

HU Collection

Engineering and Science Admissions Test

Mock Set C

Mathematics 1

Time allowed: 40 minutes
Questions: 27 multiple choice
Calculators: not permitted
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Date written: 28 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 garden hose has a circular internal cross-section of diameter 2 cm. Water flows out of it at a constant speed of 5.4 km/h, filling the whole cross-section. The hose is used to fill an empty paddling pool, which is a cylinder of internal diameter 2 m standing on level ground, to a depth of 30 cm. How long does this take?

- A 2 hours 13 minutes 20 seconds
- B 33 minutes 20 seconds
- C 5 hours 33 minutes 20 seconds
- D 3 minutes 20 seconds
- E 8 minutes 20 seconds
- F 1 hour 6 minutes 40 seconds

2. A delivery firm improves the fuel economy of four of its vans, measured in miles per gallon (mpg). Van P goes from 24 mpg to 32 mpg; van Q from 40 mpg to 60 mpg; van R from 12 mpg to 14 mpg; and van S from 30 mpg to 36 mpg. Next year all four vans will be driven the same distance. Which list orders the vans by the amount of fuel saved as a result of the improvements, greatest saving first?

- | | | |
|----------------|----------------|----------------|
| A Q, P, S, R | B R, P, S, Q | C R, Q, P, S |
| D Q, S, P, R | E P, R, S, Q | F R, P, Q, S |

3. A welder makes the skeleton of a closed cuboid from twelve straight steel rods, one along each edge, and the total length of the rods is 76 dm. The longest straight rod that fits inside the cuboid, running from one corner to the opposite corner, has length 13 dm. The six faces of the cuboid are then covered exactly with sheet metal. What is the total area of sheet metal used?

- | | | |
|----------------------|----------------------|----------------------|
| A 192 dm^2 | B 96 dm^2 | C 264 dm^2 |
| D 169 dm^2 | E 361 dm^2 | F 384 dm^2 |

4. A solid concrete block is a cuboid measuring 2 m by 1 m by 0.5 m. When it rests on one of its largest faces on level ground, it exerts a pressure of 12 kPa on the ground. A second solid block, made of the same concrete, is an enlargement of the first with scale factor 1.5. What pressure does the second block exert on level ground when it rests on one of its smallest faces?

- | | | |
|-----------|------------|----------|
| A 18 kPa | B 48 kPa | C 72 kPa |
| D 108 kPa | E 40.5 kPa | F 27 kPa |

5. A rectangular plot $ABCD$ has $AB = 6 \text{ m}$ and $BC = 8 \text{ m}$. Its four corners lie on a circular fence, so that $ABCD$ is a cyclic quadrilateral. A lamp is fixed at a point P on the fence, different from A , B , C and D . What is the value of $PA^2 + PB^2 + PC^2 + PD^2$, in m^2 ?

- A 400
- B 196
- C 200
- D It depends on the position of P .
- E 100
- F 250

6. A technician records seven consecutive terms of a quadratic sequence, starting with the first term:

3, 9, 17, 30, 47, 68, 93.

Exactly one of these seven values has been recorded incorrectly. What is the correct value of the 10th term of the sequence?

- A 197 B 201 C 190
D 129 E 192 F 188

7. Tutor group A has 12 students, whose test scores have arithmetic mean 65. Tutor group B has 18 students, whose scores have mean 50. All scores are whole numbers. One student moves from group A to group B , taking their score with them, and as a result the mean score of *each* group rises by at least 0.4. How many different scores could the student who moved have?

- A 0 B 5 C 3
D 14 E 4 F 2

8. Two archers, Xavi and Yara, take part in outdoor and indoor sessions. Outdoors, Xavi hits the target with 12 of his 20 arrows and Yara hits it with 5 of her 10 arrows. Indoors, Xavi hits the target with 9 of his 10 arrows and Yara hits it with n of her 30 arrows, where n is a whole number. For how many values of n is Xavi's proportion of hits higher than Yara's in each type of session, while Yara's proportion of hits over all of her arrows is higher than Xavi's over all of his?

- A 1 B 4 C 0
D 3 E 6 F 2

9. A caterer prepares x trays of hot food and y trays of cold food for an event, where x and y are whole numbers. Each hot tray needs 2 hours of staff time and each cold tray needs 3 hours, and 24 hours of staff time are available. The client insists on at least 2 cold trays, and on at least as many hot trays as cold trays. The caterer makes a profit of 4 pounds on each hot tray and 7 pounds on each cold tray. What is the greatest possible profit, in pounds?

- A 49 B 44 C 50
D 55 E 52 F 52.80

10. Let $f(x) = x^2 - 6x + 11$. For how many integers x is $f(f(x)) < 27$?

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

11. For each positive integer n , Ali works out $\sqrt{n}$ and rounds it to the nearest whole number, while Bea works out $\frac{n}{10}$ and rounds it to the nearest whole number, rounding halves up. For how many positive integers n do Ali and Bea obtain the same answer?

- A 14 B 30 C 10
D 16 E 24 F 20

12. A list of numbers begins 4, 10. Further numbers are then added to the end of the list, one at a time, and each new number is chosen so that the mean of all the numbers now in the list is exactly 1 more than it was before. What is the 20th number in the list?

- | | | |
|-------------|-------------|-------------|
| A 42 | B 46 | C 44 |
| D 25 | E 26 | F 40 |

13. A bucket has the shape of a right circular frustum, open at the top: its circular base has radius 10 cm and its circular rim has radius 20 cm. The bucket stands on its base on level ground, and water is poured in until its depth is exactly half the depth of the bucket. What fraction of the capacity of the bucket is filled?

- | | | |
|-------------------------|--------------------------|--------------------------|
| A $\frac{1}{8}$ | B $\frac{19}{56}$ | C $\frac{1}{2}$ |
| D $\frac{5}{12}$ | E $\frac{37}{56}$ | F $\frac{27}{64}$ |

14. A school corridor has 60 lockers, numbered 1 to 60, all of which are closed. For each prime number p less than 60, one student walks along the corridor and changes the state of every locker whose number is a multiple of p , opening it if it is closed and closing it if it is open. After all of these students have passed, how many of the lockers are open?

- | | | |
|-------------|-------------|-------------|
| A 17 | B 30 | C 7 |
| D 28 | E 25 | F 31 |

15. A bag contains 1 red counter and 1 blue counter. A counter is taken out at random, and then it is put back into the bag together with one extra counter of the same colour. This process is carried out 5 times in total, so that the bag finally holds 7 counters. What is the probability that at least 5 of the 7 counters are red?

- | | | |
|------------------------|-------------------------|-------------------------|
| A $\frac{1}{6}$ | B $\frac{5}{16}$ | C $\frac{1}{2}$ |
| D $\frac{2}{7}$ | E $\frac{1}{3}$ | F $\frac{3}{16}$ |

16. A party hat is the curved surface of a right circular cone with slant height 6 cm and base radius 2 cm; it has no base. An ant stands at a point A on the circular rim of the hat and walks, on the outside of the curved surface, to the point B on the rim that is diametrically opposite A . What is the length of the shortest possible route?

- | | | |
|--------------------------|--------------------|---------------|
| A $6\sqrt{3}$ cm | B 3π cm | C 4 cm |
| D $2\sqrt{10}$ cm | E 2π cm | F 6 cm |

17. In special relativity, speeds are measured as fractions of the speed of light. If an object moves at speed u relative to a second object, which itself moves at speed v relative to an observer in the same direction, then the first object moves at speed

$$u \oplus v = \frac{u + v}{1 + uv}$$

relative to the observer. A space station launches craft C_1 at speed $\frac{1}{2}$ relative to the station. Then, for each $k = 1, 2, \dots, 7$, craft C_k launches craft C_{k+1} at speed $\frac{1}{k+2}$ relative to C_k , all in the same direction. What is the speed of craft C_8 relative to the station?

- | | | |
|--------------------------|--------------------------|--------------------------|
| A $\frac{44}{45}$ | B $\frac{35}{37}$ | C 1 |
| D $\frac{22}{23}$ | E $\frac{9}{10}$ | F $\frac{21}{22}$ |

18. A large floor is tiled with equilateral triangles of side $6\sqrt{3}$ cm, and the lines between the tiles have negligible width. A coin of radius 1 cm is tossed onto the floor and lands flat, with its centre equally likely to be at any point of the floor. What is the probability that the coin lies entirely inside one tile, touching none of the lines?

- | | | |
|--------------------------|------------------------|------------------------|
| A $\frac{16}{27}$ | B $\frac{4}{9}$ | C $\frac{2}{3}$ |
| D $\frac{1}{4}$ | E $\frac{1}{3}$ | F $\frac{5}{9}$ |

19. Two warning lights flash at regular intervals: one every a seconds and the other every b seconds, where a and b are positive integers with $a < b$. They flash together at noon, and the next time after noon that they flash together is exactly 72 seconds later. How many possible pairs (a, b) are there?

- | | | |
|-------------|-------------|-------------|
| A 17 | B 35 | C 34 |
| D 12 | E 18 | F 15 |

20. Sixteen players, including Ann and Bea, enter a knockout tennis tournament. Their names are placed at random into the sixteen slots of a fixed draw: in round 1 the players in slots 1 and 2 play each other, those in slots 3 and 4 play each other, and so on; the winners of the first two matches meet in round 2, and so on, until the last two players meet in the final. Each player is equally likely to win any match they play, independently of all other matches. What is the probability that Ann and Bea play each other at some point in the tournament?

- | | | |
|-------------------------|------------------------|--------------------------|
| A $\frac{1}{15}$ | B $\frac{1}{8}$ | C $\frac{15}{64}$ |
| D $\frac{4}{15}$ | E $\frac{1}{4}$ | F $\frac{1}{16}$ |

21. A flower bed is in the shape of a cyclic quadrilateral $ABCD$, with its vertices in that order around a circle. Triangle ABD is equilateral, and the diagonal AC has length 10 m. What is the area of the flower bed?

- A** $50\sqrt{3}$ m²
B $\frac{100\sqrt{3}}{3}$ m²
C $\frac{75\sqrt{3}}{4}$ m²
D 50 m²
E $25\sqrt{3}$ m²
F It cannot be determined from the information given.

22. At a fair, a player tosses a fair coin at most 6 times. She wins a prize as soon as she gets heads on two consecutive tosses, and she stops tossing at that point; if this has not happened after 6 tosses, she wins nothing. What is the probability that she wins a prize?

- | | | |
|--------------------------|-----------------------------|--------------------------|
| A $\frac{21}{64}$ | B $\frac{781}{1024}$ | C $\frac{43}{64}$ |
| D $\frac{39}{64}$ | E $\frac{5}{8}$ | F $\frac{11}{16}$ |

23. In a board game, a counter starts on square 0 of a long straight track whose squares are numbered $0, 1, 2, 3, \dots$. On each turn a fair six-sided die is rolled and the counter moves forward by

the number shown. Square 4 holds a trap. What is the probability that the counter lands on square 4 at some point?

A $\frac{343}{1296}$
D $\frac{2}{7}$

B $\frac{1}{6}$
E $\frac{2401}{7776}$

C $\frac{1}{4}$
F $\frac{49}{216}$

24. A carpenter has a large solid wooden cuboid. With a single straight saw cut along a plane, she removes one corner of the block: the cut crosses the three edges that meet at that corner, and the new face it creates is a triangle with sides 5 cm, 6 cm and 7 cm. What is the volume of the piece that is removed?

A $2\sqrt{95} \text{ cm}^3$

B 35 cm^3

C $6\sqrt{95} \text{ cm}^3$

D $6\sqrt{6} \text{ cm}^3$

E $\sqrt{210} \text{ cm}^3$

F $\sqrt{95} \text{ cm}^3$

25. A model is built from identical cubes on a 4 by 4 square grid. On each grid square there is a single vertical stack of cubes (possibly with no cubes), and every cube rests either on the grid or on another cube. Viewed from the front, the tallest stacks in the four columns have heights 3, 1, 4 and 2, from left to right. Viewed from the right-hand side, the tallest stacks in the four rows have heights 4, 4, 2 and 1, from front to back. Let M and m be the greatest and least possible numbers of cubes in the model. What is $M - m$?

A 17

B 15

C 21

D 20

E 16

F 11

26. A long crate with a square cross-section of side 2 m lies on level ground. It is rolled forwards without slipping: each time, it is tipped through 90° about its leading bottom edge, and this is repeated until the crate has turned through one complete revolution. In the cross-section, the corner P of the square that starts on the ground at the back of the crate traces out a curve, ending on the ground again. What is the area of the region enclosed between this curve and the ground?

A $(8 + 4\pi) \text{ m}^2$

B $(4 + 4\pi) \text{ m}^2$

C $(8 + 2\pi) \text{ m}^2$

D $(4 + 2\pi) \text{ m}^2$

E $(2 + 4\pi) \text{ m}^2$

F $4\pi \text{ m}^2$

27. A triangular park ABC has three straight paths. The path from A goes to the point D on BC with $BD : DC = 1 : 3$; the path from B goes to the point E on CA with $CE : EA = 1 : 3$; and the path from C goes to the point F on AB with $AF : FB = 1 : 3$. The three paths enclose a small triangular region in the middle of the park. What fraction of the area of the park is this region?

A $\frac{3}{13}$
D $\frac{4}{13}$

B $\frac{1}{13}$
E $\frac{1}{4}$

C $\frac{1}{7}$
F $\frac{5}{16}$

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