

HU Collection

Engineering and Science Admissions Test

Mock Set B

Mathematics 1

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

1. A surveyor fixes three beacons at the points $A(-1, 4)$, $B(6, 5)$ and $C(7, -2)$, with all distances measured in kilometres. A relay mast M is to be placed so that it lies on the locus of points equidistant from A and B , and also on the locus of points equidistant from B and C . How far is the mast from the beacon B ?

- | | | |
|-------------------------|-------------------------|-------------------------|
| A $4\sqrt{2}$ km | B $\sqrt{29}$ km | C 10 km |
| D $5\sqrt{2}$ km | E 5 km | F $\sqrt{26}$ km |

2. A foundry makes an alloy by melting together two metals: metal P , of density 9 g/cm^3 , and metal Q , of density 6 g/cm^3 . Assume that when the metals are melted together their volumes simply add. An ingot of the alloy has mass 1.8 kg and density 7.2 g/cm^3 . More of metal P is then melted into the ingot until the density of the new, larger ingot is 7.5 g/cm^3 . What fraction of the mass of the new ingot is metal P ?

- | | | |
|------------------------|-------------------------|------------------------|
| A $\frac{3}{5}$ | B $\frac{2}{3}$ | C $\frac{5}{8}$ |
| D $\frac{1}{2}$ | E $\frac{9}{16}$ | F $\frac{2}{5}$ |

3. A garden is in the shape of a trapezium $ABCD$, in which the side AB is parallel to the side DC . Two straight paths run along the diagonals AC and BD , crossing at the point X , and they divide the garden into four triangular flower beds. The bed AXD has area 6 m^2 and the bed DXC has area 4 m^2 . Ignoring the width of the paths, what is the total area of the garden?

- | | | |
|---------------------------|---------------------------|---------------------------|
| A 36 m^2 | B 24 m^2 | C 22 m^2 |
| D 30 m^2 | E 25 m^2 | F 20 m^2 |

4. A cyclist rides along a measured course whose length is recorded as 0.40 km , correct to two significant figures. Her time is measured with a stopwatch that displays whole seconds only and works by truncation: it ignores any fraction of a second, so that, for example, a time of 50.8 seconds is displayed as 50 . At the end of her ride the stopwatch displays 50 . What is the upper bound for her average speed over the course, in kilometres per hour?

- | | | |
|----------------|----------------|------------------------------|
| A 29.52 | B 29.16 | C 32.4 |
| D 28.8 | E 8.1 | F $29.\dot{4}\dot{5}$ |

5. A stone plinth has the shape of a frustum of a right pyramid with a square base: its lower face is a 2 m by 2 m square, its upper face is a 1 m by 1 m square parallel to it, and its perpendicular height is 0.9 m . The stone has density 2400 kg/m^3 . The plinth stands on its lower face on level ground, and a bronze statue of mass 1200 kg is fixed to its upper face. Taking the gravitational field strength to be 10 N/kg , what is the pressure exerted on the ground by the plinth and statue together?

- | | | |
|-----------------------------|-----------------------------|------------------------------|
| A 12.6 kPa | B 15.6 kPa | C 15.15 kPa |
| D 62.4 kPa | E 16.5 kPa | F 24.6 kPa |

6. The lengths, $L \text{ cm}$, of 60 leaves are summarised in a grouped frequency table: 8 leaves have $0 \leq L < 10$, x leaves have $10 \leq L < 20$, 20 leaves have $20 \leq L < 30$, y leaves have $30 \leq L < 40$, and 6 leaves have $40 \leq L < 60$. Using the midpoints of the classes, an estimate of the mean length is 24.5 cm . The data are then drawn as a histogram, on which the bar for the class $40 \leq L < 60$ has a height of 1.5 cm . What is the height of the bar for the class $10 \leq L < 20$?

- A** 3.5 cm **B** 7 cm **C** 10 cm
D 3 cm **E** 14 cm **F** 6 cm

7. An isosceles trapezium $ABCD$ is inscribed in a circle of radius 13 cm and centre O . Its parallel sides are $AB = 24$ cm and $CD = 10$ cm, and the centre O lies outside the trapezium. What is the area of the trapezium?

- A** 119 cm^2 **B** 170 cm^2 **C** 289 cm^2
D 84 cm^2 **E** 102 cm^2 **F** 238 cm^2

8. Which of the following correctly lists the five numbers

$$2^{150}, \quad 3^{100}, \quad 5^{60}, \quad 7^{50}, \quad 11^{40}$$

in increasing order?

- A** $2^{150} < 3^{100} < 5^{60} < 7^{50} < 11^{40}$
B $11^{40} < 5^{60} < 7^{50} < 3^{100} < 2^{150}$
C $5^{60} < 7^{50} < 11^{40} < 3^{100} < 2^{150}$
D $11^{40} < 7^{50} < 5^{60} < 2^{150} < 3^{100}$
E $11^{40} < 5^{60} < 7^{50} < 2^{150} < 3^{100}$
F $5^{60} < 11^{40} < 7^{50} < 2^{150} < 3^{100}$

9. A freight train travels from one depot to another. For the first half of the total journey *time* it travels at a constant 100 km/h. Of the distance that then remains, it covers the first half at a constant 60 km/h and the second half at a constant 120 km/h. Ignoring the time taken to change speed, what is the average speed of the train for the whole journey?

- A** $85\frac{5}{7}$ km/h **B** 95 km/h **C** 90 km/h
D 80 km/h **E** $93\frac{1}{3}$ km/h **F** 100 km/h

10. A screening test for a medical condition has a sensitivity of 90% (the probability that a person who has the condition tests positive) and a specificity of 95% (the probability that a person who does not have the condition tests negative). In a certain population, 2% of people have the condition. Everyone who tests positive is immediately tested a second time with the same test; for any given person, the results of the two tests are independent of each other, once it is known whether or not that person has the condition. A person chosen at random from the population tests positive on both occasions. What is the probability that this person has the condition?

- A** $\frac{18}{67}$ **B** $\frac{81}{100}$ **C** $\frac{9}{10}$
D $\frac{81}{326}$ **E** $\frac{162}{187}$ **F** $\frac{324}{373}$

11. A ship sails due east in a straight line from a buoy A to a buoy B , which is 12 km from A . From A , a lighthouse L is on a bearing of 030° . From B , the same lighthouse is on a bearing of 315° . What is the shortest distance between the lighthouse and the ship's path from A to B ?

- A** $6\sqrt{3}$ km **B** $(18\sqrt{2} - 6\sqrt{6})$ km **C** $(12\sqrt{3} - 12)$ km
D $(6\sqrt{3} - 6)$ km **E** $4\sqrt{3}$ km **F** $(18 - 6\sqrt{3})$ km

12. For each real number k , the parabola C_k has equation

$$y = x^2 - 2kx + 4k.$$

Consider the following statements.

- I. There is a point that lies on every one of the parabolas C_k .
- II. As k varies, the turning point of C_k always lies on the curve $y = 4x - x^2$.
- III. No parabola C_k has its turning point above the line $y = 4$.
- IV. Every parabola C_k meets the x -axis.

Which of these statements are true?

- A** II and III only
- B** I and II only
- C** I, II and III only
- D** I and III only
- E** II only
- F** II, III and IV only
- G** I, II, III and IV
- H** I and IV only

13. In a fairground game, three fair six-sided dice, each numbered 1 to 6, are rolled together and the three scores are multiplied. The player wins a prize if this product is a multiple of 10. What is the probability of winning a prize?

- | | | |
|--------------------------|-----------------------------|-------------------------|
| A $\frac{11}{36}$ | B $\frac{91}{216}$ | C $\frac{1}{3}$ |
| D $\frac{1}{4}$ | E $\frac{637}{1728}$ | F $\frac{8}{27}$ |

14. A lampshade is the curved surface of a right circular frustum, open at both ends. The radii of its two circular ends are 6 cm and 10 cm, and the perpendicular distance between the two ends is 3 cm. It is made, with no overlap and no waste, by bending a flat annular sector of card: the region between two arcs of concentric circles, cut off by two radii of the larger circle. What are the angle of the annular sector and the radius of its inner arc?

- | | | |
|---------------------------------|---------------------------------|---------------------------------|
| A 300° and 7.5 cm | B 288° and 7.5 cm | C 216° and 4.5 cm |
| D 240° and 9 cm | E 216° and 7.5 cm | F 288° and 6 cm |

15. A water trough is a prism of length 3 m. Its cross-section is an isosceles trapezium with a horizontal base of width 40 cm at the bottom, an open top of width 100 cm, and a depth of 60 cm. The trough stands on level ground and is initially empty. Water flows in at a constant rate of 15 litres per minute. What is the depth of the water after 20 minutes?

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|----------------|----------------|-----------------------------|
| A 10 cm | B 20 cm | C $14\frac{2}{7}$ cm |
| D 24 cm | E 16 cm | F 25 cm |

16. Fifteen different positive integers are arranged in increasing order. For this question the lower quartile is the 4th value, the median is the 8th value and the upper quartile is the 12th value. The

lower quartile is 10, the median is 20, the upper quartile is 30, and the range is 40. Let G be the greatest possible value of the mean of the fifteen integers, and let S be the smallest possible value. What is $G - S$?

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|--------------------------|--------------------------|--------------------------|
| A $\frac{28}{5}$ | B $\frac{64}{15}$ | C 6 |
| D $\frac{88}{15}$ | E $\frac{86}{15}$ | F $\frac{92}{15}$ |

17. A bag contains at least 30 and at most 40 counters. Each counter is red or blue, and there are more red counters than blue counters. Two counters are taken out at random, without replacement. The probability that they are the same colour is exactly $\frac{1}{2}$. How many red counters are in the bag?

- | | | |
|-------------|-------------|-------------|
| A 30 | B 18 | C 24 |
| D 21 | E 20 | F 15 |

18. A packaging company makes closed cuboid boxes whose three edge lengths, measured in centimetres, are all whole numbers, and whose volume is exactly 360 cm^3 . Two boxes count as the same design if one is congruent to the other, that is, if they have the same three edge lengths in some order. How many different designs are possible?

- | | | |
|-------------|--------------|-------------|
| A 30 | B 34 | C 36 |
| D 27 | E 180 | F 32 |

19. $ABCDEF$ is a regular hexagon, with its vertices labelled in order. Let $\overrightarrow{AB} = \mathbf{a}$ and $\overrightarrow{AF} = \mathbf{b}$. The point M is the midpoint of the side CD , and the straight line through A and M meets the diagonal BF at the point P . Which of the following is equal to $\overrightarrow{AP}$?

- | | | |
|--|--|--|
| A $\frac{5}{7}\mathbf{a} + \frac{2}{7}\mathbf{b}$ | B $\frac{4}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$ | C $\frac{2}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$ |
| D $\frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b}$ | E $\frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$ | F $\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$ |

20. A triangular field ABC has $BC = 12 \text{ m}$. Two straight fences, each parallel to BC and each running from the side AB to the side AC , divide the field into three regions whose areas, taken in order starting from the vertex A , are in the ratio $1 : 2 : 3$. What is the total length of the two fences?

- | | | |
|---|--|--|
| A $(4\sqrt{3} + 4\sqrt{6}) \text{ m}$ | B 8 m | C $(2\sqrt{3} + 6\sqrt{2}) \text{ m}$ |
| D $(6\sqrt{2} + 2\sqrt{30}) \text{ m}$ | E $(2\sqrt{6} + 6\sqrt{2}) \text{ m}$ | F $(4\sqrt{6} + 6\sqrt{2}) \text{ m}$ |

21. A rectangular sheet of card has sides in the ratio $1 : \sqrt{2}$. A guillotine is used repeatedly as follows: each time, the largest possible square is cut off from the rectangle that remains (one side of the square lying along a shorter side of the rectangle), and the square is thrown away. After three squares have been removed in this way, what fraction of the area of the original sheet remains?

- | | | |
|-------------------------------------|------------------------------------|----------------------------|
| A $\frac{10 - 7\sqrt{2}}{2}$ | B $5\sqrt{2} - 7$ | C $17 - 12\sqrt{2}$ |
| D $\frac{7 - 4\sqrt{2}}{4}$ | E $\frac{3\sqrt{2} - 4}{2}$ | F $3 - 2\sqrt{2}$ |

22. In a Fibonacci-type sequence, each term from the third onwards is the sum of the two terms immediately before it. The first two terms of such a sequence are positive integers (not necessarily different), and its 10th term is 2026. How many such sequences are there?

- | | | |
|------------|------------|------------|
| A 5 | B 2 | C 1 |
| D 4 | E 6 | F 3 |

23. Seven positive integers have a mean of 10 and a median of 9, and the number 12 is their only mode. Let R be the greatest possible range of the seven integers, and let r be the least possible range. What is $R - r$?

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|-------------|-------------|-------------|
| A 24 | B 27 | C 29 |
| D 20 | E 26 | F 30 |

24. A tiler wants to fit three regular polygons together around a point P , so that each polygon has a vertex at P , no two of the polygons overlap, and together they fill the whole angle around P with no gaps. No two of the three polygons may have the same number of sides. How many different sets of three polygons, described by their numbers of sides, are possible?

- | | | |
|------------|------------|-------------|
| A 5 | B 7 | C 10 |
| D 8 | E 4 | F 6 |

25. In a tennis match between Ana and Bea, the first player to win three sets wins the match, and no further sets are played once the match has been decided. Ana wins each set with probability $\frac{2}{3}$, independently of the results of all other sets. Given that Ana wins the match, what is the probability that the match lasted exactly four sets?

- | | | |
|-------------------------|--------------------------|------------------------|
| A $\frac{8}{27}$ | B $\frac{1}{3}$ | C $\frac{3}{8}$ |
| D $\frac{1}{2}$ | E $\frac{10}{27}$ | F $\frac{4}{5}$ |

26. Five friends each bring a wrapped present to a party and put it in a sack. The presents are thoroughly mixed, and the friends then take turns to take one present each, chosen at random from those remaining in the sack, until the sack is empty. What is the probability that at most one of the friends ends up with the present that they brought?

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|--------------------------|---------------------------|------------------------|
| A $\frac{7}{10}$ | B $\frac{89}{120}$ | C $\frac{2}{3}$ |
| D $\frac{19}{24}$ | E $\frac{11}{30}$ | F $\frac{3}{8}$ |

27. A glass paperweight is a solid right pyramid with a square base, and all eight of its edges have length 6 cm. A manufacturer wants to set the largest possible sphere entirely inside the paperweight. What is the radius of this sphere?

- | | | |
|---------------------------------------|---|-----------------------------------|
| A $\frac{\sqrt{6}}{2}$ cm | B $(\sqrt{6} - \sqrt{2})$ cm | C $(6 - 3\sqrt{2})$ cm |
| D $\frac{3\sqrt{3} - 3}{2}$ cm | E $\frac{3\sqrt{6} - 3\sqrt{2}}{2}$ cm | F $\frac{3\sqrt{2}}{2}$ cm |

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