

2023 SUPER MOCK ELECTIVE MATHEMATICS 1

PAPER 1

1½ hour

OBJECTIVES

[40 marks]

Answer **all** the questions.

Each question is followed by **four** options lettered *A* to *D*. Find out the correct option for **each** question and shade **in pencil** on your answer sheet, the answer space which bears the same letter as the option you have chosen. Give only **one** answer to **each** question.

Do all rough work on this question paper.

Now answer the following questions.

1. In how many ways can the letters of the word “JUDGE” be arranged so that vowels always occupy end positions?
- A. $3! \times 2!$
B. $3! \times 3!$
C. $3! \times 5!$
D. $5! \times 2!$
2. Given $M = \begin{bmatrix} 2 & 4 \\ 1 & 3 \end{bmatrix}$, find the determinant of M .
- A. 10
B. 11
C. 2
D. 5
3. If $x + y = 2$ and $x^2 + y^2 = 2$, find the value of xy ?
- A. -2,
B. -1,
C. 0
D. 1
4. If $\sqrt[6]{x} = 6$, find the value of $\sqrt{x^6}$
- A. $6\sqrt{6}$
B. 6^6
C. 6^{18}
D. 6^{36}
5. A die is rolled and a coin tossed simultaneously. What is the probability of getting a head and an odd number?
- A. $\frac{1}{3}$
B. $\frac{1}{4}$
C. $\frac{1}{2}$
D. $\frac{2}{3}$
6. Let $*$ be a binary operation on N defined by $a * b = a - b + ab^2$, find the identity element of the operation $*$.
- A.
B. 0
C. -1
D. None
7. If the 17th term of an AP exceeds its 10th term by 7, find the common difference.
- A. -1
B. 0
C. 1
D. 2

8. Find the remainder when $2x^2 - 5x - 1$ is divided by $x - 5$

- A. 25
- B. 24
- C. 23
- D. -1

9. Evaluate the $\lim_{x \rightarrow \infty} \frac{x+4}{x-4}$

- A. 0
- B. 1
- C. 2
- D. Infinite

10. If the mean and median of a data a , b and c are 50 and 35 respectively, where $a < b < c$. If $c - a = 55$, find the value of $b - a$.

- A. 3
- B. 5
- C. 7
- D. 8

11. Find the second derivative of $x^3 - 5x^2 + x = 0$

- A. $6x^2 - 5$
- B. $6x - 10$
- C. $3x + 10$
- D. $3x^2 - 5x$

12. A 90 cm uniform lever has a load of 30N suspended at 15cm from one of its ends. If the fulcrum is at the center of gravity, find the force that must be applied at its other end to keep it in horizontal equilibrium.

- A. 15N
- B. 20 N
- C. 30 N
- D. 60 N

13. Find the domain of $\frac{2x^2+9x+10}{x^2-4}$

- A. $x \in \mathbb{R}, x \neq -2$
- B. $x \in \mathbb{R}, x \neq 4$
- C. $x \in \mathbb{R}, x \neq 2$
- D. $x \in \mathbb{R}, x \neq -4$

14. Find two numbers whose sum is 26 and whose product is as large as possible.

- A. 7, 19
- B. 22, 4
- C. 21, 5
- D. 13, 13

15. The first three terms of a G.P. are 10, 30, 90. Find the next two terms of the sequence.

- A. 100, 120
- B. 120, 150
- C. 270, 810
- D. 150, 180

16. A line segment AB is produced to C such that $AC = 2AB$. If the coordinates of A and B are (6, 8) and (8, 6) respectively, what are the coordinates of C ?

- A. (10, 4)
- B. (5, 2)
- C. (7, 7)
- D. (8, 7)

17. The mean of 5 numbers is 15. If one more number is included, the mean changes 17. Find the included number.

- A. 24
- B. 25
- C. 26
- D. 27

18. Given that the vector $(-2\hat{i})$ and $(y\hat{j})$ are parallel vectors, find the value of y .

- A. -16
- B. -15
- C. -12
- D. -10

19. If $f(x) = 2x^2$ and $g(x) = \frac{1}{3x}$, find $f \circ g$.

- A. $\frac{3}{2x^2}$
- B. $\frac{2}{3x^2}$
- C. $\frac{2}{9x^2}$
- D. $\frac{1}{2x^2}$

20. Let $a = 5\mathbf{i} + 2\mathbf{j}$ and $b = (-3, 1)$, find $a \cdot b$

- A. 17
- B. -13
- C. 13
- D. -17

21. The unique linear transformation $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$, such that $T(1, 2) = (2, 3)$ and $T(0, 1) = (1, 4)$, find the rule for T .

- A. $T(x, y) = (y, -5x + 4y)$
- B. $T(x, y) = (-5x + 4y, y)$
- C. $T(x, y) = (x, -5x + 4y)$
- D. $T(x, y) = (-5x + 4y, x)$

22. Find $\tan(a + b)$ if $\tan a = \frac{3}{2}$ and $\tan b = \frac{1}{2}$

- A. 2
- B. 4
- C. 6
- D. 8

23. Solve $\frac{(n+1)!}{(n-2)!} = 20(n-1)$

- A. 5
- B. 4
- C. 3
- D. 2

24. Which of the following statement is true about cross products?

- A. The magnitude of projection of one vector onto another.
- B. A vector perpendicular to both given vectors.
- C. A vector parallel to both given vectors.
- D. The division of one vector by another.

25 If $\tan A = \frac{1}{2}$ and $\tan B = \frac{1}{3}$, find the value of $A + B$

- A. $\frac{\pi}{6}$
- B. π
- C. 0
- D. $\frac{\pi}{4}$

26. Find the point of inflection of the curve $y = x^3 - 3x^2 + 6$

- A. (0, 2)
- B. (1, 3)
- C. (1, 4)
- D. (2, 1)

27. Find the equation of the normal to $x^2 + y^2 = 5$ at the point (2, 1)

- A. $x - 2y = 0$
- B. $x + 2y = 0$
- C. $2x - y = 0$
- D. $2x + y = 0$

28. Consider the recurrence equation $a_n = a_{n-1} + n$, what is the value of a_{13} ?

- A. 91
- B. 101
- C. 113
- D. 85

29. In triangle ABC , right angled at B , $AB = 24$, $BC = 7$ cm. Find the value of $\cot C$.

- A. $\frac{12}{7}$
- B. $\frac{24}{7}$
- C. $\frac{20}{7}$
- D. $\frac{7}{24}$

30. What is the length of an arc of a circle of radius 14cm which subtends an angle of 135° at the center?

- A. 22cm
- B. 42 cm
- C. 28 cm
- D. 33 cm

31. Solve for the matrix X , such that $X + \begin{pmatrix} 3 & 2 \\ 1 & 0 \end{pmatrix} =$

- A. $\begin{pmatrix} 6 & 3 \\ 7 & -1 \end{pmatrix}$
- B. $\begin{pmatrix} 3 & 6 \\ 1 & 3 \end{pmatrix}$
- C. $\begin{pmatrix} 1 & 3 \\ 6 & 1 \end{pmatrix}$
- D. $\begin{pmatrix} 3 & 1 \\ 6 & -1 \end{pmatrix}$

32. Let $*$ and $\circ$ be two binary operations such that

$$a * b = a^2b \text{ and } a \circ b = 2a + b.$$

Find: $(3 * 3) \circ (6 * 7)$

- A. 256
- B. 286
- C. 276
- D. 275

33. If $(2k - 1, k)$ is a solution of the equation $10x - 9y = 12$, find the value of k .

- A. 5
- B. 4
- C. 3
- D. 2

34. Which of the following statements is true given

$$\text{that } \log \frac{a}{b} + \log \frac{b}{a} = \log(a + b)$$

- A. $a + b = 1$
- B. $a - b = 1$
- C. $a = b$
- D. $a^2 - b^2 = 1$

35. Find $\int 6x(x^2 + 6) dx$

- A. $\frac{3x^4}{2} + 18x^2 + C$
- B. $\frac{3x^4}{2} - 18x^2 + C$
- C. $\frac{3x^4}{2} + 18x^2 - C$
- D. $\frac{3x^4}{2} - 18x^2 - C$

36. A committee of 5 is to be selected from 7 men and 5 women. In how many ways can this be done if a certain man and a certain woman must be on the committee?

- A. ${}^{10}C_3$
- B. ${}^{12}C_5$

C. ${}^{10}C_5$

D. ${}^{12}C_3$

37. Find the coordinate of the centre of the circle

$$3x^2 + 3y^2 - 6x + 9y - 5 = 0$$

- A. $(1, -\frac{3}{2})$
- B. $(3, -\frac{9}{2})$
- C. $(-3, \frac{9}{2})$
- D. $(-1, \frac{3}{2})$

38. A particle moving in a straight line covers a distance of x meters in t seconds where $x = t^3 + 6t^2 - 15t + 8$. When does the particle stops?

- A. 4 seconds
- B. 3 seconds
- C. 2 seconds
- D. 1 second

39. The equation of a circle is represented by $x^2 - 7x + y^2 - 5y + K = 0$. If the radius of the circle is $\sqrt{3.5}$ units, what is the value of K ?

- A. 10
- B. 15
- C. 6
- D. 18

40. Solve the equation, $\frac{3+\log_7 x}{2-\log_7 x} = 4, x > 0$

- A. 0
- B. 7
- C. 5
- D. 10

END OF PAPER