynomial  $x - 2$ . Also find the quotient and remainder.

3. Without using the table, find the value of:  $\operatorname{cosec}(-690^\circ)$

4. Prove that: 
$$\frac{\sin^2(\pi + \theta) \tan\left(\frac{3\pi}{2} + \theta\right)}{\cot^2\left(\frac{3\pi}{2} - \theta\right) \cos^2(\pi - \theta) \operatorname{cosec}(2\pi - \theta)} = \cos \theta$$

5. If  $\alpha, \beta, \gamma$  are the angles of a triangle ABC, then prove that:  $\sin(\alpha + \beta) = \sin \gamma$ .

6. Prove that:  $\sin\left(\theta + \frac{\pi}{6}\right) + \cos\left(\theta + \frac{\pi}{3}\right) = \cos \theta$

7. Show that:  $\cot(\alpha - \beta) = \frac{\cot \alpha \cot \beta + 1}{\cot \beta - \cot \alpha}$

8.

Prove the following:  $\cos^2 \frac{\pi}{8} + \cos^2 \frac{3\pi}{8} + \cos^2 \frac{5\pi}{8} + \cos^2 \frac{7\pi}{8} = 2$

9 . Show that:  $\cos 2\theta = \frac{1 - \tan^2 \theta}{1 + \tan^2 \theta}$

10 . Express the following sums and differences as products:  $\sin 5\theta + \sin 3\theta$

11 . Express the following sums and differences as products:  $\cos 6\theta + \cos 3\theta$

12 . Without using tables, find the values of all trigonometric functions of  $105^\circ$ .

**Q3. write the answers of following questions. Any 8**

8X2=16

1 . Find the periods of the following function:  $\frac{1}{2} \sin\left(\frac{3x}{2} - \frac{\pi}{2}\right)$

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

3 . Find the periods of the following function:  $6 - 4 \cot\left(\frac{7x}{4} + \frac{\pi}{4}\right)$

4 . Find the limit of the following sequence if exists:  $b_n = \frac{2n+3}{n^2+1}$

5 . Evaluate the following limit:  $\lim_{x \rightarrow 1} \frac{x^3 - 1}{x^2 - 1}$

6 . Discuss the continuity of  $f(x)$  at  $x=c$ :  $f(x) = \begin{cases} 2x+5 & \text{if } x \leq 2 \\ 4x+1 & \text{if } x > 2 \end{cases}$ ,  $c = 2$

7 . Consider the function  $f(x) = \frac{x^2 - 1}{x - 1}$ , discuss the continuity of  $f$  at  $x=1$ .

8 . Find the maximum and minimum values of the following function:  $2+3 \sin x$

9 . Evaluate the following limit by using algebraic techniques:  $\lim_{x \rightarrow -1} \frac{x^3 - x}{x + 1}$

10 . A stock price grows according to the function  $P(t) = 50e^{0.05t}$ . Calculate the price after 10 years.

11 . Determine whether the following functions are even, odd or neither odd nor even:  $\tan x + \sec x$

12 . Find the periods of the following function:  $\sin 5x$

**Q4. write the answers of following questions. Any 9**

9X2=18

1 . Find by definition, the derivatives w.r.t 'x' of the following function defined as:  $2 - \sqrt{x}$

2 . Find the gradient and equation of the tangent line to  $y=3x^2-4x+1$  at  $x=2$ .

3 . Differentiate w.r.t 'x':  $\frac{2x-3}{2x+1}$

4 .

Differentiate w.r.t 'x':  $\frac{x^2 + 1}{x^2 - 3}$

5 . Find derivative of  $y = (2\sqrt{x} + 2)(x - \sqrt{x})$  with respect to x.

6 . For the vectors,  $\underline{u}=[1,-2,3]$ ,  $\underline{v}=[2,1,3]$  and  $\underline{w}=[-1,4,0]$ , find the following:  $|\underline{v}-2\underline{w}|$

7 . Show that the vectors  $3\underline{i}-2\underline{j}+\underline{k}$ ,  $\underline{i}-3\underline{j}+5\underline{k}$  and  $2\underline{i}+\underline{j}-4\underline{k}$  form a right triangle.

8 . Prove that in any triangle ABC:  $c=a \cos B + b \cos A$

9 . Find the work done, if the point at which the constant force  $\underline{F}=2\underline{i}+5\underline{j}+3\underline{k}$  is applied to an object, moves it from  $P_1(2,-3)$  to  $P_2(7,5,3)$ .

10 . Find the derivative of the following function by definition:  $f(x)=x^2$

11 . Find the direction cosines for the given vector:  $\underline{u}=6\underline{i}+3\underline{j}+2\underline{k}$

12 . Find the angle between the vectors:  $\underline{u}=2\underline{i}-\underline{j}+\underline{k}$  and  $\underline{v}=-\underline{i}+\underline{j}$

13 . Prove that:  $\underline{a} \times (\underline{b}+\underline{c}) + \underline{b} \times (\underline{c}+\underline{a}) + \underline{c} \times (\underline{a}+\underline{b}) = \underline{0}$

Q5. write the answers of following questions. Any 6

3X10=30

a1 . Prove that:  $\frac{\tan(180^\circ + \alpha) \cot(90^\circ - \alpha)}{\sin(360^\circ - \alpha) \cos(270^\circ + \alpha)} = -\sec^2 \alpha$ .

b . If  $\alpha + \beta + \gamma = 180$ , show that  $\cot \alpha \cot \beta + \cot \beta \cot \gamma + \cot \gamma \cot \alpha = 1$ .

2a . Express the following product as sums or differences:  $2 \sin 3\theta \cos \theta$

b . Prove that:  $\frac{\sin^2 \alpha - \sin^2 \beta}{\sin \alpha \cos \alpha - \sin \beta \cos \beta} = \tan(\alpha + \beta)$

3a . Find the periods of the following function:  $9 + 30 \sec\left(\frac{x}{15} + \frac{2\pi}{15}\right)$

b . Find the maximum and minimum values of the following function:  $5-2 \cos 3x$

4a . Evaluate the following limit by using algebraic techniques:  $\lim_{x \rightarrow 2} \left( \frac{x^3 - 6x^2 + 12x - 8}{x^3 - 4x} \right)$

b . Discuss the continuity of  $f(x)$  at  $x=c$ :  $f(x) = \begin{cases} 3x-1 & \text{if } x < 1 \\ 4 & \text{if } x = 1, c = 1 \\ 2x & \text{if } x > 1 \end{cases}$

5a . If  $y = x^4 + 2x^2 + 2$ , prove that  $\frac{dy}{dx} = 4x\sqrt{y-1}$ .

b . Show that the vectors  $\overrightarrow{AB} = 2\underline{i} - \underline{j} + \underline{k}$ ,  $\overrightarrow{BC} = \underline{i} - 3\underline{j} - 5\underline{k}$  and  $\overrightarrow{AC} = 3\underline{i} - 4\underline{j} - 5\underline{k}$  are the sides of a right triangle.