19. Andrew and Dean recently took part in a marathon. After they had finished, they noticed that Andrew had finished ahead of twice as many runners as finished ahead of Dean and that Dean had finished ahead of $1\frac{1}{2}$ times as many runners as finished ahead of Andrew. Andrew finished in 21st place. How many runners took part in the marathon?

A 31   B 41   C 51   D 61   E 81

20. One of the following nets cannot be folded along the dashed lines shown to form a cube. Which one?

     A   B   C   D   E
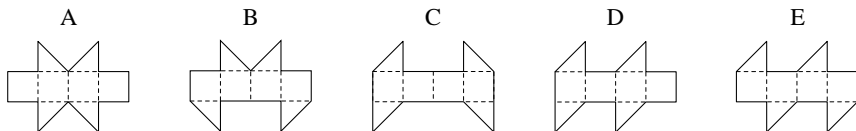
21. Four cars enter a roundabout at the same time, each one from a different direction, as shown in the diagram. Each car drives in a clockwise direction and leaves the roundabout before making a complete circuit. No two cars leave the roundabout by the same exit. How many different ways are there for the cars to leave the roundabout?

A 9   B 12   C 15   D 24   E 81
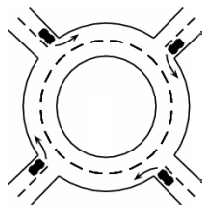
22. The first five terms of a sequence are $1, -1, -1, 1, -1$. After the fifth term, every term is equal to the product of the two preceding terms. For example, the sixth term is equal to the product of the fourth term and the fifth term. What is the sum of the first 2013 terms of the sequence?

A -1006 B -671 C 0   D 671   E 1007

23. Ria bakes six raspberry pies one after the other, numbering them 1 to 6 in order, with the first being number 1. Whilst she is doing this, her children occasionally run into the kitchen and eat the hottest pie. Which of the following could not be the order in which the pies are eaten?

A 123456   B 125436   C 325461   D 456231   E 654321

24. Each of the four vertices and six edges of the tetrahedron $PQRS$ is marked with one of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and 11; so the number 10 is not used. Each number is used exactly once. Each edge is marked with the sum of the numbers at the two vertices connected by that edge. Edge PQ is marked with number 9. Which number is used to mark edge RS?

A 4   B 5   C 6   D 8   E 11
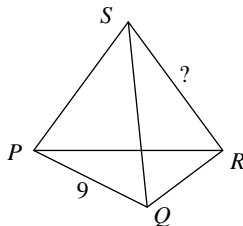
25. A positive integer N is smaller than the sum of its three greatest divisors (naturally, excluding N itself). Which of the following statements is true?

A All such N are divisible by 4.   B All such N are divisible by 5.

C All such N are divisible by 6.   D All such N are divisible by 7.

E There is no such N.
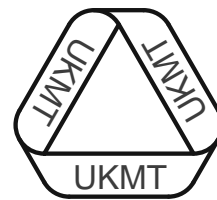
RULES AND GUIDELINES (to be read before starting):

1. Do not open the paper until the Invigilator tells you to do so.

2. Time allowed: **1 hour**.
   No answers, or personal details, may be entered after the allowed hour is over.

3. The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.

4. Candidates in England and Wales must be in School Year 9 or below.
   Candidates in Scotland must be in S2 or below.
   Candidates in Northern Ireland must be in School Year 10 or below.

5. **Use B or HB pencil only**. For each question mark *at most one* of the options A, B, C, D, E on the Answer Sheet. Do not mark more than one option.

6. Five marks will be awarded for each correct answer to Questions 1 - 15.
   Six marks will be awarded for each correct answer to Questions 16 - 25.

7. *Do not expect to finish the whole paper in 1 hour*. Concentrate first on Questions 1-15. When you have checked your answers to these, have a go at some of the later questions.

8. The questions on this paper challenge you **to think**, not to guess. Though you will not lose marks for getting answers wrong, you will undoubtedly get more marks, and more satisfaction, by doing a few questions carefully than by guessing lots of answers.

1. It is true that $\frac{1111}{101} = 11$. What is the value of $\frac{3333}{101} + \frac{6666}{303}$?

   A 5   B 9   C 11   D 55   E 99

2. Ann has the square sheet of paper shown in the left-hand diagram. By cutting along lines of the square, she produces copies of the shape shown in the right-hand diagram. What is the smallest possible number of cells she can leave unused?

   A 0   B 2   C 4   D 6   E 8

3. Roo wants to tell Kanga a number whose digits have a product of 24. What is the sum of the digits of the smallest number Roo could choose?

   A 6   B 8   C 9   D 10   E 11

4. There are five families living in my road. Which of the following could not be the mean number of children per family that live there?

   A 0.2   B 1.2   C 2.2   D 2.4   E 2.5

5. Nicky and Rachel stand on opposite sides of a circular fountain. They then start to run at a constant speed clockwise round the fountain. Nicky's speed is $\frac{9}{8}$ of Rachel's speed. How many circuits has Rachel completed when Nicky catches up with her for the first time?

   A 2   B 4   C 8   D 9   E 72

6. The positive integers x, y and z satisfy $xy = 14$, $yz = 10$ and $xz = 35$. What is the value of $x + y + z$?

   A 10   B 12   C 14   D 16   E 18

7. Olivia and a friend are playing a game of 'battleships' on a 5×5 board. Olivia has already placed two ships as shown. She still has to place a 3×1 ship so that it covers exactly three cells. No two ships can have a boundary point in common. How many positions are there for her 3×1 ship?

   A 4   B 5   C 6   D 7   E 8

8. In the diagram, $\alpha = 55°$, $\beta = 40°$ and $\gamma = 35°$. What is the value of δ?

   A 100°   B 105°   C 120°   D 125°   E 130°

9. The perimeter of a trapezium is 5 units and the length of each of its sides is an integer number of units. What are the two smallest angles of the trapezium?

   A 30° and 30°   B 60° and 60°   C 45° and 45°   D 30° and 60°   E 45° and 90°

10. Carl wrote down several consecutive integers. Which of the following could not be the percentage of odd numbers among them?

    A 40   B 45   C 48   D 50   E 60

11. All the 4-digit positive integers with the same digits as the number 2013 are written in increasing order. What is the largest difference between two adjacent numbers?

   A 702   B 703   C 693   D 793   E 198
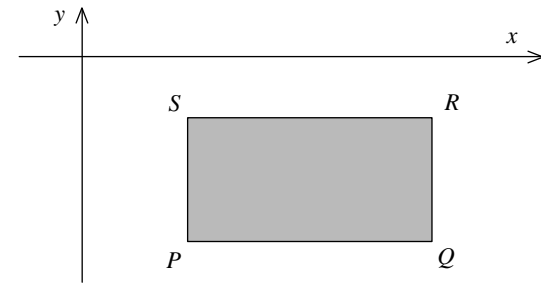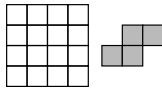
12. The edges of rectangle $PQRS$ are parallel to the coordinate axes. $PQRS$ lies below the x-axis and to the right of the y-axis as shown in the diagram. The coordinates of P, Q, R and S are all integers. For each point, we calculate the value (y-coordinate) $\div$ (x-coordinate). Which of the four points gives the least value?

    A P   B Q   C R   D S   E It depends on the rectangle.

13. In the 6×8 grid shown, 24 cells are not intersected by either diagonal. When the diagonals of a 6×10 grid are drawn, how many cells are not intersected by either diagonal?

   A 28   B 29   C 30   D 31   E 32
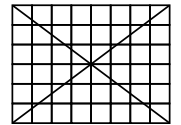
14. John has made a building of unit cubes standing on a 4×4 grid. The diagram shows the number of cubes standing on each cell. When John looks horizontally at the building from behind, what does he see?
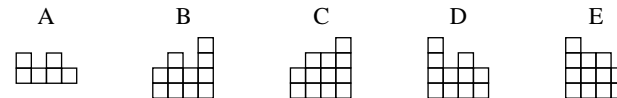
    BEHIND

4	2	3	2
3	3	1	2
2	1	3	1
1	2	1	2

    FRONT

    A   B   C   D   E

15. The diagram shows a shaded quadrilateral $PQRS$ drawn on a grid. Each cell of the grid has sides of length 2 cm. What is the area of quadrilateral $PQRS$?

    A 96 cm^2 B 84 cm^2 C 76 cm^2 D 88 cm^2 E 104 cm^2
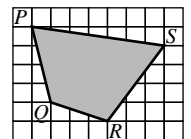
16. Let S be the number of square numbers among the integers from 1 to 2013^6 inclusive. Let Q be the number of cube numbers among the same integers. Which of the following relationships between S and Q is true?

    A $S = Q$ B $2S = 3Q$ C $3S = 2Q$ D $S = 2013Q$ E $S^3 = Q^2$

17. Adam chooses a 5-digit positive integer and deletes one of its digits to form a 4-digit integer. The sum of this 4-digit integer and the original 5-digit integer is 52713. What is the sum of the digits of the original 5-digit integer?

    A 17   B 19   C 20   D 23   E 26

18. A gardener wants to plant 20 trees along one side of an avenue. He decides to use a mixture of maple trees and linden trees. The number of trees between any two maple trees must not be equal to three. What is the largest number of maple trees that the gardener can plant?

    A 8   B 10   C 12   D 14   E 16