



WESTMINSTER SCHOOL  
THE CHALLENGE 2019

**MATHEMATICS II**

Tuesday 30 April 2019

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 A florist has 60 bunches of Gypsophila to sell. She sells 41 bunches for £4.30 each. Towards the end of the day she offers a discount, and sells all the remaining bunches at a reduced price. If her costs were £180 and she finished the day with a profit of £62.80, what was the reduced price per bunch?

2 Vehicle A travels 44 miles per gallon of fuel used.  
Vehicle B uses 6.3 litres of fuel per 100 km driven.

Use the conversion factors 1 mile  $\approx$  1.609 km ; 1 gallon  $\approx$  4.546 litres  
to work out which vehicle is more efficient. Show clearly how you decide.

3 a i What would need to be subtracted from  $5x$  to obtain  $3x + a$ ?

ii By what would you multiply  $\frac{2x}{3y}$  to make  $\frac{3}{y}$ ?

b Make  $L$  the subject of

$$K = \frac{M}{\sqrt{A-L}}.$$

c Solve the equation

$$\frac{2}{5}(1-3x) = 4 - \frac{3x}{4}.$$

d Simplify

$$5 - \frac{5(6-x)}{6}.$$

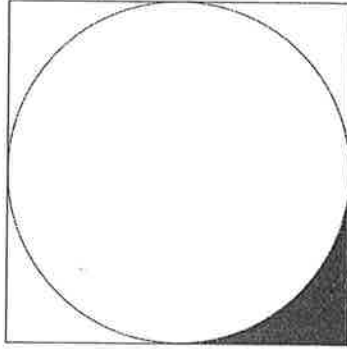
4 a The mass of a green anaconda increases by 22% each year. If the snake currently weighs 72 kg, how much did it weigh four years ago?

b The level of radiation in a nuclear fallout zone decreases by a constant percentage each year. If a radiation counter in the zone read 500 counts per minute in January 2000, and 120 counts per minute in January 2019, what would it have read in January 2012?

5 Josh collects trading cards. The size of his collection grew by 14% during 2016, but it fell during 2017. During 2018, the size increased by 7%. At the end of 2018, Josh calculated that he would have to sell 9% of the collection to reduce it back to the size it was at the beginning of 2016. By what percentage did the size fall during 2017?

6 The surface area of a sphere is known to be between  $27.5 \text{ cm}^2$  and  $28.5 \text{ cm}^2$ . Show clearly that the volume of the sphere, correct to the nearest cubic centimetre, is guaranteed to be  $14 \text{ cm}^3$ .

- 7 The diagram shows a circle fitting snugly inside a square.



- a If the circumference of the circle is 41 cm, what is the perimeter of the shaded region?  
b If the shaded area is  $8.8 \text{ cm}^2$ , what is the area of the square?
- 8 Last week, all my Year 7 class handed in their homework and it took me an average of seven and a half minutes to mark each boy's work. All of the 18 boys in my Year 8 class handed in their homework, which took a lot longer to mark: altogether it took me 6 hours and 36 minutes to mark my Year 7 and 8 homework.
- This week, four of my Year 7 class and two of my Year 8 class failed to hand in their homework. It only took me an average of six minutes to mark each Year 7 boy's work, but it took me four minutes longer than last week to mark each Year 8 boy's prep, on average. Altogether, this week's marking took twenty minutes less than last week.
- How many boys are in my Year 7 class and how long did it take me on average to mark each Year 8 boy's prep last week?
- 9 The traditional English system of weights and measures includes four units of mass: the ton, the stone, the pound, and the ounce. There are 16 ounces in a pound, 14 pounds in a stone, and 160 stones in a ton.
- Convert 1 234 567 ounces into the form "w tons, x stones, y pounds, and z ounces."

10 I have a large number of identical maths textbooks, which I am trying to stack in a rectangular space on my wall.

- If I stack the books **upright**, as in Figure 1, I can fit 5 rows of 75, leaving a 1 cm gap along the top and right-hand edges of the space, as shown in Figure 2.

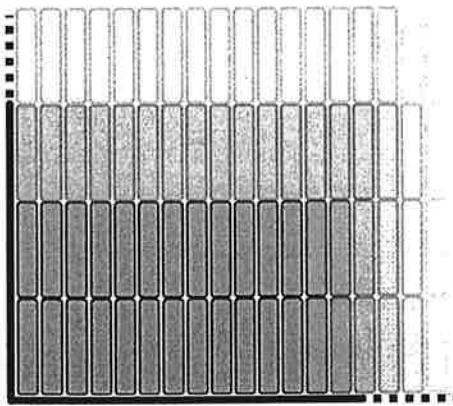


Figure 1

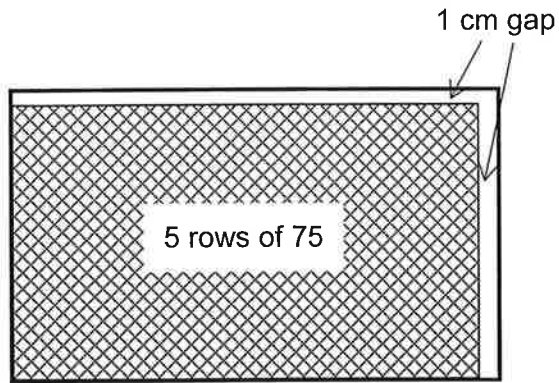


Figure 2

- If I stack the books **on their side**, as in Figure 3, I can fit 16 columns of 23, leaving a 2 cm gap along the top and right-hand edges of the space, as shown in Figure 4.

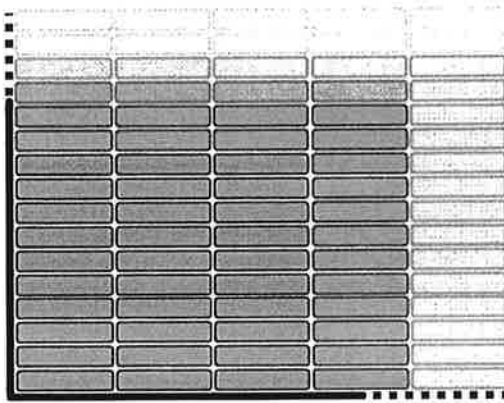


Figure 3

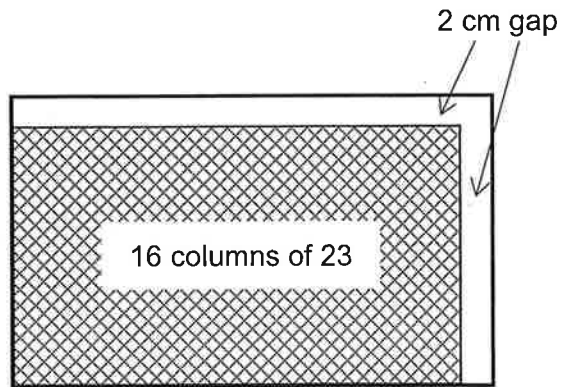
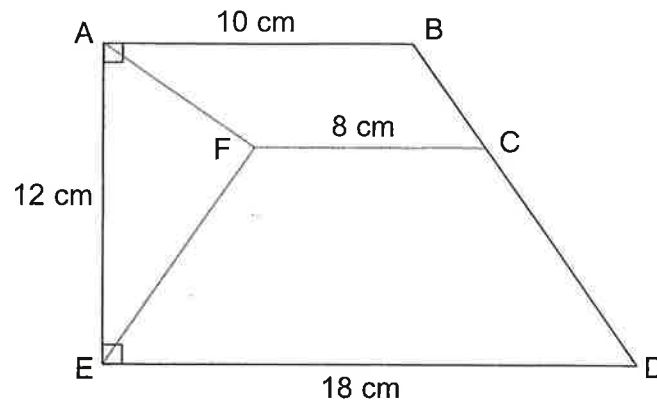


Figure 4

Find the height and width of the rectangular space.

- 11 In the diagram below, AB, FC and ED are parallel, and AE is perpendicular to ED. BCD is a straight line.



Given that CDEF has three times the area of ABCF, find the area of AFE.

- 12 Stefan and Toby want to build toy spacecraft from *Astro* construction parts. Stefan wants to build an *Astro Scout*, whilst Toby wants to build an *Astro Transport*. They do not have all the parts they need, so they write down how many more of each part they will buy.

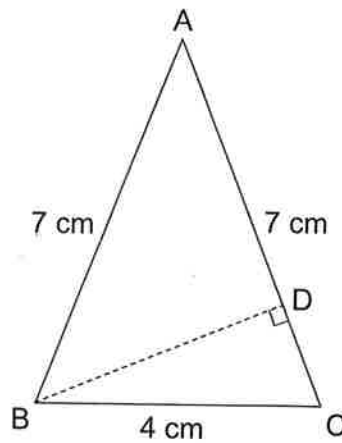
	<i>Astro Scout</i>	<i>Astro Transport</i>
Guns	17	27
Cosmic shields	8	13
Turbo engines	5	8

At the toy shop Stefan is told his extra parts will cost £53.05, and Toby is told his extra parts will cost £84.95. Each part costs a whole number of pence, and there are no discounts for bulk buying.

Which costs more, a gun or a cosmic shield, and by how much?

- 13 A prism with a volume of  $963 \text{ cm}^3$  has a right-angled triangle as its cross-section. The length of the hypotenuse of the cross-section is three times its shortest side, and the length of the prism is five times the hypotenuse of the cross-section. Find the cross-sectional area of the prism.

- 14 a The triangle ABC is isosceles with  $AB = AC = 7$  cm and  $BC = 4$  cm.



- i Find the area of ABC.

The point D lies on AC such that BD is perpendicular to AC.

- ii Find the length of BD, correct to 3 significant figures.

- b A circle drawn on horizontal ground has centre O and radius 3 metres. A vertical flagpole of height 10 metres stands at O. A wire support connects F, the top of the flagpole, to G, a point on the circle's circumference. Another point H on the circle's circumference is such that angle  $GOH = 90^\circ$ .

A strip of decorative bunting is to be added. One end will be attached to the ground at H, and the other end will be fixed to the wire support at a point X. The bunting is made as short as possible, so that angle  $HXF$  is a right angle.

Calculate the length HX.

