

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier

Paper 3 Calculator

Tuesday 11 June 2019

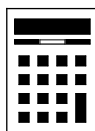
Morning

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.



Answer **all** questions in the spaces provided

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

[1 mark]

$$\frac{150}{60} = \frac{5}{2}$$

$\frac{2}{5}$

$\frac{1}{4}$

$\frac{4}{1}$

$\frac{5}{2}$

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

[1 mark]

$$\frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$$

$\frac{6}{25}$

$\frac{6}{10}$

$\frac{9}{25}$

$\frac{9}{5}$

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

[1 mark]

5

45

75

150

|
not a
multiple
of 25



- 4 Circle the **two** roots of $(x-5)(x+3) = 0$ $x = -3$
 $x = 5$ [1 mark]

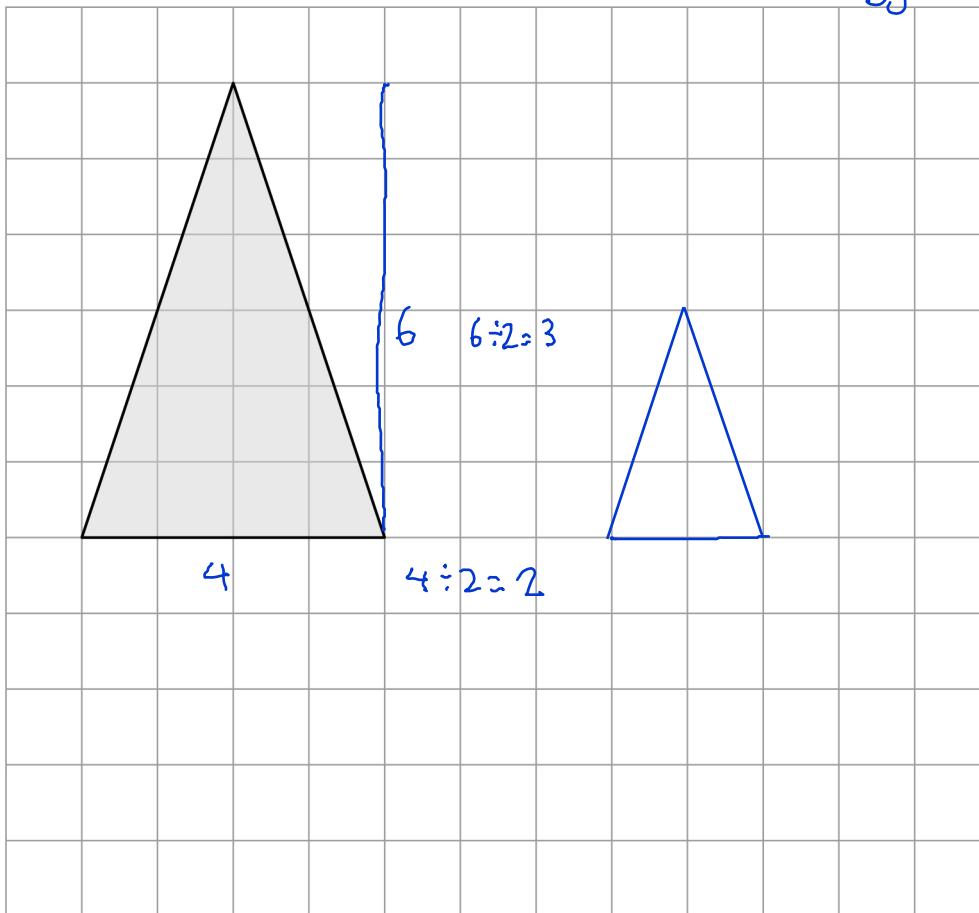
-5

-3

3

5

- 5 On the grid, draw an enlargement of the triangle with scale factor $\frac{1}{2}$ [2 marks]
divide each length by 2



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]

$$\text{Joe} \quad 8.50 \leq £ < 9.50$$

$$\text{OR} \quad 8.50 \leq £ \leq 9.49$$

$$\text{Ellie} \quad 6.25 \leq £ < 6.75$$

$$\text{OR} \quad 6.25 \leq £ \leq 6.74$$

UB + UB

$$6.74 + 9.49$$

Answer £ 16.23

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	13 cm ³
Density	6 g/cm ³	6 g/cm ³

$\frac{48}{8} =$ $\frac{78}{6}$

same

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} \qquad \text{Volume} = \frac{\text{Mass}}{\text{Density}}$$

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

Circle your answer.

[1 mark]

$$x = \frac{y}{3} - 2 \qquad \textcircled{x = \frac{y+2}{3}} \qquad x = \frac{y-2}{3} \qquad x = \frac{y}{3} + 2$$

$$\begin{aligned} y &= 3x - 2 \\ &+ 2 \\ y + 2 &= 3x \\ &\div 3 \\ \frac{y+2}{3} &= x \end{aligned}$$

Turn over ►



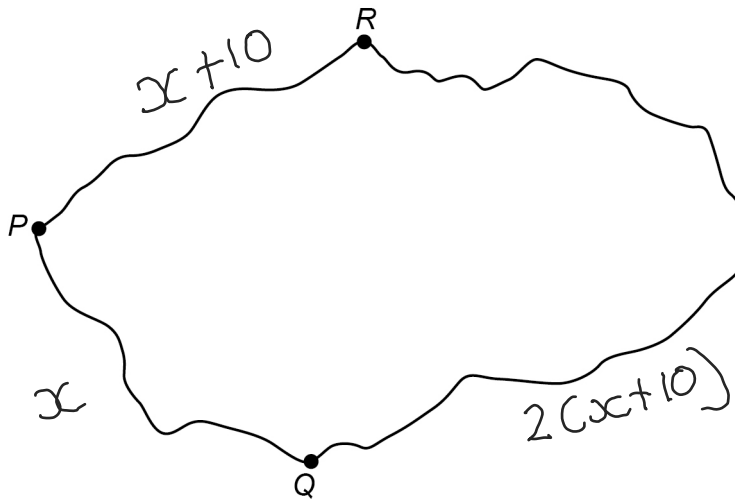
9

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]

$$\begin{aligned} \text{Total length: } & x + x + 10 + 2(x + 10) \\ & = x + x + 10 + 2x + 20 \end{aligned}$$

$$170 = 4x + 30$$

$$140 \stackrel{-30}{=} 4x$$

$$35 \stackrel{\div 4}{=} x = PQ$$

Answer 35 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%

$$100\% + 3\% = 103\% = \times 1.03$$

$$\begin{aligned} &\times 1.01 \\ &\times 1.05 \end{aligned}$$

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]

$$\textcircled{1} \quad 6000 \times 1.03^2 = \pounds 6365.40$$

$$\textcircled{2} \quad 6000 \times 1.01 \times 1.05 = \pounds 6363$$

$\begin{matrix} 1^{\text{st}} \text{ year} & 2^{\text{nd}} \text{ year} \end{matrix}$

No, the numbers are different
so she would pay back
different amounts

Turn over for the next question



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]

$$\text{Mean of A : } \frac{200 + 104 + 100 + 160}{4} = 141$$

$$\text{Ratio } 3:8 \xrightarrow{\times 47} 141:376 \quad \leftarrow \text{mean of B}$$

$$\frac{270 + 400 + 483 + 300 + x}{5} = 376$$

$$1453 + x = 1880$$

Answer $x = 427$



12

A straight line

has gradient 4

$$m=4$$

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]**

$$y = 4x + c$$

$$23 = 4(5) + c$$

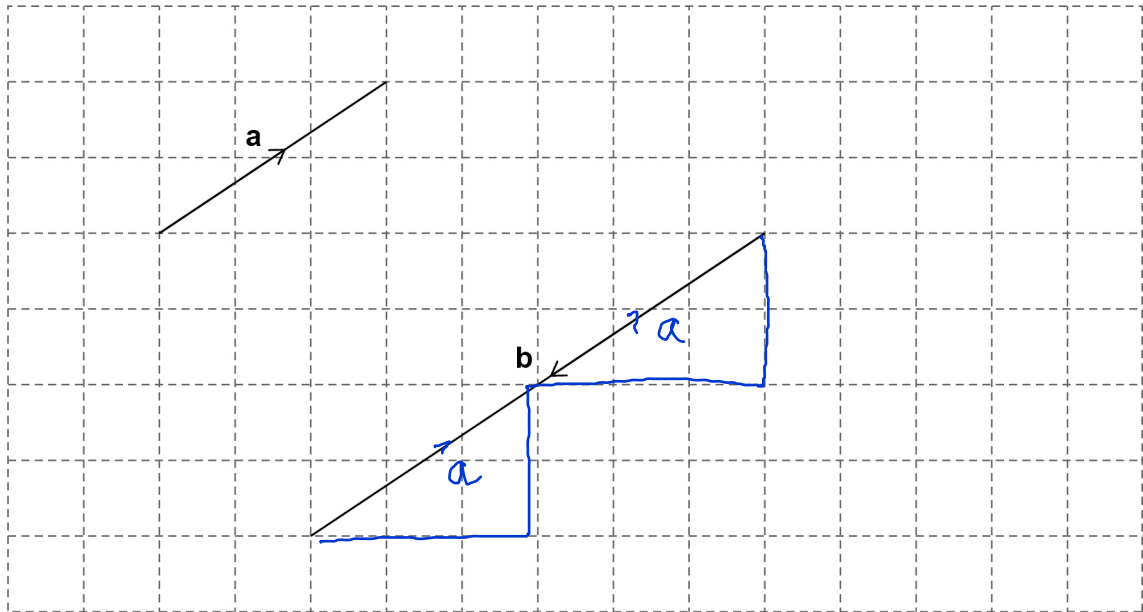
$$23 - 20 = c = 3$$

Answer

$$y = 4x + 3$$

Turn over for the next question**Turn over ►**

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



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

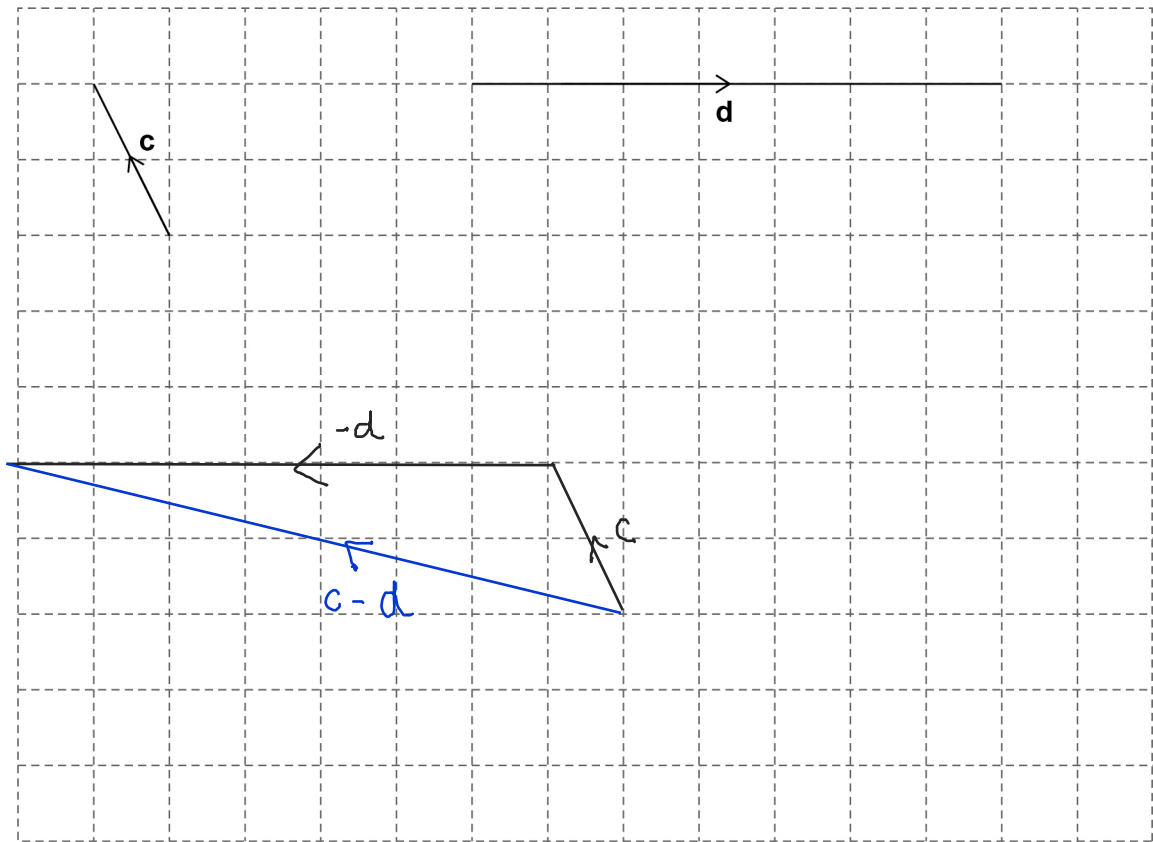
opp direction

[1 mark]

$b = \underline{\quad -2a \quad}$



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



On the grid above, draw a vector representing $c - d$

[2 marks]

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

$$\frac{7}{15}b \quad \frac{8}{15}g$$

$$\frac{3}{7}b \quad \frac{4}{7}g$$

Which statement **must** be true?

Tick **one** box.

[1 mark]

Class X has more boys than class Y \times

Class X has twice as many girls as class Y \times

Class X has a greater proportion of boys than class Y

Class X has the same proportion of boys as class Y \times

15 Simplify fully

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

[3 marks]

$$= \frac{a^3 b^2 c}{a b^5 c d}$$

$$a^3 \div a = a^2$$

$$b^2 \div b^5 = b^{-3}$$

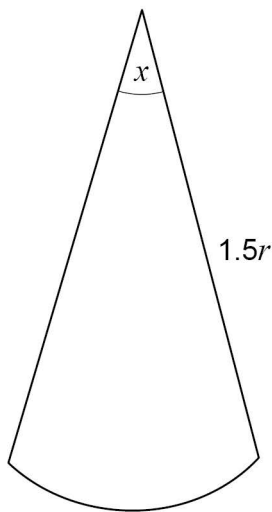
Answer = $\frac{a^2}{b^3 d}$



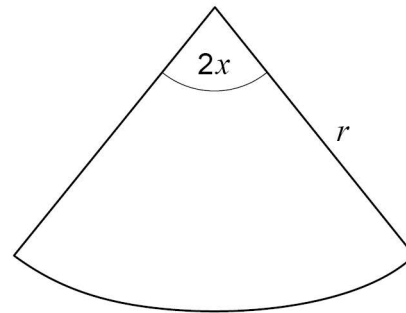
16

Here are two sectors from different circles.

Sector A



Sector B

Not drawn
accurately

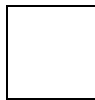
$$\text{Area of sector} = \pi r^2 \times \frac{\text{angle}}{360}$$

Which sector has the bigger area?

Tick a box.



Sector A



Sector B

Show working to support your answer.

$$\textcircled{1} \quad \text{Area} = \pi (1.5r)^2 \times \frac{x}{360} = \frac{x\pi r^2}{160} \quad [2 \text{ marks}]$$

$$\textcircled{2} \quad \text{Area} = \pi r^2 \times \frac{2x}{360} = \frac{x\pi r^2}{180}$$

$$\frac{x\pi r^2}{180} < \frac{x\pi r^2}{160}$$



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]

$$P: 200 \times 0.03 = 6$$

$$Q: 200 \times 0.035 = 7 \quad \text{--- biggest}$$

$$R: 200 \times 0.015 = 3$$

$$S: 200 \times 0.01 = 2 \quad \text{--- smallest}$$

$$7 - 2$$

Answer 5



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

[1 mark]

$$3x^2 - 9x = 4$$

$$3x^2 - 9x - 4 = 0$$

Answer $3x^2 - 9x - 4$

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

Give your answers to 2 decimal places.

[2 marks]

Quadratic Formula: $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a = 3$ $b = -9$ $c = -4$

$$\frac{-(-9) \pm \sqrt{(-9)^2 - 4 \times 3 \times -4}}{2 \times 3} = \frac{9 \pm \sqrt{129}}{6}$$

$$\oplus = 3.393 \dots$$

$$\ominus = -0.393 \dots$$

Answer 3.39 or -0.39

Turn over for the next question

Turn over ►

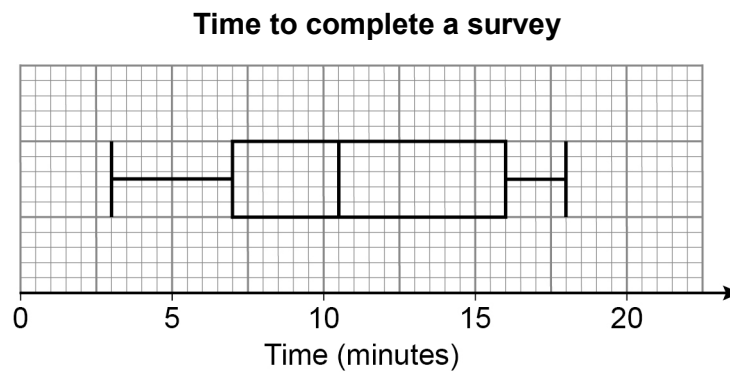


19

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.



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

[2 marks]

Criticism 1 Median is 11 not 10.5

Criticism 2 Upper Quartile is $7+8=15$
not 16



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]

$$d \propto v^2$$

$$d = kv^2$$

$$6 = k(20)^2$$

$$\frac{6}{400} = k = \frac{3}{200}$$

Answer $d = \frac{3}{200} v^2$

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

[2 marks]

$$d = \frac{3}{200} \times 30^2$$

$$= \frac{3 \times 900}{200} = \frac{27}{2}$$

Answer 13.5

Turn over for the next question

Turn over ►



21 Hanif makes green paint by mixing blue paint and yellow paint in the ratio
blue : yellow = 7 : 3

He buys blue paint in 50-litre containers, each costing £225

He buys yellow paint in 20-litre containers, each costing £80

He wants to

sell the green paint in 5-litre tins

make 40% profit on each tin.

How much should he sell each tin for?

Making 10l paint

[5 marks]

$$\text{Blue : } £225 \div 50 = £4.5 \text{ per l}$$

$$4.5 \times 7 = £31.5$$

$$\text{Yellow : } 80 \div 20 = £4 \text{ per l}$$

$$4 \times 3 = £12$$

$$\text{Total Cost: } 31.5 + 12 = £43.50 \text{ for } 10\text{l}$$

$$\div 2$$

$$£21.75 \text{ for } 5\text{l}$$

$$40\% \text{ profit} = \times 1.4$$

$$21.75 \times 1.4 =$$

Answer £ 30.45

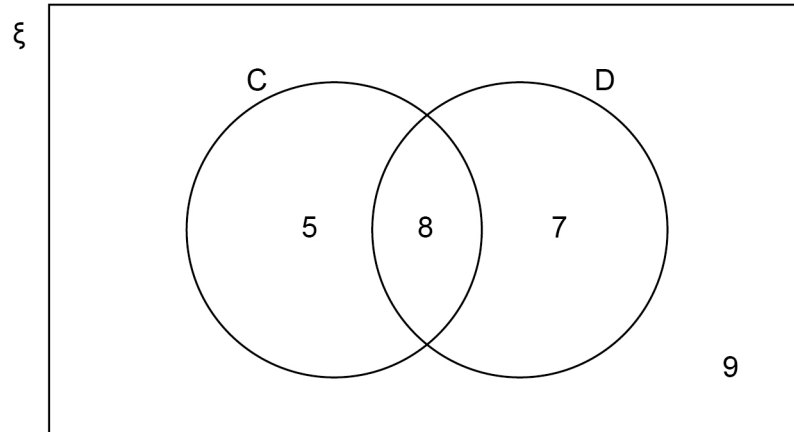


22

 $\xi = 29$ 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.

$$\frac{5+7}{29}$$

$$\frac{12}{29}$$

$$\frac{13}{29}$$

$$\frac{15}{29}$$

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

[1 mark]

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

Circle the probability that the student also owns a cat.

$$\frac{8 \text{ own a cat}}{15}$$

$$\frac{7}{15}$$

$$\frac{8}{15}$$

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

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

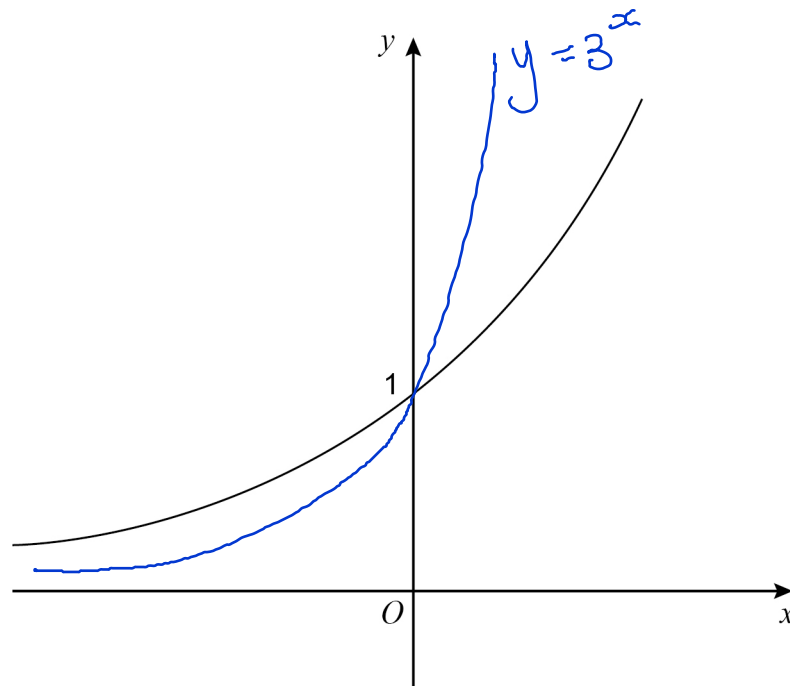
[1 mark]

7

Turn over ►



23

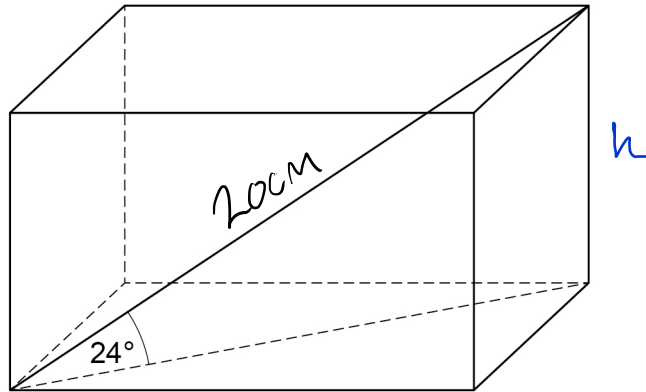
Here is a sketch of the curve $y = 2^x$ On the axes above, sketch the curve $y = 3^x$ **[2 marks]**

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]

$$\sin x = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 24 = \frac{h}{20}$$

$$20 \sin 24 = h$$

$$\text{Volume} = \text{cross sectional area} \times h$$

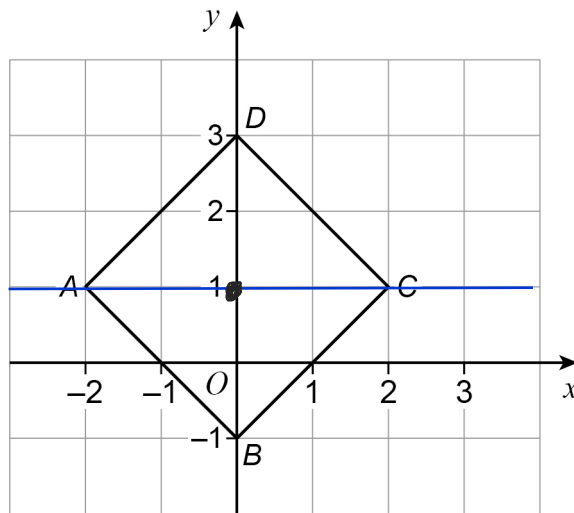
$$150 \times 20 \sin 24$$

$$= 3000 \sin 24$$

Answer 1220.2 cm^3



25

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

Describe fully the transformation.

[2 marks]

Reflection in line $y=1$



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 180° centre $(0, 1)$

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

Solve $gh(x) = 24$

[3 marks]

$$gh(x) = 16 - x^3$$

$$16 - x^3 = 24$$

$$-8 = x^3$$

$$-2 = x$$

$$x = -2$$

Turn over for the next question



27

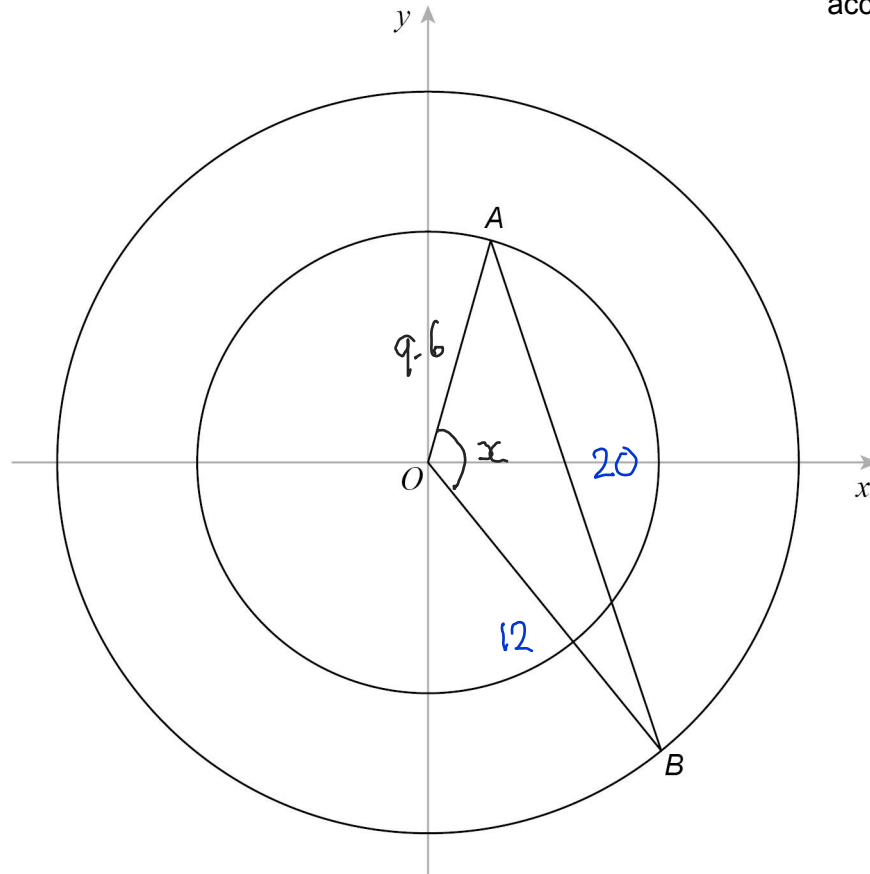
In this question, all lengths are in centimetres.

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 $x^2 + y^2 = 144$ $r = \sqrt{144} = 12$

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

$$\times \frac{12}{5} \left(4 : 5 \right) \times \frac{12}{5}$$

$$\rightarrow 9.6 : 12 \leftarrow$$



Work out the size of angle AOB .

[5 marks]

$$\text{COSine : } \cos A : \frac{b^2 + c^2 - a^2}{2bc}$$

$$b = 9.6$$

$$c = 12$$

$$a = 20$$

$$\cos A = \frac{9.6^2 + 12^2 - 20^2}{2 \times 12 \times 9.6}$$

$$\cos A = \frac{-32}{45}$$

$$A = \cos^{-1} \left(\frac{-32}{45} \right)$$

$$= 135.325\dots$$

Answer = 135 degrees

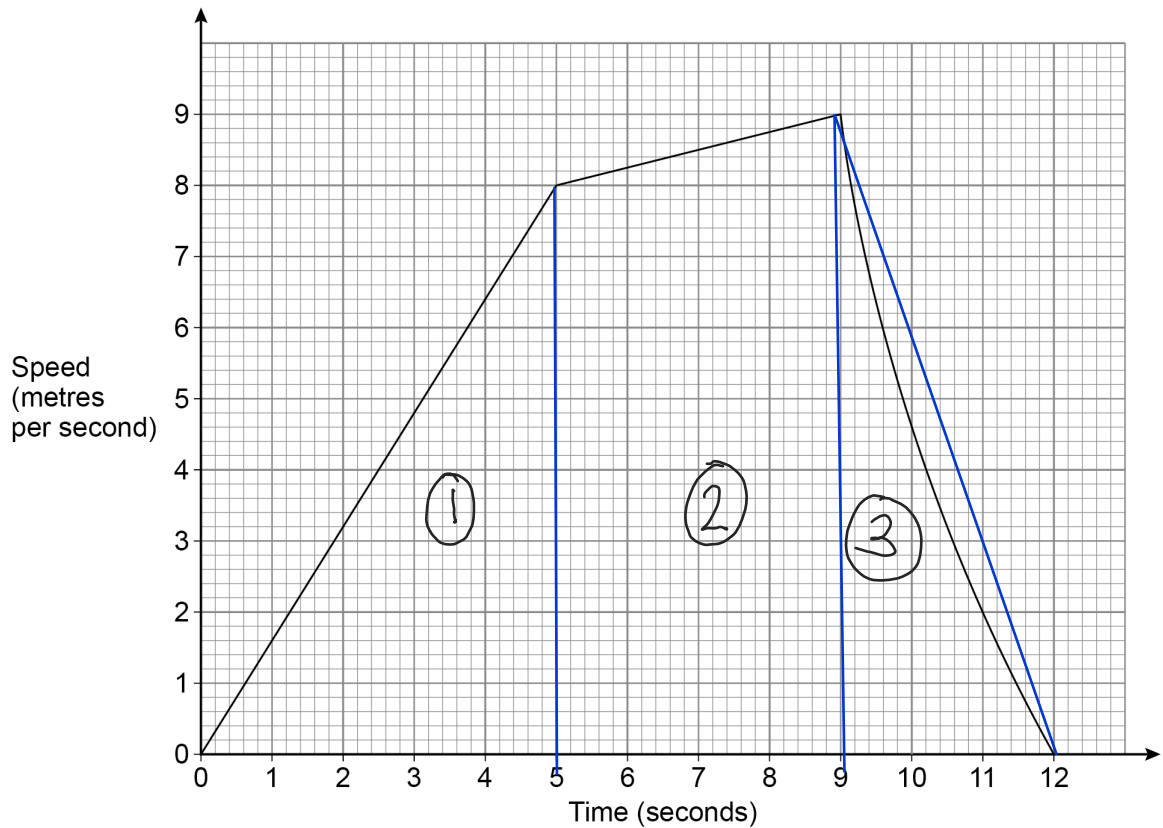
Turn over for the next question



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]

$$\text{Area of 1: } \frac{1}{2} \times 5 \times 8 = 20$$

$$\text{of 2: } \frac{1}{2} \times 4 (8+9) = 34$$

$$\text{of 3: } \frac{1}{2} \times 3 \times 9 = 13.5$$

/ overestimate

$$\text{Total} = 67.5$$

The distance is less than 67.5m
as Area 3 is an overestimate



- 28 (b) Work out his average acceleration for the first 9 seconds.
State the units of your answer.

[2 marks]

$$\text{Acc} = \frac{\text{speed}}{\text{Time}} = \frac{9 \text{ ms}^{-1}}{9 \text{ s}}$$

Answer $\underline{\hspace{2cm}} = 1 \text{ m/s}^2$

END OF QUESTIONS

There are no questions printed on this page

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outside the
box*

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2 8



1 9 6 G 8 3 0 0 / 3 H

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