



WESTMINSTER SCHOOL
THE CHALLENGE 2018

MATHEMATICS II

Tuesday 1st May 2018

Time allowed: 1 hour 30 minutes

You will need a calculator for this paper.

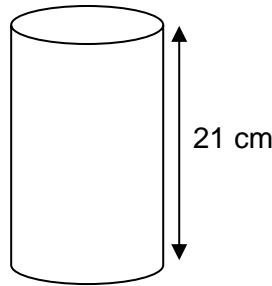
All your working should be clearly shown.

You should attempt all the questions.

Please write in black or blue ink.

- 1 Alex had £51.35 when he set out to the shops. He paid for seven muffins at £1.19 each and eleven giant cookies. When he got home, he had £27.84 left. How much was each cookie?
- 2 Sam ran 800 metres in 2 minutes and 28 seconds. Tom ran 1500 metres in 4 minutes and 37 seconds. Which of them ran faster on average? Show the working you do to decide.
- 3 a i What is the result of adding $\frac{1}{2}(x+1)$ and $x+\frac{1}{2}$?
- ii By what would you need to multiply $\frac{10b}{a}$ to make $\frac{5a}{b}$?
- b Make V the subject of
$$P = \frac{RT}{V-b}.$$
- c Solve the equation
$$\frac{x+10}{3} - 2(x-1) = 3.$$

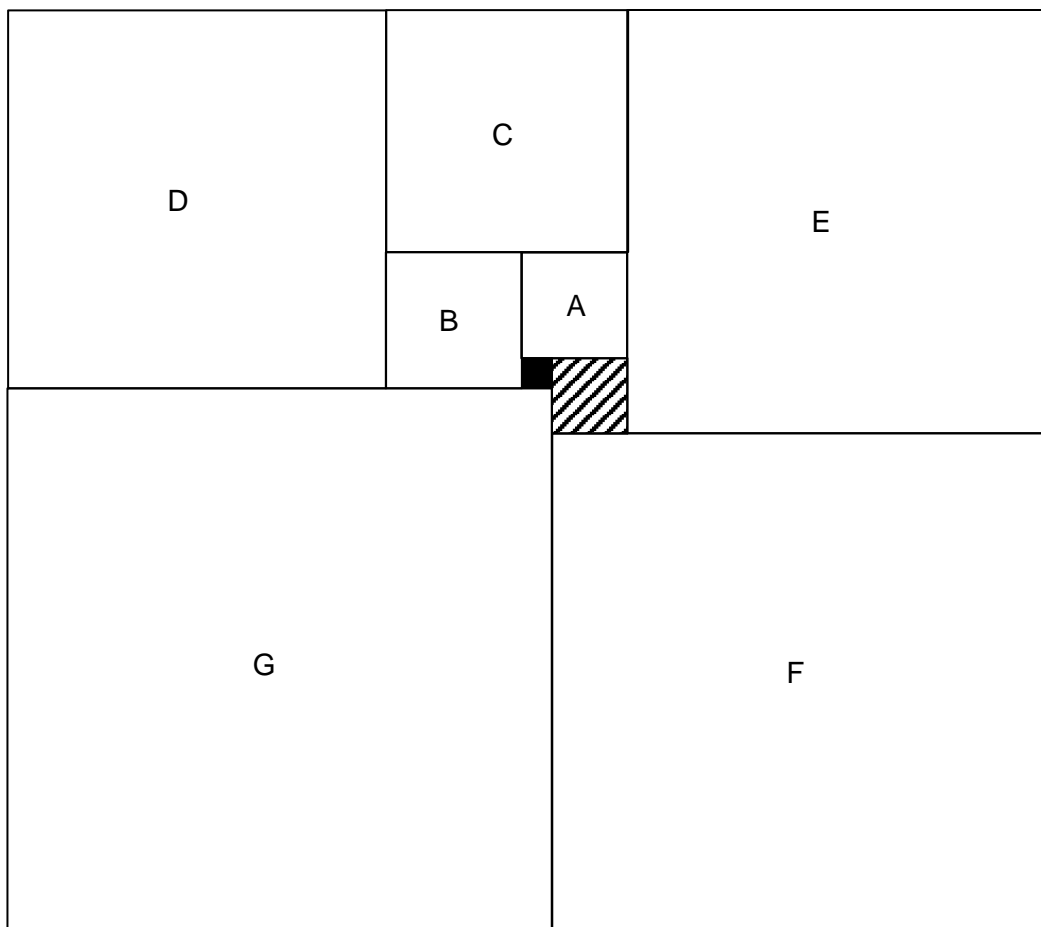
- 4 The diagram shows a cylinder with a height of 21 cm and a volume of 1336 cm^3 . What is the surface area of the cylinder?



- 5 a The volume of a meteorological balloon increases by 14% for each 1000 metres it rises through the atmosphere. The volume of the balloon is 5488 cm^3 at a height of 3000 metres. What was its volume at ground level?
- b The pressure in a meteorological balloon decreases by the same percentage, P , for each 1000 metres it rises through the atmosphere. The pressure in the balloon is 101300 Pascals at ground level and 34800 Pascals at a height of 8000 metres.
- What is the pressure in the balloon at a height of 5000 metres?
- [The Pascal is a unit of pressure equal to one Newton per square metre].
- 6 There are 2018 students in a school. Every student must study either History or Geography, but students can study both subjects. The head teacher knows that between 80% and 85% of the students study History, and that between 30% and 40% study Geography.
- a What are the maximum and minimum numbers of students who study Geography?
- b What are the maximum and minimum numbers of students who study both subjects?

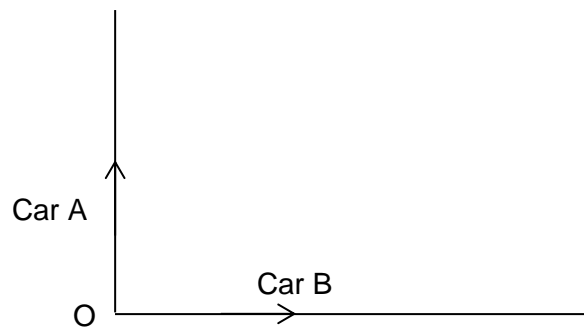
- 7 The tuck shop sells sandwiches, which all cost the same amount.
David buys eight sandwiches, and pays between £13 and £14 for them.
- a If a sandwich costs K pence, what is the range of possible values of K ?
- Ezra buys eleven sandwiches, and pays between £17 and £18 for them.
- b Find the cost of a sandwich.

- 8 The diagram shows how nine squares have been fitted together to form a rectangle. The smallest square (black) has side length 2 cm and the second smallest square (shaded) has side length x cm.
- a Find the side lengths of the other squares, labelled A to G, in terms of x .
- b Find the value of x , and hence the length and width of the rectangle.



- 9 A Subonacci list of numbers is formed as follows:
- the first two numbers in the list are given
 - each subsequent number is one less than the sum of the previous two.
- For example, a Subonacci list could start as follows
- 2 6 7 12
because $7 = 2 + 6 - 1$ and $12 = 6 + 7 - 1$.
- The first number in a Subonacci list is 4 and the second is 7.
- a Find the next four numbers in the list.
- b Is the 2018th number in the list even or odd? Justify your answer.
- c Prove that none of the numbers in the list is a multiple of three.

- 10 The diagram shows two straight roads, one heading due North and one heading due East from point O.



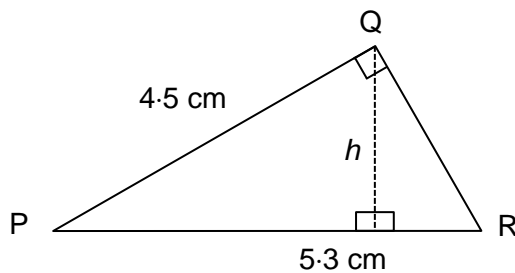
Car A heads North and Car B East; they leave O simultaneously.
Car A travels at 27.4 metres per second, and Car B travels at 30.8 metres per second.

- a How long does it take before Car A and Car B are 1000 metres apart?

When they are 1000 metres apart, Car A and Car B turn and head directly towards each other, at the same speeds as before.

- b How long is it before they collide?

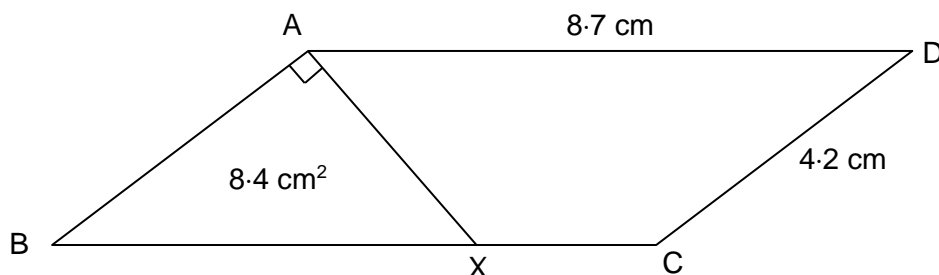
- 11 a The diagram shows triangle PQR. Angle PQR is a right angle



$PR = 5.3$ cm and $PQ = 4.5$ cm.

- i Find QR.
- ii Find the area of triangle PQR.
- iii Find height h , correct to three significant figures.

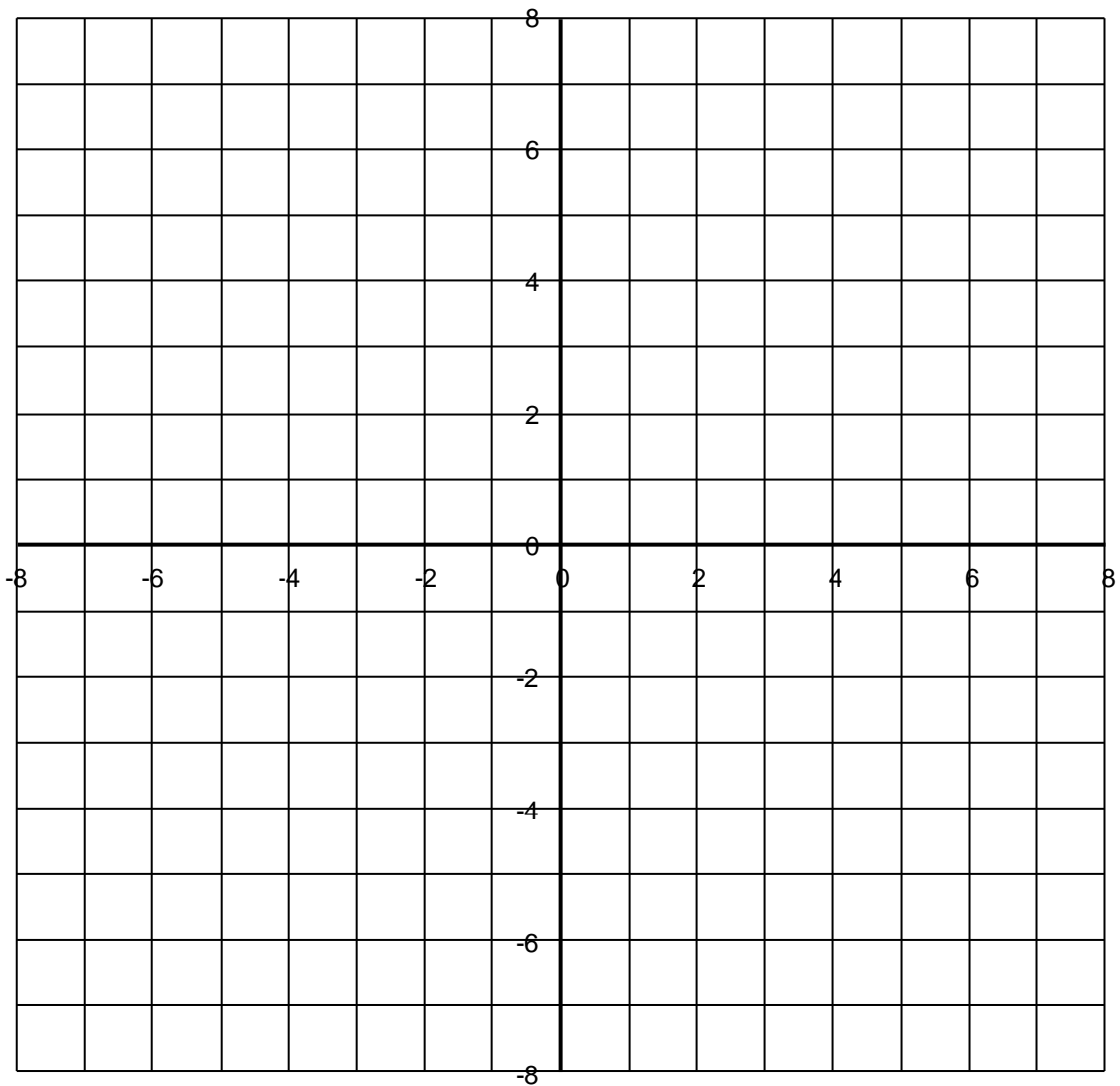
- b The diagram shows a parallelogram ABCD. Angle BAX is a right angle.



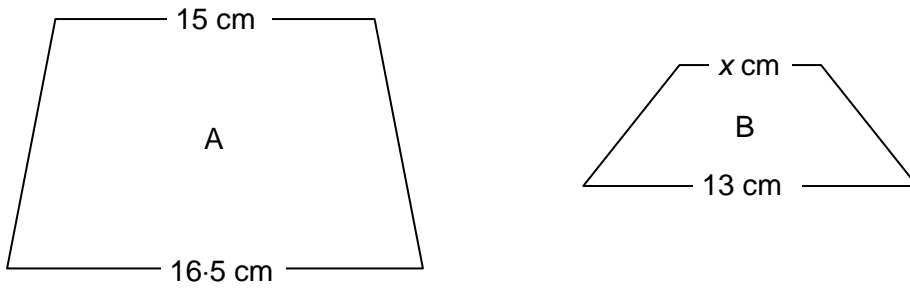
$AD = 8.7$ cm and $CD = 4.2$ cm.
The area of triangle ABX is 8.4 cm².
Find the area of trapezium AXCD.

- 12 The point A has co-ordinates (7, 2). The point O has co-ordinates (0,0)
B is a reflection of A in the line $y = x$.
C is a reflection of A in the y axis.
D is a rotation of A by 90° clockwise about O.
- a** Work out the co-ordinates of points B, C and D.
b Find the area of quadrilateral ABCD.

Use the grid below to help you if you wish, but do all your working in the answer booklet.

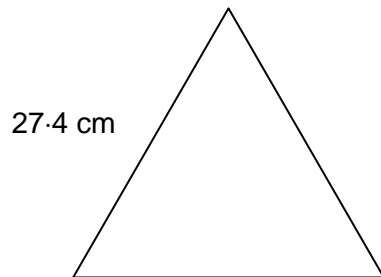


- 13 The diagram shows trapezium A and trapezium B.

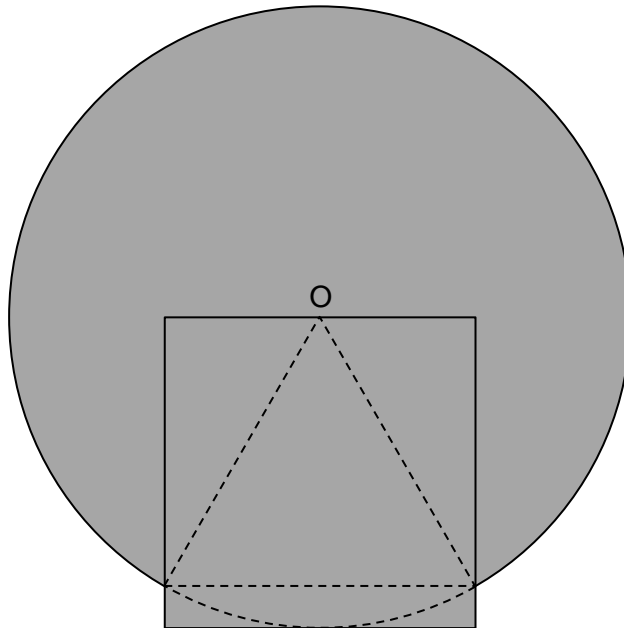


The height of trapezium A is twice that of trapezium B.
The area of trapezium A is three times that of trapezium B.
Find x .

- 14 a Find the area of the equilateral triangle shown below.



The circle below has radius R cm. Point O is the centre of the circle and the midpoint of one of the sides of a square of side length R cm.



- b Find the total shaded area if $R = 27.4$.
c Find R if the total shaded area is 1445 cm^2 .