

Please write clearly in block capitals.

Centre number Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

**GCSE
MATHEMATICS**

H

Higher Tier Paper 3 Calculator

Tuesday 11 June 2019

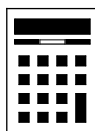
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments.



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26–27	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



Please note that these worked solutions have neither been provided nor approved by AQA and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer **all** questions in the spaces provided

- 1 Work out £1.50 as a fraction of 60p
Circle your answer.

[1 mark]

$\frac{2}{5}$

$\frac{1}{4}$

$\frac{4}{1}$

$\frac{5}{2}$

£1.50 is 150p. $150/60$

- 2 For a biased dice, $P(6) = \frac{3}{5}$
Circle the probability of two sixes when the dice is rolled twice.

[1 mark]

$\frac{6}{25}$

$\frac{6}{10}$

$\frac{9}{25}$

$\frac{9}{5}$

Six AND six so the probability of getting a six ($3/5$) needs to be multiplied by the probability of getting another six

- 3 Circle the lowest common multiple (LCM) of 5, 15 and 25

[1 mark]

~~5~~

45

75

150

5 isn't a multiple of 15 so it can't be 5. We need the smallest number which is a multiple of 5, 15 and 25



- 4 Circle the **two** roots of $(x - 5)(x + 3) = 0$

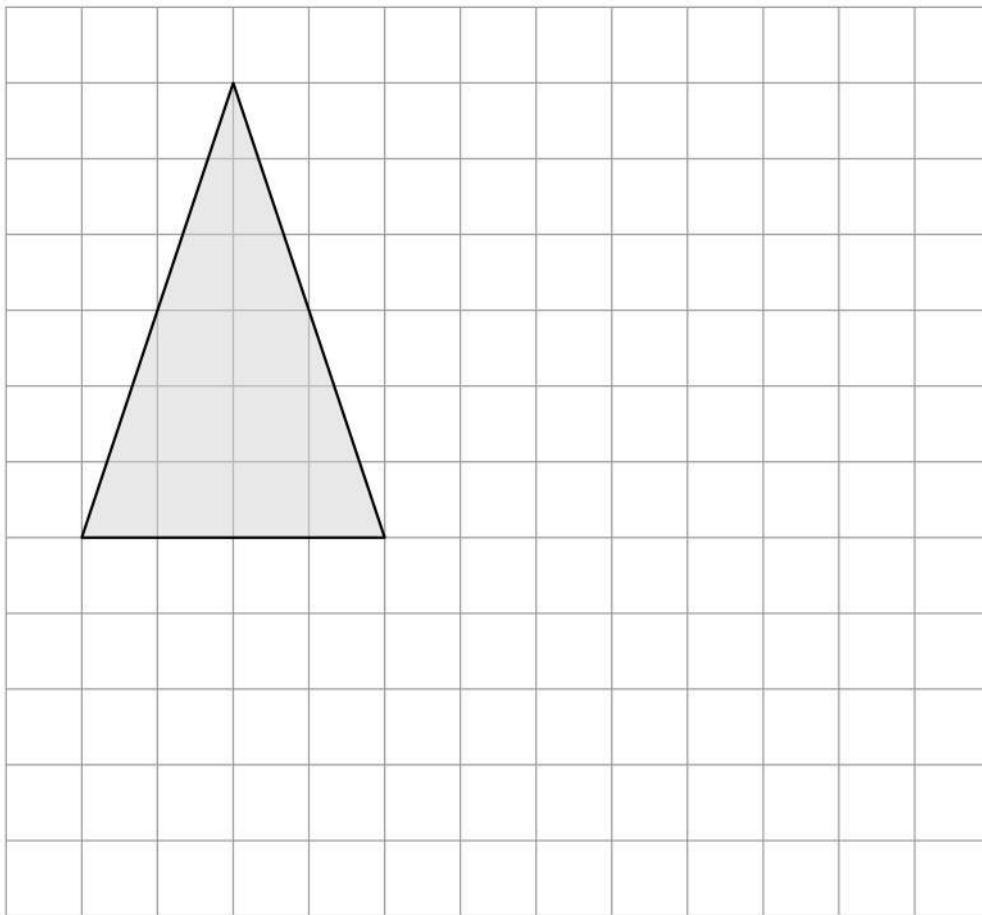
[1 mark]

-5 -3 3 5

Either $x - 5 = 0$ or $x + 3 = 0$
Rearranging these to make x the subject finds the roots

- 5 On the grid, draw an enlargement of the triangle with scale factor $\frac{1}{2}$

[2 marks]



Multiply the base and height of the triangle
by $\frac{1}{2}$ to work out the new base and height



- 6 To the nearest pound, Jon has £9
To the nearest 50p, Ellie has £6.50

Work out the maximum possible total amount of money.

[3 marks]

To work out the upper bound for each person, add half of the resolution (what it goes up in, which is £1 for Jon and 50p for Ellie) but bear in mind the amounts of money can't quite be equal to the upper bounds as they would round up rather than down to £9 and £6.50

Answer £ _____



7 Two solids, J and K, have the same density.

Complete the table.

Include units in your answers.

[3 marks]

	J	K
Mass	48 g	78 g
Volume	8 cm ³	
Density		

$d \ m \ v$

From the formula triangle:
Density = mass/volume
Volume = mass/density

To work out the units of density,
consider that g is divided by cm³

8 Rearrange $y = 3x - 2$ to make x the subject.

Circle your answer.

[1 mark]

$$x = \frac{y}{3} - 2$$

$$x = \frac{y+2}{3}$$

$$x = \frac{y-2}{3}$$

$$x = \frac{y}{3} + 2$$

Follow BIDMAS backward to decide what to get rid of
on the right side first. Do the opposite operation to both
sides to get rid of the 3 and -2 to leave x on its own

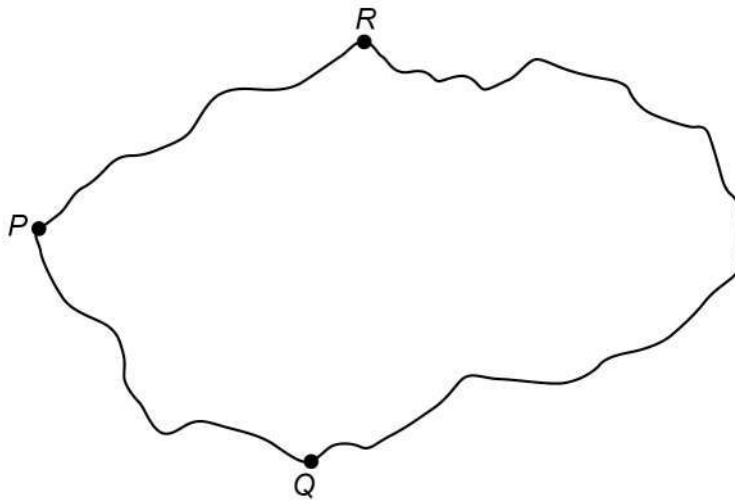


9 Towns P , Q and R are connected by roads PQ , PR and QR .

PR is 10 km longer than PQ .

QR is twice as long as PR .

The total length of the three roads is 170 km



Not drawn
accurately

Work out the length of PQ .

[4 marks]

Let x be PQ . Express PR and QR in terms of x . Express the total length of the three roads by adding them together. This makes an equation in terms of x which can be simplified, rearranged and solved

Answer _____ km



10

Mia wants to borrow £6000 and repay it, with interest, after two years.
She sees two offers for loans.

Offer 1
Compound interest
3% per year

Offer 2
Compound interest
First year 1%
Second year 5%

Mia says,

“I will pay back the same amount because the average of 1% and 5% is 3%”

Is she correct?

You **must** show your working.

[3 marks]

Work out how much needs to be paid back for both offers. If they are the same, she is correct.

$100\% + 3\% = 103\%$. Convert this into a decimal and multiply £6000 by it twice to increase £6000 by 3% twice. Do a similar method for Offer 2

Turn over for the next question

Turn over ►



11 Here are two sets of numbers, A and B.

Set A

200	160
104	100

Set B

270	400	483
300	x	

mean of Set A : mean of Set B = 3 : 8

Work out the value of x .

[4 marks]

Mean = total/number

Total = mean x number

Work out the mean of Set A. Use the ratio to work out the mean of Set B. Work out the total of the numbers in Set B then subtract the other numbers to leave x

Answer _____



12

A straight line

has gradient 4

and

passes through the point (5, 23)

Work out the equation of the line.

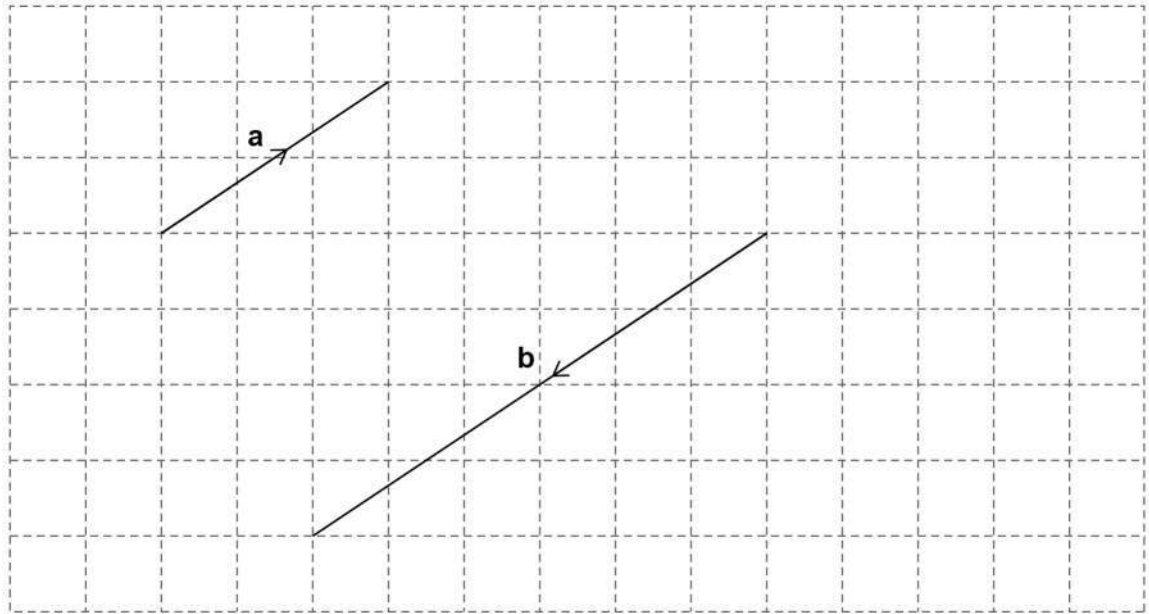
Give your answer in the form $y = mx + c$ **[3 marks]**

m is the gradient. c can be found by rearranging $y = mx + c$ to make c the subject and substituting in the gradient and the x and y coordinates from the point (5, 23)

Answer _____

Turn over for the next question

- 13 (a) Vectors **a** and **b** are drawn on a grid.



Write **b** in terms of **a**.

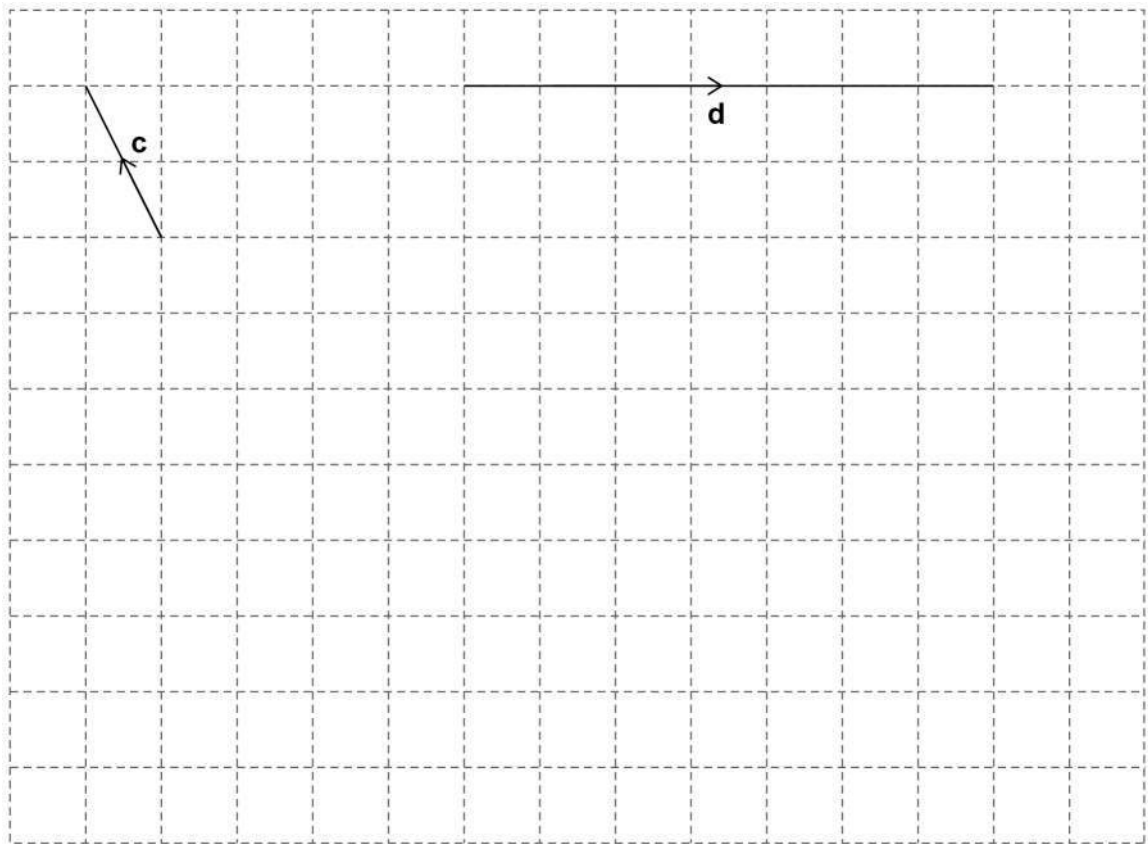
[1 mark]

b = _____

Vector **b** is twice as long as **a** but in the opposite direction



13 (b) Vectors **c** and **d** are drawn on a grid.



On the grid above, draw a vector representing $\mathbf{c} - \mathbf{d}$

[2 marks]

Combine the vectors **c** and **-d** by imagining them drawn tip to tail. **-d** is the same length as **d** but in the opposite direction

Turn over for the next question



- 14 For Class X, number of boys : number of girls = 7 : 8
For Class Y, number of boys : number of girls = 3 : 4

Which statement **must** be true?

Tick **one** box.

[1 mark]

~~Class X has more boys than class Y~~

The ratios don't provide any information on the numbers of boys and girls

~~Class X has twice as many girls as class Y~~

Class X has a greater proportion of boys than class Y

Class X has the same proportion of boys as class Y

Convert the ratios into fractions for the number of boys in Class X and Y. Convert them into decimals so they can be compared

- 15 Simplify fully

$$\frac{a^3b^2}{cd} \times \frac{c}{ab^5}$$

[3 marks]

$$\frac{a^3b^2c}{ab^5cd}$$

The fractions are multiplied by multiplying the numerators and denominators

Divide the numerator and denominator by common factors to simplify the fraction.

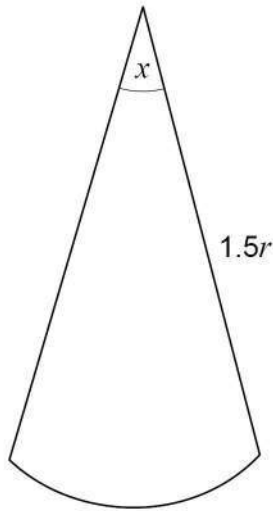
$$a^x/a^y = a^{x-y}$$

Answer _____

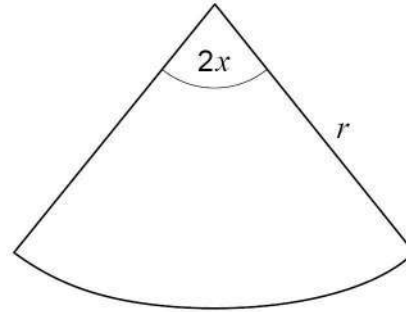


16 Here are two sectors from different circles.

Sector A



Sector B



Not drawn
accurately

Which sector has the bigger area?

Tick a box.

Sector A

Sector B

Show working to support your answer.

[2 marks]

Area of a sector = $\frac{a}{360} \times \pi r^2$, where a is the angle of the sector and r is the radius.
Express both areas in a comparable form. They can both be expressed as a fraction of πr^2 . The greatest fraction must mean it is the biggest area



17

A factory makes kettles.

Four samples of kettles are tested for faults.

Each sample has size 200

Here are the relative frequencies of faulty kettles in the samples.

Sample	P	Q	R	S
Relative frequency	0.03	0.035	0.015	0.01

Work out the range of the number of faulty kettles in the four samples.

[3 marks]

Sample size \times relative frequency = number of faulty kettles
Range = largest - smallest

Answer _____



18 (a) Write $x(3x - 9) = 4$ in the form $ax^2 + bx + c = 0$ where a , b and c are integers.

[1 mark]

Expand the brackets then subtract 4 from both sides

Answer _____

18 (b) Solve $x(3x - 9) = 4$

Give your answers to 2 decimal places.

[2 marks]

Use the quadratic formula on the answer to part (a).

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Answer _____

Turn over for the next question

Turn over ►

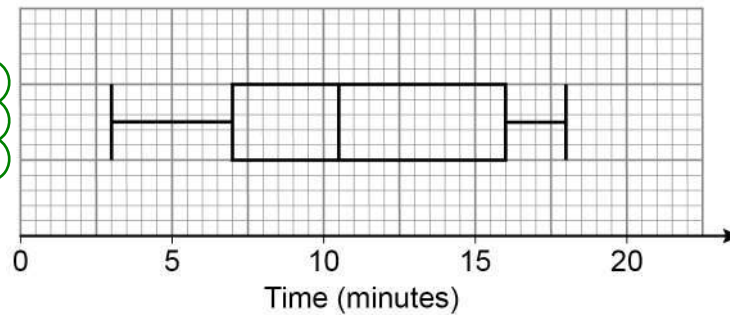


- 19 Here is some information about the times people took to complete a survey.

Fastest time	3 minutes
Slowest time	18 minutes
Median	11 minutes
Lower quartile	7 minutes
Interquartile range	8 minutes

Ben draws this box plot to show the information.

Time to complete a survey



The scale goes up 5 over 10 boxes. $5/10 = 0.5$ so the scale is going up in 0.5 every small box

Make **two** criticisms of his box plot.

[2 marks]

Criticism 1

Something is wrong with the median on the box plot

Criticism 2

Something is wrong with the upper quartile on the box plot



20 d is directly proportional to the square of v .

$$d = 6 \text{ when } v = 20$$

20 (a) Work out an equation connecting d and v .

[3 marks]

$$d = k v^2$$

v^2 can be multiplied by anything and still be directly proportional to d

Rearrange to make k the subject and find it by substituting in the given values of d and v . Substitute the value of k back into the original equation above

Answer _____

20 (b) Work out the value of d when $v = 30$

[2 marks]

Substitute 30 for v in the equation found in part (a)

Answer _____

Turn over for the next question

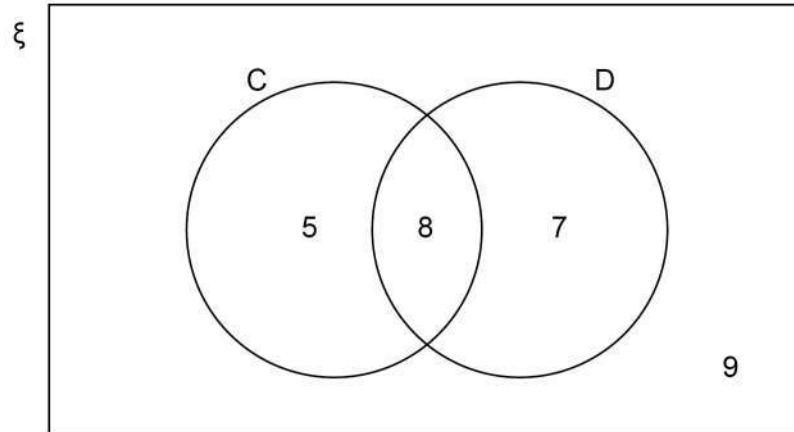


22

 $\xi = 29$ students in a class

C = students who own a cat

D = students who own a dog



22 (a) A student is chosen at random.

Circle the probability that the student owns a cat or a dog but not both.

20 own a cat or a dog or both so it isn't this option

$\frac{12}{29}$

$\frac{13}{29}$

$\frac{15}{29}$

~~$\frac{20}{29}$~~

[1 mark]

5 own a cat but not a dog. 7 own a dog but not a cat

22 (b) A student who owns a dog is chosen at random.

Circle the probability that the student also owns a cat.

$\frac{7}{15}$

$\frac{8}{15}$

~~$\frac{7}{29}$~~

~~$\frac{8}{29}$~~

[1 mark]

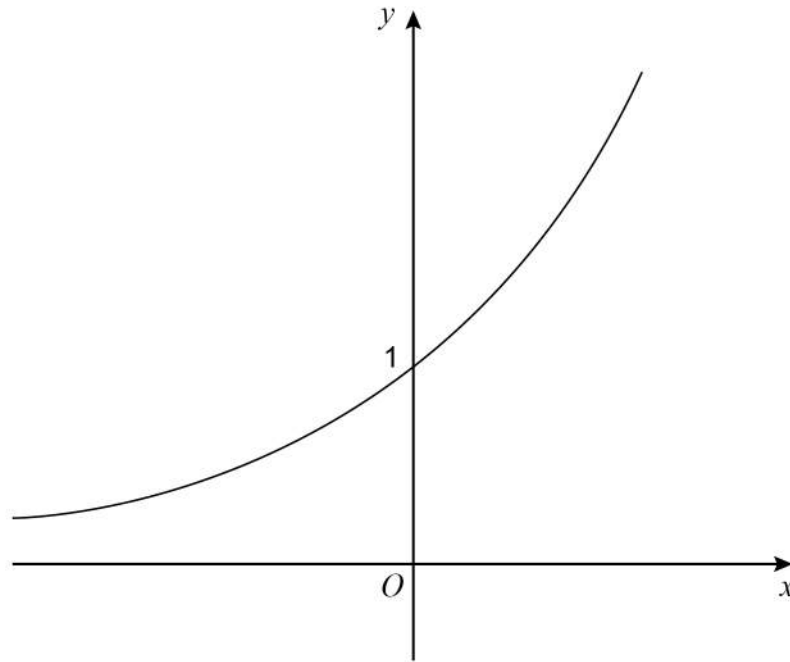
It is out of the 15 who own a dog so it can't be these two

7

Turn over ►



23

Here is a sketch of the curve $y = 2^x$ On the axes above, sketch the curve $y = 3^x$ **[2 marks]**

Use table mode on the calculator to create a table of values for $f(x) = 2^x$ and $g(x) = 3^x$.

Press Menu then 3. Set $f(x) = 2^x$ then press =. Set $g(x) = 3^x$ then press =. Start: -5. End: 5. Step: 1

Plot where the curve $y = 3^x$ crosses the y-axis then roughly sketch what it does relative to the curve $y = 2^x$

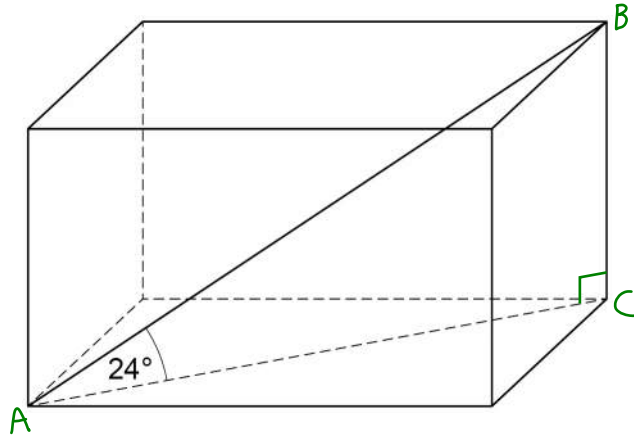


24

The length of a diagonal of a cuboid is 20 cm

The diagonal makes an angle of 24° with the base.

The area of the base is 150 cm^2



Work out the volume of the cuboid.

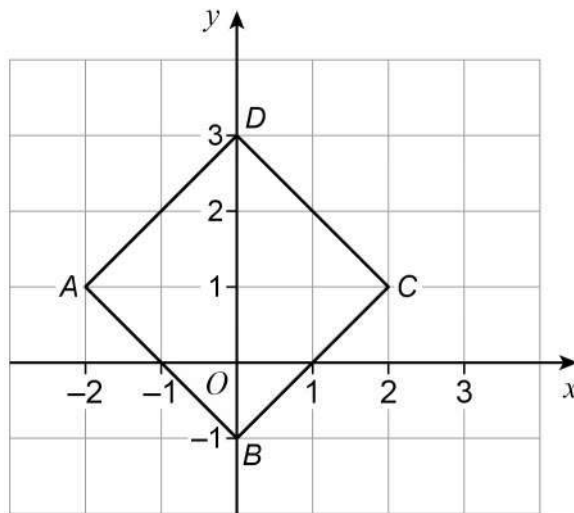
[3 marks]

Volume of prism = cross sectional area \times length
 The cuboid can be treated like a prism. The base is the cross section and has an area of 150. The length is BC which can be found by using right angled trigonometry (SOH CAH TOA) in the triangle ABC

Answer _____ cm^3



25

 $ABCD$ is a square. A is $(-2, 1)$ B is $(0, -1)$ C is $(2, 1)$ D is $(0, 3)$ 

Translation,
enlargement,
reflection or
rotation

25 (a) A **single** transformation of $ABCD$ is such that B is mapped to D D is mapped to B A and C are invariant points.

B swaps with D .
 A and C don't
change

Describe fully the transformation.

[2 marks]



25 (b) A different **single** transformation of $ABCD$ is such that

B is mapped to D

D is mapped to B

the only invariant point is $(0, 1)$

Describe fully the transformation.

[3 marks]

Rotation...

26 $g(x) = 16 - x$ $h(x) = x^3$

Solve $gh(x) = 24$

[3 marks]

Substitute $h(x)$ for x in $g(x)$ to get the composite function $gh(x)$. Set it equal to 24 then rearrange to find x

$x =$ _____

Turn over for the next question



27

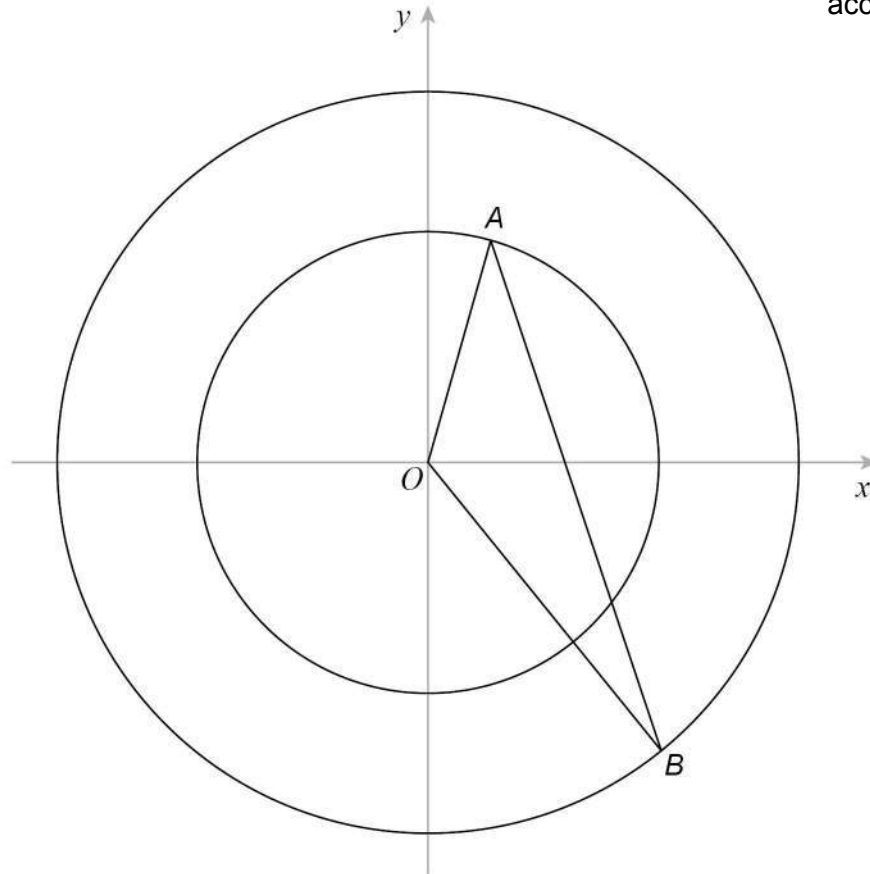
In this question, all lengths are in centimetres.

A is a point on a circle, centre O .

B is a point on a different circle, centre O .

$AB = 20$

Not drawn
accurately



The equation of the larger circle is $x^2 + y^2 = 144$

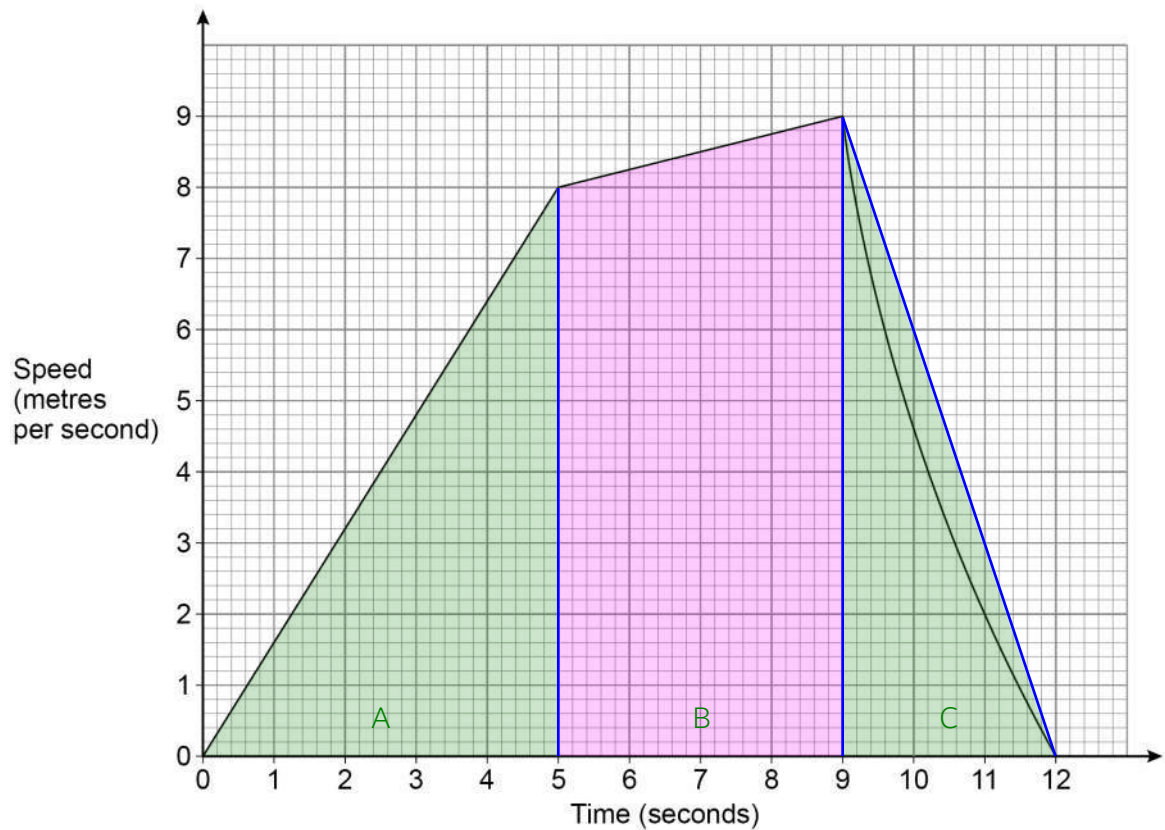
radius of smaller circle : radius of larger circle = 4 : 5



28

Leo runs for 12 seconds.

The graph shows his speed.



28 (a) Show that the distance he runs is less than 67.5 metres.

[4 marks]

The distance is the area under the line on a speed-time graph. Work out an estimate of the area by using triangle A, trapezium B and triangle C. As the area under the curve is less than the triangle C, the distance must be less than the estimate.

Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$

Area of trapezium = $\frac{1}{2} (a + b) \times h$, where a and b are the parallel sides and h is the distance between them



28 (b) Work out his average acceleration for the first 9 seconds.

State the units of your answer.

[2 marks]

The average acceleration is the gradient of the straight line which runs from (0, 0) to (9, 9). Gradient = (change in y)/(change in x). For the units, we are dividing change in speed (m/s) by change in time (s)

Answer _____

END OF QUESTIONS

