

HU Collection

Engineering and Science Admissions Test

Mock Set A

Mathematics 2

Time allowed: 40 minutes
Questions: 27 multiple choice
Calculators: not permitted
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Date written: 24 October 2026

Name: Date sat: Score: / 27

Instructions

Answer all 27 questions. Each question has exactly one correct option and is worth one mark. No marks are deducted for wrong answers, so answer every question. Calculators are not permitted. This paper is deliberately longer than the time allows: move on from any question that is costing you more than two minutes, and come back to it at the end.

Q	1	2	3	4	5	6	7	8	9	10
Ans										

Q	11	12	13	14	15	16	17	18	19	20
Ans										

Q	21	22	23	24	25	26	27			
Ans										

H I and III only

6. What is the sum of all real solutions of the equation

$$\log_{x-1}(x^2 - 5x + 7) + 2 \log_{x^2-5x+7}(x-1) = 3?$$

A 2

B 8

C 4

D 6

E 11

F There are no real solutions.

7. For which real values of k does the equation

$$\frac{x^2 - 4}{x^2 - 1} = k$$

have exactly two distinct real solutions?

A $k \leq 1$ or $k > 4$

B $1 < k < 4$

C $k < 1$ or $k > 4$

D $k < 1$ or $k \geq 4$

E $k > 4$

F $k < 1$

8. The function f is defined by $f(x) = x^2 - 6x + 10$ for $x \geq 3$, and f^{-1} is its inverse function. What is the sum of all real solutions of the equation $f(x) = f^{-1}(x)$?

A 5

B 7

C $\frac{15 + \sqrt{5}}{2}$

D 2

E 12

F $\frac{5 + \sqrt{5}}{2}$

9. How many values of x in the interval $0 \leq x \leq 2\pi$ satisfy $\sin 5x = \sin x$?

A 8

B 11

C 10

D 7

E 5

F 9

10. The curve $y = x^2 - 2x$ and the line $y = mx$ enclose a finite region of area 36. What is the sum of all possible values of the constant m ?

A -4

B -8

C 0

D 4

E 12

F -2

11. For a real constant c , the shortest distance from the point $(0, c)$ to the curve $y = x^2$ is exactly 1. What is the sum of all possible values of c ?

A $\frac{1}{4}$

B -1

C 1

D 0

E $\frac{5}{4}$

F $\frac{9}{4}$

12. The points A and B have coordinates $(0, 0)$ and $(3, 0)$. A point P , not on the x -axis, moves so that $PA = 2PB$.

What is the greatest possible area of triangle PAB ?

- | | | |
|------------------------|------------|------------------------|
| A 6 | B 3 | C $\frac{9}{2}$ |
| D $\frac{3}{2}$ | E 4 | F 2 |

13. Let $a = \log_2 3$, $b = \log_3 5$ and $c = \log_5 8$. Which of the following is true?

- | | | |
|----------------------|----------------------|----------------------|
| A $c > b > a$ | B $b > a > c$ | C $a > b > c$ |
| D $c > a > b$ | E $a > c > b$ | F $b > c > a$ |

14. What is the smallest positive integer n for which

$$\sum_{k=1}^n \log_2 \left(\frac{k+2}{k} \right) > 10?$$

- | | | |
|-------------|-------------|---------------|
| A 44 | B 63 | C 1023 |
| D 31 | E 45 | F 43 |

15. The curve $y = x^4 - 4x^3 + ax^2$, where a is a real constant, has exactly one stationary point. Which of the following describes all possible values of a ?

- | | | |
|--|-------------------------------|---------------------------------------|
| A $a < \frac{9}{2}$ | B $a \geq \frac{9}{2}$ | C $a > \frac{9}{2}$ or $a = 0$ |
| D $a \geq \frac{9}{2}$ or $a = 0$ | E $a > 9$ | F $a > \frac{9}{2}$ |

16. How many pairs (n, x) , where n is an integer and $0 \leq x \leq \frac{3\pi}{2}$, satisfy

$$3 \sin x + 4 \cos x = n?$$

- | | | |
|-------------|-------------|-------------|
| A 14 | B 11 | C 12 |
| D 15 | E 13 | F 16 |

17. What is the total area of the regions enclosed between the curves $y = \sin x$ and $y = \sin 2x$ for $0 \leq x \leq \pi$?

- | | | |
|------------------------|------------------------|------------------------|
| A $\frac{9}{4}$ | B $\frac{5}{2}$ | C $\frac{1}{2}$ |
| D 3 | E 2 | F $\frac{7}{2}$ |

18. Consider the equation $x^2 - kx + k + 3 = 0$, where k is an integer.

What is the sum of all values of k for which the equation has two integer roots? (The two roots are allowed to be equal.)

- | | | |
|-------------|-------------|------------|
| A 11 | B 10 | C 7 |
| D 4 | E 13 | F 8 |

19. Some circles touch both of the lines $y = 0$ and $3y = 4x$, and also pass through the point $(8, 1)$. What is the sum of the radii of all such circles?

- A** $\frac{17}{4}$ **B** $\frac{104}{9}$ **C** $\frac{17}{2}$
D 9 **E** 17 **F** $\frac{65}{4}$

20. What is the sum of all real solutions of the equation $\sqrt{x+6} = x^2 - 6$?

- A** $\frac{5 - \sqrt{21}}{2}$ **B** 3 **C** 0
D $\frac{5 + \sqrt{21}}{2}$ **E** 1 **F** $\frac{-1 - \sqrt{21}}{2}$

21. Let $f(x) = x^3 - 3x$. How many distinct real solutions does the equation $f(f(x)) = 2$ have?

- A** 4 **B** 6 **C** 7
D 3 **E** 5 **F** 9

22. The line $y = mx$, where $m > 0$, meets the curve $y = x^3 - 6x^2 + 9x$ at three distinct points, and the line and the curve enclose two regions of equal area. Find m .

- A** 2 **B** 1 **C** $\frac{9}{4}$
D 3 **E** 4 **F** $\frac{1}{2}$

23. What is the sum of all values of x in the interval $0 \leq x \leq \pi$ that satisfy

$$\sin x + \sin 2x + \sin 3x = \cos x + \cos 2x + \cos 3x?$$

- A** $\frac{3\pi}{4}$ **B** $\frac{11\pi}{12}$ **C** $\frac{2\pi}{3}$
D $\frac{17\pi}{12}$ **E** $\frac{19\pi}{24}$ **F** $\frac{61\pi}{24}$

24. What is the value of

$$\binom{10}{0} + \frac{1}{2}\binom{10}{1} + \frac{1}{3}\binom{10}{2} + \frac{1}{4}\binom{10}{3} + \cdots + \frac{1}{11}\binom{10}{10}?$$

- A** $\frac{1024}{11}$ **B** $\frac{1023}{11}$ **C** $\frac{2047}{10}$
D $\frac{2048}{11}$ **E** $\frac{2047}{11}$ **F** $\frac{1023}{10}$

25. For which positive values of k does the equation $e^x = kx^2$ have exactly three real solutions?

- A** $0 < k < \frac{e^2}{4}$ **B** $k > \frac{e}{2}$ **C** $k \geq \frac{e^2}{4}$
D $k > \frac{e^2}{2}$ **E** $k > \frac{e^2}{4}$ **F** $k > e$

26. The circles $x^2 + y^2 = 1$ and $(x - 4)^2 + y^2 = 4$ have exactly four common tangents. What is the product of the gradients of these four lines?

A $-\frac{3}{35}$
D $-\frac{1}{15}$

B $-\frac{9}{7}$
E $\frac{1}{105}$

C $\frac{9}{35}$
F $\frac{3}{35}$

27. For how many integer values of k do exactly three distinct tangents to the curve $y = x^3 - x$ pass through the point $(2, k)$?

A 5
D 8

B 3
E 7

C 9
F 6



End of paper