

# NEW MILLENNIUM ACADEMY

Final Examination - 2082

Subject: Additional Maths

Class: 9 (NINE)

F.M: 75

Time: 3 hours

Date: 2082/12/15

Name of Student: \_\_\_\_\_ Symbol No: \_\_\_\_\_

Attempt all questions:

## Group 'A' (Objective Questions) [11 × 1 = 11]

1. Write the correct option on your answer sheet.

a. If  $f(x) = 2x + m$  and  $f(3) = 11$ , what is the value of  $m$ ?

- i. 5                      ii. 7                      iii. 3                      iv. 1

b. For what value of  $n$  are  $y^3$  and  $\sqrt{y^{n-2}}$  equal?

- i. 8                      ii. 6                      iii. 4                      iv. 2

c. In matrix addition, the relation  $A + B = B + A$  represents which property?

- i. Associative                      iii. Commutative  
ii. Closure                      iv. Distributive

d.  $\cos(180^\circ - A)$  is equal to...

- i.  $\sin A$                       ii.  $-\sin A$                       iii.  $\cos A$                       iv.  $-\cos A$

e. How many degrees does it equal to  $1^g$ ?

- i.  $(\frac{9}{10})^\circ$                       ii.  $(\frac{10}{9})^\circ$                       iii.  $(\frac{180}{\pi})^\circ$                       iv.  $1^\circ$

f. If point  $P$  is always at a fixed distance from a point  $O$ , what is the locus of  $P$ ?

- i. Line                      ii. Circle                      iii. Parabola                      iv. Ellipse
- g.** Which point satisfies the equation  $4x + 5y = 9$ ?
- i. (1, 1)                      ii. (2, 1)                      iii. (0, 1)                      iv. (1, 2)
- h.** What is the image of a point  $P(x, y)$  when it is reflected across the line  $y = k$ ?
- i.  $P'(x, 2k - y)$                       iii.  $P'(x, -h)$   
 ii.  $P'(2k - x, y)$                       iv.  $P'(-x, y)$
- i.** What is the direction of the vector  $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$ ?
- i.  $0^\circ$                       ii.  $90^\circ$                       iii.  $180^\circ$                       iv.  $270^\circ$
- j.** If  $Q_3 = 55$  and  $Q_1 = 15$ , what is the interquartile range?
- i. 70                      ii. 45                      iii. 40                      iv. 30
- k.** For the function  $f(x) = \frac{5}{x-4}$ , at what value of  $x$  is the function undefined?
- i. 5                      ii. 4                      iii. 0                      iv.  $-3$

## Group 'B' (WCA) [12 Questions = 40 Marks]

- 2. A manufacturing company calculates its production using a specific formula. The number of pencils produced by a company and its cost are represented by the function  $f(x) = 12x + 8$ , where  $x$  is the number of pencils.**
- (a) Define a One-to-One function. (1)
- (b) A student listed the cost as ordered pairs  $f = \{(3, 44), (4, 56), (5, 68), (6, 78)\}$  when the number of pencils produced were  $\{3, 4, 5, 6\}$ . Identify the mistake the student made in the ordered pairs and correct it. (2)
- 3. During a practical math session, a Mathematics teacher wrote two matrices  $M_1 = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$  and  $M_2 = \begin{pmatrix} 5 & 1 \\ 0 & 3 \end{pmatrix}$  on the whiteboard to test the students' understanding.**

- (a) Ramesh told the teacher, “Every Scalar Matrix is also a Diagonal Matrix.” Was Ramesh correct? Give your reaction. (1)
- (b) Among the matrices given above, which one is a Diagonal Matrix? Give one reason. (1)
- (c) Construct a  $2 \times 2$  matrix  $A$  where the elements are given by the rule  $a_{ij} = 2i + j$ . (1)

**4. While practicing algebraic expressions for an upcoming test, Samiksha has written to solve a polynomial  $x^2 - 9$  in her notebook.**

- (a) Find the zero roots of that polynomial expression. (1)
- (b) Simplify the related surd expression:  $\frac{\sqrt{a+2}-1}{\sqrt{a+2}+1} + \frac{\sqrt{a+2}+1}{\sqrt{a+2}-1}$ . (2)

**5. A civil engineer is surveying a tall building and calculates that  $\sin A = \frac{4}{5}$ . The measurements depend on accurate trigonometric derivations.**

- (a) Find the value of  $\cos A$ . (1)
- (b) Prove that:  $\frac{\tan(90^\circ - A) \cdot \tan A}{\cos A} = \sec A$ . (3)

**6. Sarmila has written a complex trigonometric expression in this way:**

$$\sqrt{\frac{1+\sin A}{1-\sin A}} + \sqrt{\frac{1-\sin A}{1+\sin A}}$$

- (a) Write down the rationalizing factor of  $(1 - \sin A)$ . (1)
- (b) By putting  $(1 - \sin^2 A) = \cos^2 A$ ,  
prove that:  $\sqrt{\frac{1+\sin A}{1-\sin A}} + \sqrt{\frac{1-\sin A}{1+\sin A}} = 2 \sec A$ . (3)

**7. A city planner is designing a straight road on a grid map. A straight line intersects both axes. The x-intercept of the line is twice the y-intercept, and the line passes through the point  $(2, 4)$ .**

- (a) Write the double intercept form of the line. (1)
- (b) Find the equation of the line. (2)

**8. An underground fiber optic cable is laid out straight across a landscape. A straight line  $AB$  connects the points  $A(3, 4)$  and  $B(5, -2)$ .**

- (a) Find the midpoint of the line. (1)
- (b) Find the equation of the line. (1)

- (c) If the line  $AB$  is internally divided by a point  $P(x, y)$  in the ratio  $2 : 3$ , find the coordinates of that point. (2)

**9. A graphic designer is creating a mirror effect for a logo. Triangle  $ABC$  with vertices  $A(1, 3)$ ,  $B(4, 5)$  and  $C(6, 2)$  is reflected in the line  $x - 3 = 0$ .**

- (a) What is the nature of the line  $x - 3 = 0$ ? (1)  
(b) Find the coordinates of the image of vertex  $A$ . (1)  
(c) Determine the vertices of the image triangle  $A'B'C'$  and draw both triangles on the same graph. (2)

**10. Two airplanes are flying along flight paths dictated by vectors. Two vectors  $\vec{a} = \begin{pmatrix} 3 \\ k \end{pmatrix}$  and  $\vec{b} = \begin{pmatrix} -6 \\ 8 \end{pmatrix}$  are parallel.**

- (a) What is the condition for two vectors to be parallel? (1)  
(b) Find the value of  $k$ . (1)  
(c) Ram states that if two vectors are parallel, their unit vectors must be identical. Is this always true? Explain. (1)

**11. A teacher analyzes test results to grade her class fairly. The marks obtained in Mathematics by the students in the first term exam are given in a frequency table with marks  $\{20, 30, 40, 50, 60, 70\}$ .**

- (a) Find the quartile deviation of the data. (2)  
(b) Is the mean deviation of the given data always positive? (1)

**12. An engineer calculates velocity thresholds using mathematical limits. A function  $f(x) = \frac{x^2 - 9}{x + 3}$  is given.**

- (a) Write the meaning of  $\lim_{x \rightarrow a} f(x)$  in a sentence. (1)  
(b) What is an Indeterminate form? (1)  
(c) Find the limit:  $\lim_{x \rightarrow -3} \frac{x^2 - 9}{x + 3}$ . (1)

**13. A mechanical gear's rotation angle  $B$  must precisely satisfy certain conditions to work. A trigonometric expression  $5 \cos B - 4 = 0$  is given.**

- (a) Solve the given expression. (1)  
(b) Find the value of  $\sin B$  and  $\tan B$ . (2)

## Group 'C' (Cross Content Area) [ $4 \times 6 = 24$ ]

- 14. Sushmita and Radhika are standing at the points  $(6, 0)$  and  $(0, 4)$  on the coordinate axes. They divide the axes into double intercept form.**
- If Ram is standing exactly midway between Sushmita and Radhika, at which point is he standing? Find. (1)
  - Find the equation of the straight line joining Sushmita and Radhika. (2)
  - Find the area of the triangle formed by Sushmita, Radhika, and the origin. (3)
- 15. A real valued function  $f(x) = 6x - 2$  represents the marks obtained by 10 students. If the marks of these 10 students correspond to  $x = \{1, 2, 3, 4, \dots, 10\}$ :**
- Find the marks obtained by the 10 students. (2)
  - If two more students are added and one of them scores 70, determine the position of this student in the data. (1)
  - Find the standard deviation of marks obtained by the 10 students. (3)
- 16. A city park is designed in the shape of a polygon. The angles of a quadrilateral are in the ratio  $2 : 3 : 4 : 6$ .**
- How many grades is equal to the sum of all the interior angles of the quadrilateral? (1)
  - Find all the angles of the quadrilateral in grades. (2)
  - Find the difference between the largest and the smallest angle in grades. (1)
  - Convert the smallest angle into radians. Consider this radian as the central angle of a circular coin with arc length  $BC = 12$  cm. Find the radius of the circular coin in this case. (2)
- 17. Point A is  $(5, 7)$  where Ram is standing, and point B is  $(8, 9)$  where Binita is standing. Ram is looking towards Binita, and Binita is looking towards Ram.**
- Represent the direction from Ram to Binita as a vector, and find that vector. (2)

- (b) Represent the direction from Binita to Ram as a vector, and find that vector. (1)
- (c) Sujita reflected a triangle  $ABC$  across the x-axis to get triangle  $A'B'C'$ , then rotated it  $+90^\circ$  about the origin to get triangle  $A''B''C''$ . Find the coordinates of the final triangle  $A''B''C''$  and represent both the original triangle and its transformations in the same graph, where vertices of triangle  $ABC$  are  $A(1, 0)$ ,  $B(2, 3)$  and  $C(4, 6)$ . (3)

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**Happy New Year 2083!**

*Best of Luck for your examination.*

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