Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname StemUp Model Solution

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.

Advice

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

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	

Do not write outside the box

Answer **all** questions in the spaces provided

1 Work out £1.50 as a fraction of 60p

Circle your answer.

[1 mark]

$\frac{2}{5}$ $\frac{1}{4}$ $\frac{4}{1}$ $\frac{5}{2}$

2 For a biased dice, $P(6) = \frac{3}{5}$

Circle the probability of two sixes when the dice is rolled twice.

[1 mark]

$\frac{6}{25}$ $\frac{6}{10}$ $\frac{9}{25}$ $\frac{9}{5}$

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

[1 mark]

5 45 75 150

Do not write outside the box

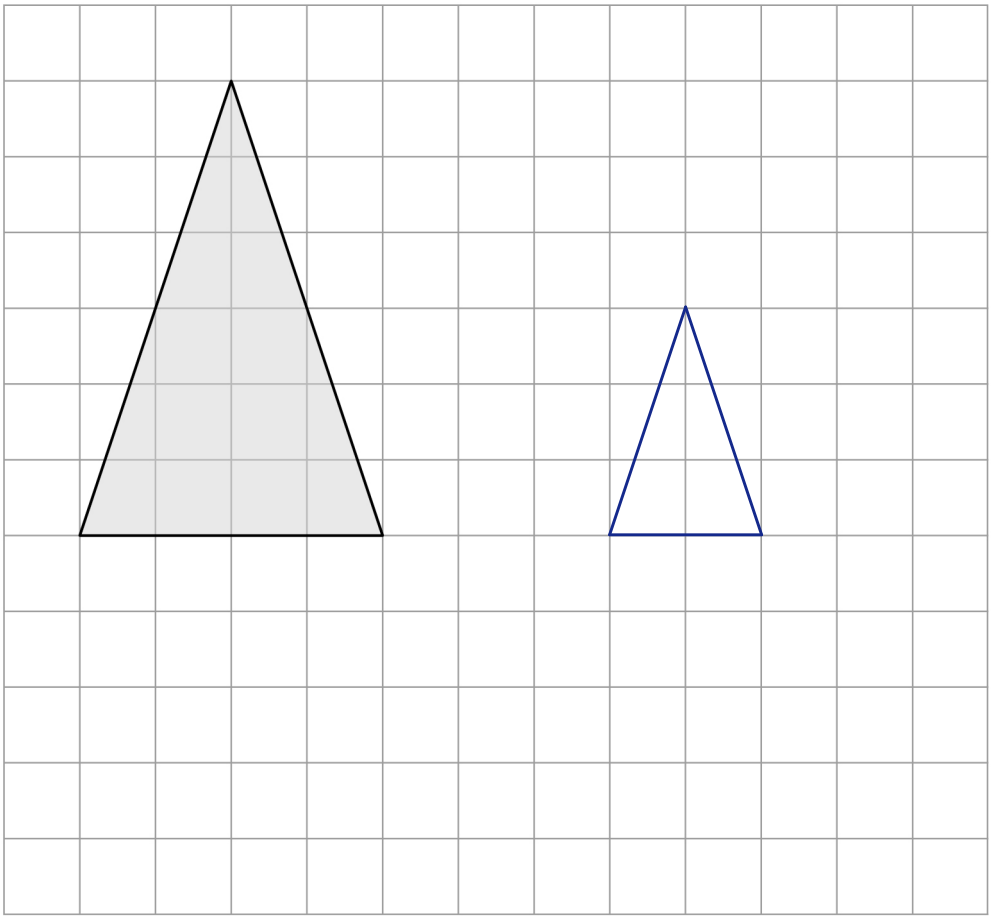
4 Circle the **two** roots of $(x - 5)(x + 3) = 0$

[1 mark]

–5 –3 3 5

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

[2 marks]



6

Turn over ►

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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]

Jon: £8.50 ≤ amount < £9.50, so max = £9.49

Ellie: £6.25 ≤ amount < £6.75, so max = £6.74

Max total = 9.49 + 6.74

= £16.23

Answer £ 16.23

Do not write outside the box

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

Density of J = 48 ÷ 8 = 6 g/cm^3 (same density for K)

Volume of K = 78 ÷ 6 = 13 cm^3

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

Circle your answer.

[1 mark]

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

7

Turn over ►

Do not write outside the box

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

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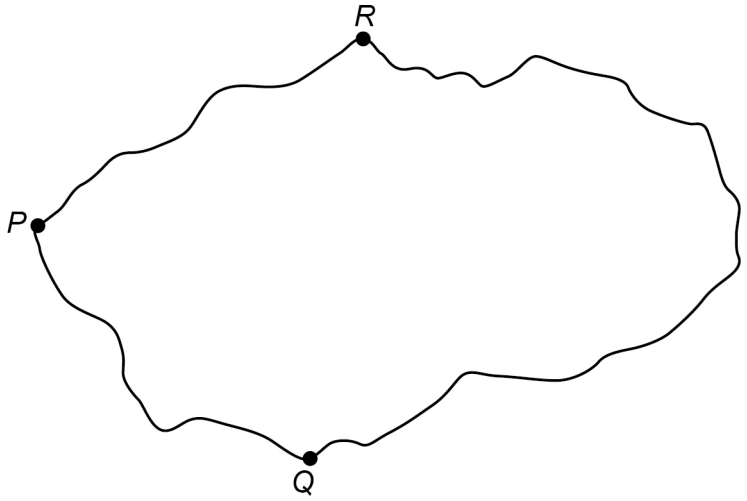


Work out the length of *PQ*.

[4 marks]

Let PQ = x

PR = x + 10 QR = 2(x + 10) = 2x + 20

x + (x + 10) + (2x + 20) = 170

4x + 30 = 170

4x = 140

x = 35

Answer 35 km

Do not write outside the box

10 Mia wants to borrow £6000 and repay it, with interest, after two years.

She sees two offers for loans.

Offer 1	**Offer 2**
Compound interest	Compound interest
3% per year	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]

Offer 1: 6000 × 1.03 = 6180, 6180 × 1.03 = £6365.40

Offer 2: 6000 × 1.01 = 6060, 6060 × 1.05 = £6363

£6365.40 ≠ £6363 (difference of £2.40)

No, she is not correct. She would pay back £2.40 less

with Offer 2, so the amounts are not the same.

Turn over for the next question

7

Do not write outside the box

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 of A = (200 + 160 + 104 + 100) ÷ 4

= 564 ÷ 4 = 141

Mean of B = 141 ÷ 3 × 8 = 47 × 8 = 376

Total of B = 376 × 5 = 1880

x = 1880 − (270 + 400 + 483 + 300)

x = 1880 − 1453 = 427

Answer 427

Do not write outside the box

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]

$y = 4x + c$

$23 = 4 \times 5 + c$

$23 = 20 + c$, so $c = 3$

$y = 4x + 3$

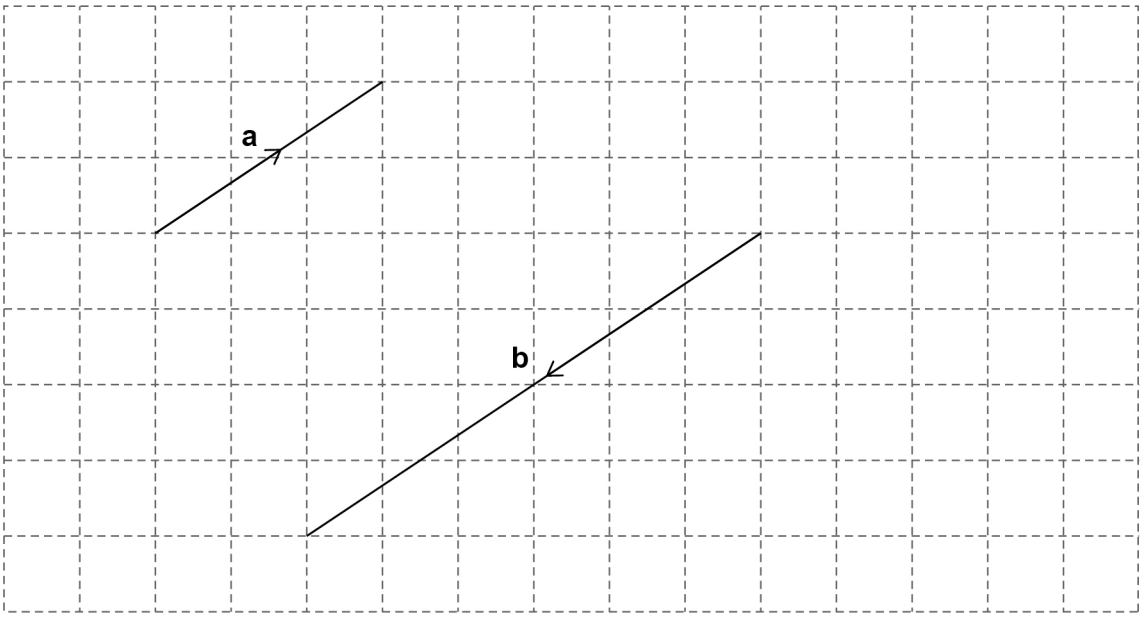
Answer $y = 4x + 3$

Turn over for the next question

7

Do not write outside the box

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



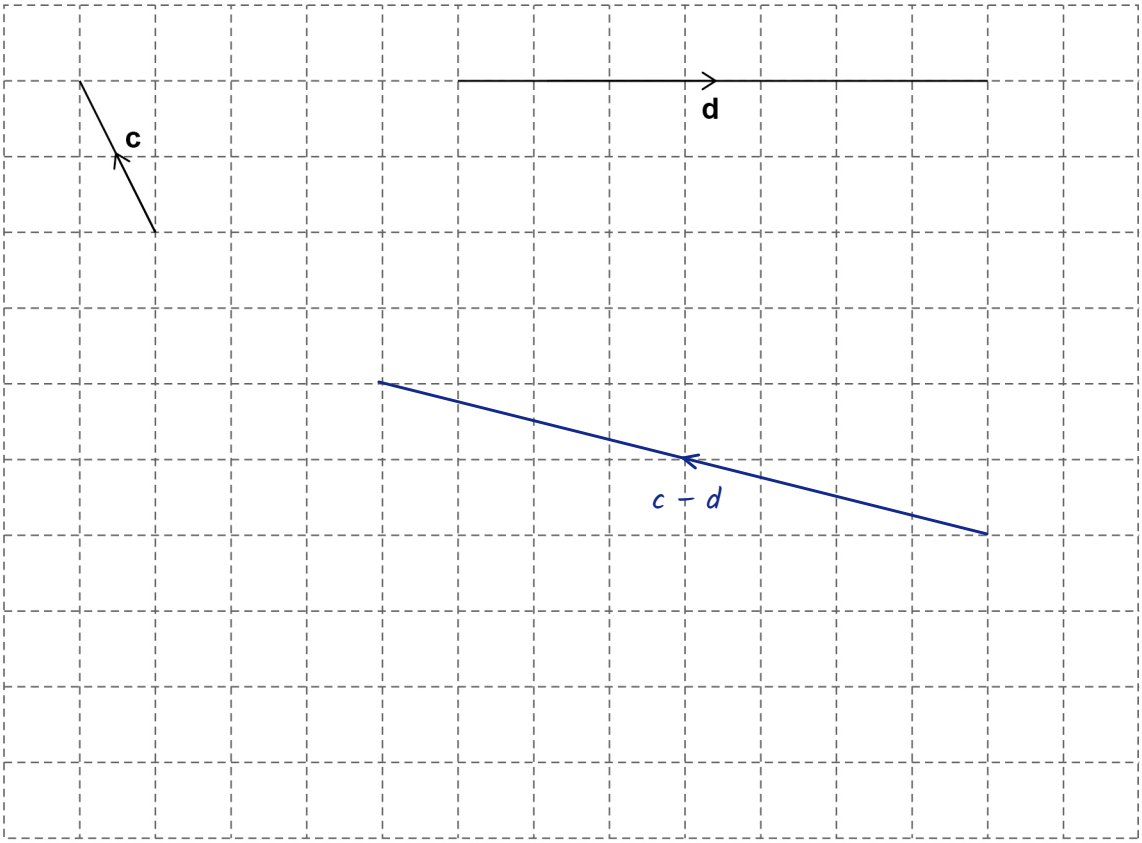
Write **b** in terms of **a**.

[1 mark]

b = $-2a$

Do not write outside the box

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

3

Do not write outside the box

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
- [ ] Class X has twice as many girls as class Y
- [x] Class X has a greater proportion of boys than class Y
- [ ] Class X has the same proportion of boys as class Y

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

[3 marks]

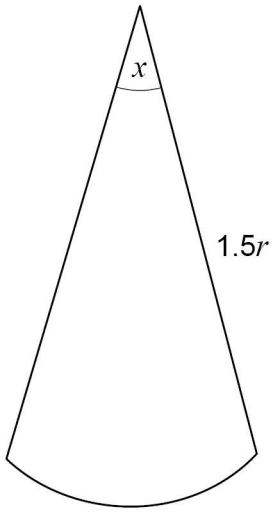
$= \frac{a^3b^2c}{ab^5cd} = \frac{a^2}{b^3d}$ $(a^3 \div a = a^2,\ b^2 \div b^5 = b^{-3},\ c \text{ cancels})$

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

Do not write outside the box

16 Here are two sectors from different circles.

Sector A



Sector B

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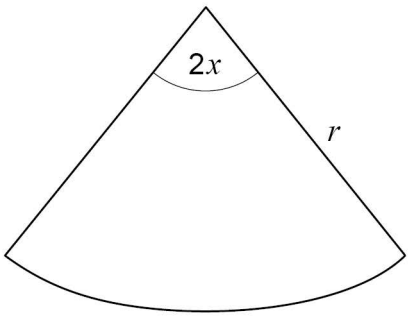


Which sector has the bigger area?

Tick a box.

☑ Sector A ☐ Sector B

Show working to support your answer.

[2 marks]

Area A $= \frac{x}{360} \times \pi \times (1.5r)^2 = \frac{2.25\pi r^2 x}{360}$

Area B $= \frac{2x}{360} \times \pi \times r^2 = \frac{2\pi r^2 x}{360}$

2.25 > 2, so Sector A has the bigger area.

6

Turn over ►

Do not write outside the box

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]

Number faulty = relative frequency × 200

P: 0.03 × 200 = 6 Q: 0.035 × 200 = 7

R: 0.015 × 200 = 3 S: 0.01 × 200 = 2

Range = 7 − 2

= 5

Answer 5

Do not write outside the box

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

[1 mark]

$3x^2 - 9x = 4$

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

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

Give your answers to 2 decimal places.

[2 marks]

$a = 3, \quad b = -9, \quad c = -4$

$x = \dfrac{-(-9) \pm \sqrt{((-9)^2 - 4 \times 3 \times (-4))}}{2 \times 3}$

$x = \dfrac{9 \pm \sqrt{129}}{6}$

$x = 3.3929...$ or $x = -0.3929...$

Answer 3.39 and −0.39

Turn over for the next question

6

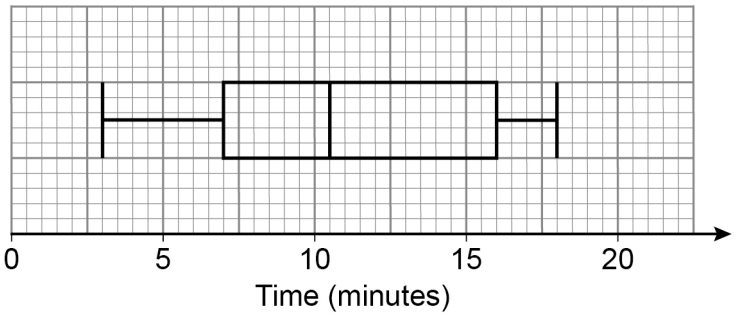
Do not write outside the box

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



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

[2 marks]

Criticism 1 *The median should be at 11 minutes, not 10.5 minutes.*

Criticism 2 *The upper quartile should be at 7 + 8 = 15 minutes, not 16.*

Do not write outside the box

20 d is directly proportional to the square of v.

$d = 6$ when $v = 20$

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

[3 marks]

$d = kv^2$

$6 = k \times 20^2$

$6 = 400k$

$k = 6 \div 400 = 0.015$

Answer $d = 0.015v^2$

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

[2 marks]

$d = 0.015 \times 30^2$

$d = 0.015 \times 900 = 13.5$

Answer 13.5

Turn over for the next question

7

Do not write outside the box

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?

[5 marks]

Blue: 225 ÷ 50 = £4.50 per litre

Yellow: 80 ÷ 20 = £4 per litre

10 litres of green = 7 litres blue + 3 litres yellow

Cost of 10 litres = 7 × 4.50 + 3 × 4 = 31.50 + 12 = £43.50

Cost of one 5-litre tin = 43.50 ÷ 2 = £21.75

Selling price = 21.75 × 1.4

= £30.45

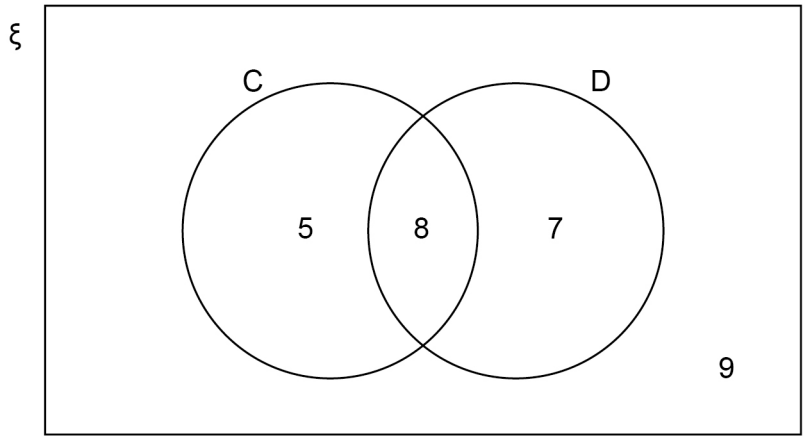
Answer £ 30.45

Do not write outside the box

22 ξ = 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.

[1 mark]

$\frac{12}{29}$ $\frac{13}{29}$ $\frac{15}{29}$ $\frac{20}{29}$

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

Circle the probability that the student also owns a cat.

[1 mark]

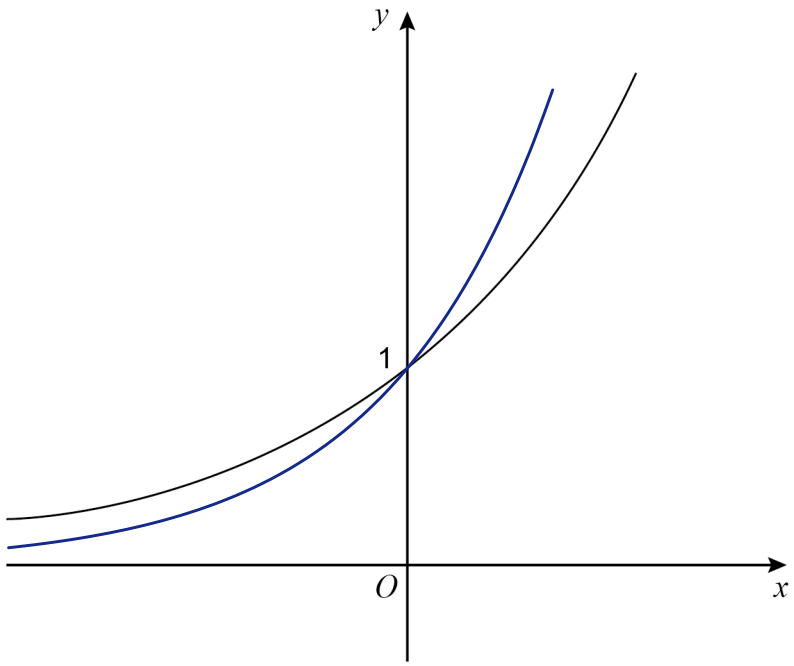
$\frac{7}{15}$ $\frac{8}{15}$ $\frac{7}{29}$ $\frac{8}{29}$

7

Turn over ►

Do not write outside the box

23 Here is a sketch of the curve $y = 2^x$



On the axes above, sketch the curve $y = 3^x$

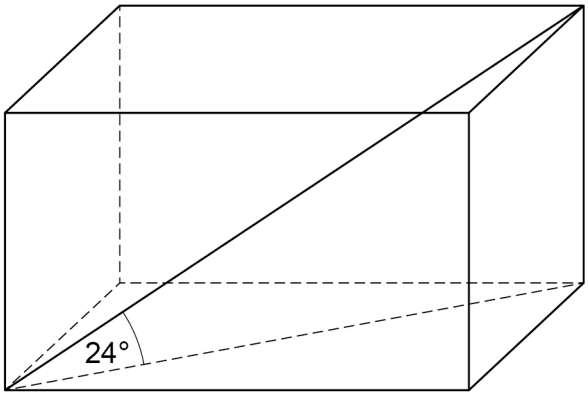
[2 marks]

Do not write outside the box

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]

Let h = height of the cuboid

sin 24° = h ÷ 20

h = 20 × sin 24° = 8.1347...

Volume = base area × height = 150 × 8.1347...

= 1220.209...

Answer 1220.2 cm^3

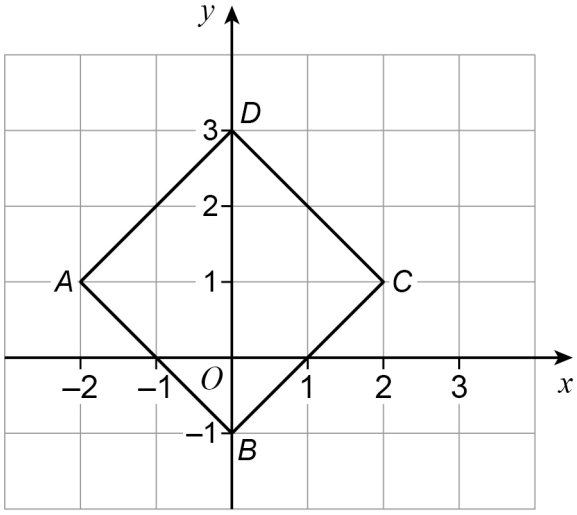
5

Turn over ►

Do not write outside the box

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 the line y = 1

Do not write outside the box

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 of 180° about the centre (0, 1)

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

Solve $gh(x) = 24$

[3 marks]

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

$16 - x^3 = 24$

$x^3 = 16 - 24 = -8$

$x = \sqrt[3]{(-8)}$

$x = -2$

$x =$ -2

Turn over for the next question

8

Do not write outside the box

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

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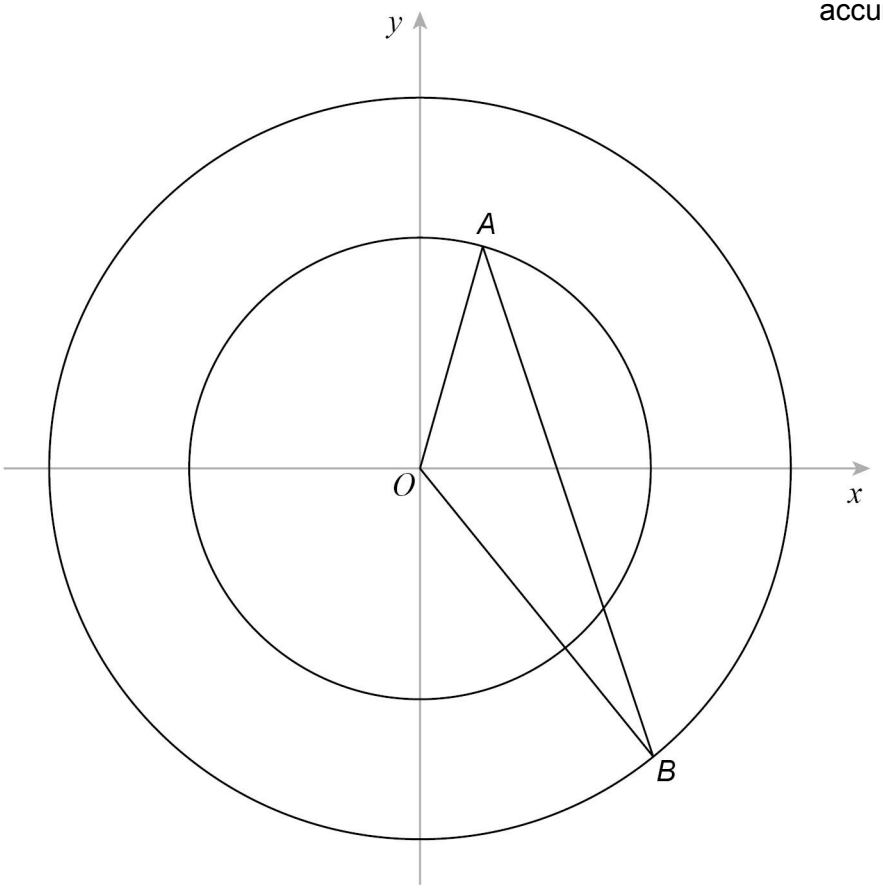


The equation of the larger circle is $x^2 + y^2 = 144$

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

Do not write outside the box

Work out the size of angle AOB.

[5 marks]

$x^2 + y^2 = 144$, so radius of larger circle $OB = \sqrt{144} = 12$

Radius of smaller circle $OA = 12 \div 5 \times 4 = 9.6$

Cosine rule:

$\cos AOB = \dfrac{12^2 + 9.6^2 - 20^2}{2 \times 12 \times 9.6} = \dfrac{144 + 92.16 - 400}{230.4}$

$\cos AOB = \dfrac{-163.84}{230.4} = -0.7111...$

$AOB = \cos^{-1}(-0.7111...) = 135.325...$

Answer 135.3 degrees

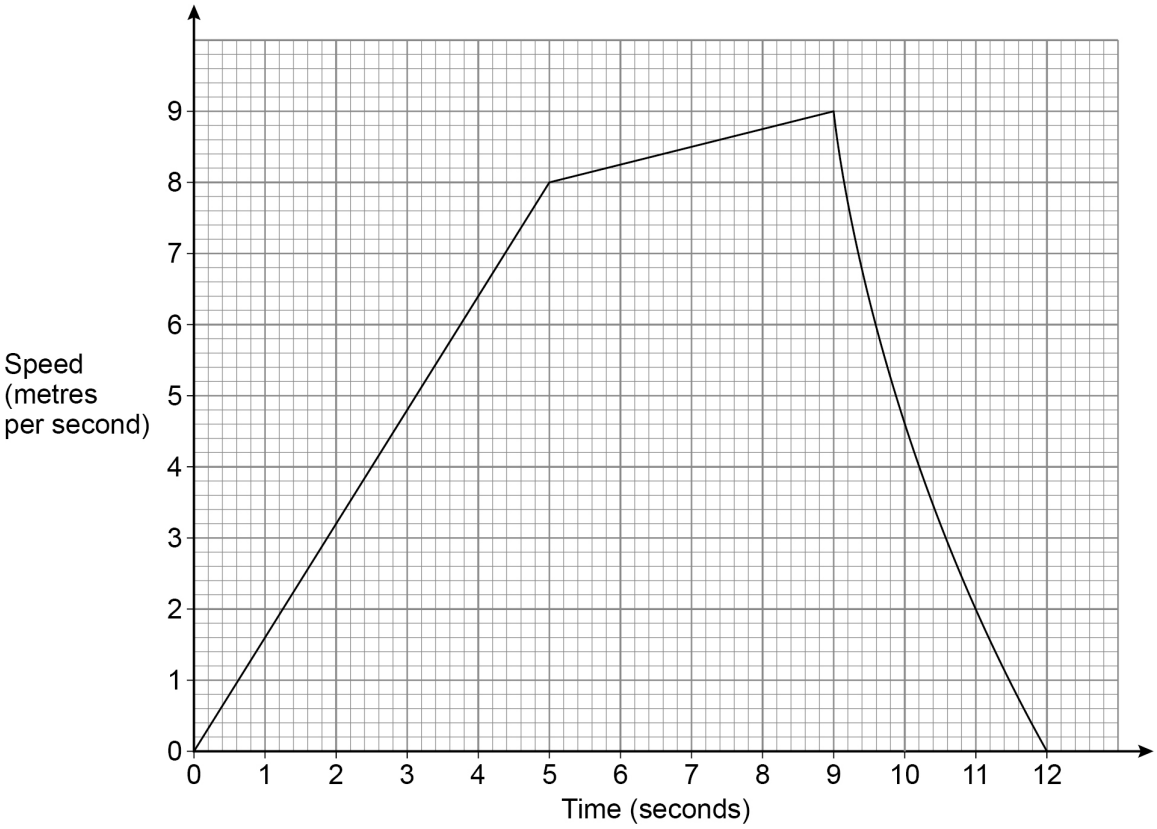
Turn over for the next question

5

Do not write outside the box

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]

Distance = area under the graph

0 to 5 s (triangle): ½ × 5 × 8 = 20

5 to 9 s (trapezium): ½ × (8 + 9) × 4 = 34

9 to 12 s (two trapezia and a triangle, speeds 9, 4.6, 2, 0):

½ × (9 + 4.6) × 1 + ½ × (4.6 + 2) × 1 + ½ × 1 × 2

= 6.8 + 3.3 + 1 = 11.1

Total ≈ 20 + 34 + 11.1 = 65.1 m

The curve bends below the straight edges, so the real distance is

less than 65.1 m, and 65.1 < 67.5, so distance < 67.5 metres.

Do not write outside the box

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

State the units of your answer.

[2 marks]

Acceleration = change in speed ÷ time = (9 − 0) ÷ 9 = 1

Answer 1 m/s^2

END OF QUESTIONS

6

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