



TONBRIDGE SCHOOL

Scholarship Examination Sample Paper

MATHEMATICS I

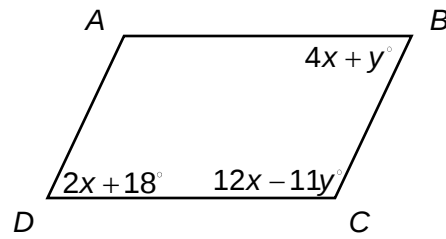
Time allowed: 1 hour 30 minutes

Answer as many questions as you can.
Questions 1 to 5 are worth 8 marks each.
Questions 6 to 9 are worth 15 marks each.
You may attempt the questions in any order.

All answers must be supported by adequate explanation.
Calculators may be used in any question.

There is space for extra working at the end of the paper.
If you use it, you should indicate the question number clearly.

- 1 The quadrilateral $ABCD$ in the diagram is a parallelogram. Angle $\hat{ABC} = 4x + y^\circ$, angle $\hat{BCD} = 12x - 11y^\circ$, angle $\hat{CDA} = 2x + 18^\circ$.



- a Use the information given to write down two equations connecting x and y .
- b Solve these simultaneous equations to find x and y .

TURN OVER

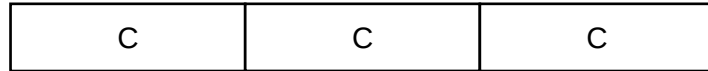
- 2 In this question you will need to use the facts that 1 mile = 1.609 km and there are 1760 yards in a mile.
- a The river Medway has length 113 km. 1065 copies of Manchester City's football pitch would fit along this length. Calculate the length of Manchester City's football pitch in yards.
 - b 9830 double decker buses would fit, end to end, along the length of the river Medway. The equator of the planet Mercury has length 9525 miles. How many double decker buses would fit, end to end, around the equator of Mercury? Give your answer to the nearest thousand buses.

TURN OVER

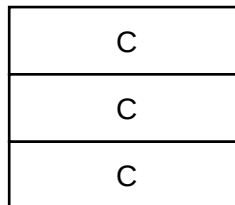
- 3 a The width of rectangle A is 2 cm. The width of rectangle B is 5 cm.
The ratio of the area of rectangle A to the area of rectangle B is 3:7.
The height of rectangle A is 1cm greater than the height of rectangle B.

Find the height of rectangle A.

- b Three identical copies of rectangle C are placed end to end to create a larger rectangle of perimeter 40.6 cm as shown below.



The three rectangles are rearranged top to bottom to create a different rectangle of perimeter 30.6 cm as shown below.



Find the area of rectangle C.

TURN OVER

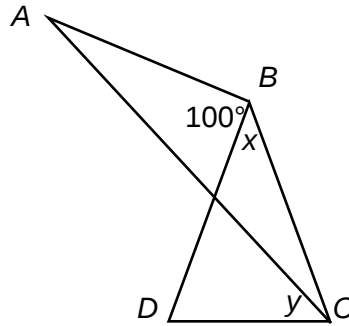
- 4 The units of a force are called Newtons and denoted by the letter N.

The force F N required to move an object of mass m kg a distance x m along a straight line from rest to a speed of v ms⁻² is given by the formula $F = \frac{mv^2}{2x}$

- a If $m = 3.1$, $v = 8.3$ and $x = 18.2$, find F .
- b If $F = 2.8$, $m = 1.3$ and $x = 11.4$, find v .
- c If $F = 19.5$, $m = 2.3$ and $v = 23.8$, find x .

TURN OVER

- 5 The diagram shows two overlapping isosceles triangles in which the lengths AB , BC , and BD are all equal.

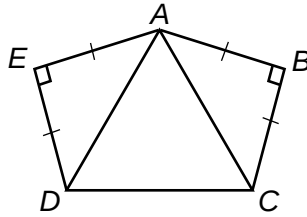


Angle $\hat{A}BD = 100^\circ$, angle $\hat{D}BC = x$, and angle $\hat{A}CD = y$.

- a If $x = 60^\circ$, find angle y .
- b Use algebra to show that, whatever the value of angle x is in part (a), you get the same answer for angle y .

TURN OVER

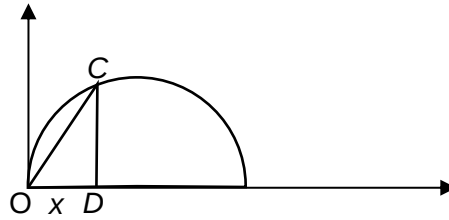
- 6 The diagram shows a pentagon $ABCDE$ of perimeter 54.142 cm correct to 3 decimal places. The pentagon is formed from an equilateral triangle ACD and two identical isosceles right-angle triangles ABC and ADE .



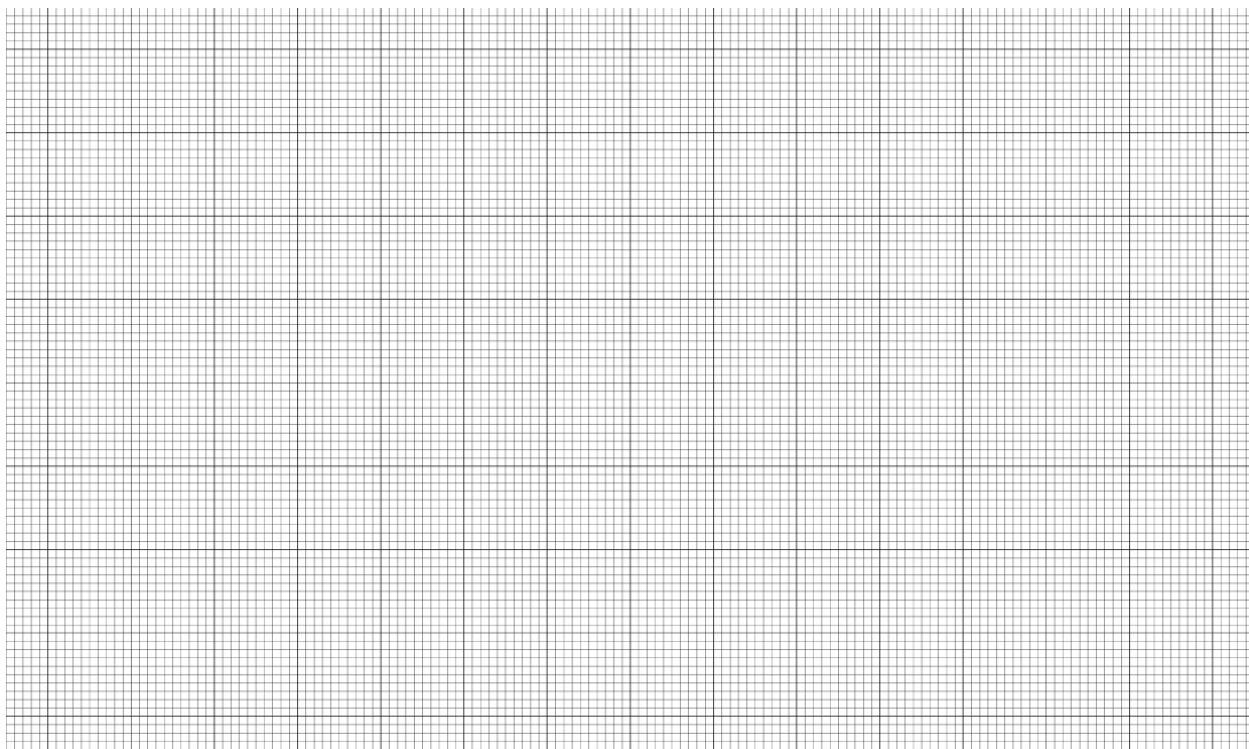
- a By forming and solving an equation, show that length AB is 10 cm.
- b Find the area of pentagon $ABCDE$ giving your answer correct to 1 decimal place.

TURN OVER

- 7 The diagram shows a right-angled triangle OCD inside a semi-circle of diameter 8 cm. The diameter of the semi-circle lies on the horizontal axis. CD is vertical and OD has length x cm. The area A of the triangle is given by the formula $A = \frac{x}{2} \sqrt{16 - (x - 4)^2}$.



- a Show that, when $x = 1$, $A = 1.32$ (correct to 2 decimal places).
- b Make a table of values of A for $x = 2, 3, 4, 5, 6, 7$
- c Using your value of x and A and choosing sensible scales, plot a graph of A against x using the graph paper opposite.
- d What is the maximum area of the triangle OCD ?
- e For the triangle with maximum area, find the lengths CD and OC , and hence determine the angle $\hat{C}OD$.

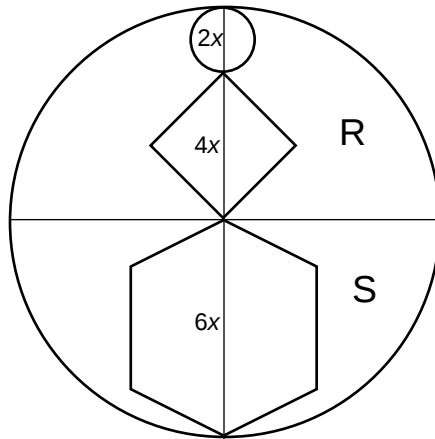


TURN OVER

- 8 The figure below shows a circle, a square, and a regular hexagon contained within a larger circle. The two diameters of the large circle shown are perpendicular.

The vertical distances from the top to the bottom of the circle, square, and hexagon are respectively $2x$, $4x$, and $6x$ as shown.

Regions R and S, both on the right-hand side of the large circle, are marked inside the diagram.



- a In the case where $x = 5$, find the area of R and the area of S.
- b Show that, for any value of x , the ratio $\frac{\text{Area of R}}{\text{Area of S}}$ is 1.37 correct to 2d.p.

TURN OVER

- 9 Study carefully the entries in the table below. Column B gives the answer to the sum in Column A; Column C gives the answer in Column B in an alternative form.

	Column A	Column B	Column C
Row 1	2^2	4	$\frac{1 \times (6 \times 1^2 + 3 \times 1 - 1)}{2}$
Row 2	$2^2 + 5^2$	29	$\frac{2 \times (6 \times 2^2 + 3 \times 2 - 1)}{2}$
Row 3	$2^2 + 5^2 + 8^2$	93	$\frac{3 \times (6 \times 3^2 + 3 \times 3 - 1)}{2}$
Row 4	$2^2 + 5^2 + 8^2 + 11^2$	214	$\frac{4 \times (6 \times 4^2 + 3 \times 4 - 1)}{2}$
Row 5			
Row 6			
.			
.			
.			
Row n			

- a Write down the entries in Columns A, B and C for Rows 5 and 6.
- b For Row n , find formulae in terms of n for
- the number at the right-hand end of Column A
 - the entry in Column C.
- c If the entry in Column C is $\frac{87 \times (6 \times 87^2 + 3 \times 87 - 1)}{2}$ what is the number at the right-hand end of Column A?
- d If the entry in Column A is $2^2 + 5^2 + 8^2 + 11^2 + \dots + 146^2$, what is the entry in Column B?
- e If, in Row k , the entry in Column B is 996004 greater than the Column B entry for Row $k - 1$, what is the value of k ?

END OF PAPER

Additional Answer Space

Additional Answer Space

Additional Answer Space

Additional Answer Space

Additional Answer Space