AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

# GCSE MATHEMATICS

H

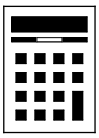
Higher Tier Paper 3 Calculator

Monday 7 November 2022 Morning Time allowed: 1 hour 30 minutes

**Materials**

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



**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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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 | |
| 28–29 | |
| **TOTAL** | |

Answer **all** questions in the spaces provided.

*Do not write outside the box*

**1** $2^x = 32$

Circle the value of $x$.

**[1 mark]**

4 5 6 7

**2** What is $1.8 \times 10^{-4}$ as an ordinary number?

Circle your answer.

**[1 mark]**

−180 000 −18 000 0.000 18 0.000 018

*Do not write outside the box*

**3** Expand $6x^2(x^3 + 2)$

Circle your answer.

**[1 mark]**

$6x^5 + 2$ $6x^6 + 2$ $6x^5 + 12x^2$ $6x^6 + 12x^2$

**4** $30 < x < 300$

$x$ is 200% of $y$

Circle the correct inequality.

**[1 mark]**

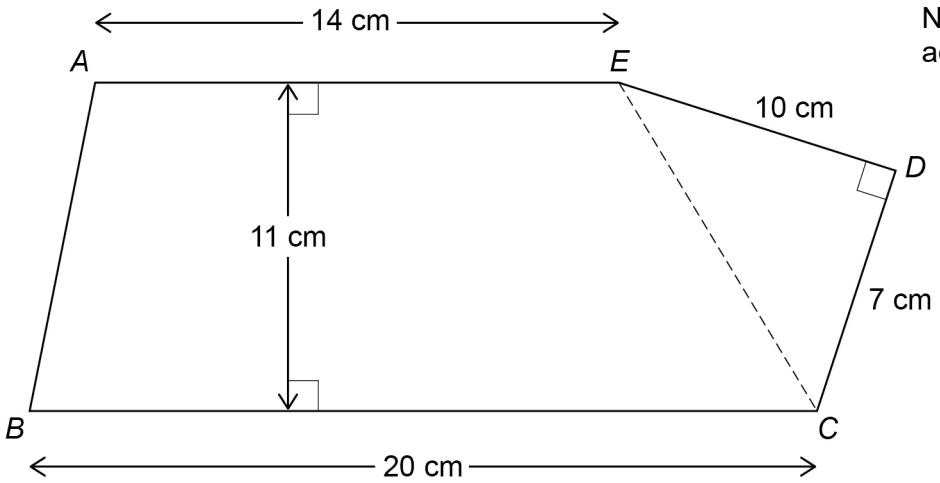
$10 < y < 100$ $15 < y < 150$ $60 < y < 600$ $90 < y < 900$

**Turn over for the next question**

4

Do not write outside the box

**5** *ABCDE* is a pentagon.

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Work out the area of the pentagon.

**[3 marks]**

Area of trapezium : $\frac{1}{2} \times (14+20) \times 11 = 187 \text{ cm}^2$ (1)

Area of triangle : $\frac{1}{2} \times 10 \times 7 = 35 \text{ cm}^2$ (1)

Total area : $187 + 35 = 222 \text{ cm}^2$ (1)

Answer 222 $\text{cm}^2$

Do not write outside the box

**6** Joe, Kim and Lisa each have an amount of money.

Joe has £72

Joe's amount : Kim's amount = 6 : 5

Lisa's amount is $1\frac{1}{2}$ times Joe's amount.

Show that, in total, they have **less** than £250

**[3 marks]**

Kim's amount : $\frac{£72}{6} \times 5 = £60$ (1)

Lisa's amount : $1.5 \times £72 = £108$ (1)

Total amount : £72 + £60 + £108

= £240 (1)

**Turn over for the next question**

6

*Do not write outside the box*

**7 (a)** Here is the rule for a sequence.

> After the first two terms, each term is the sum of the previous two terms

The 1st term is 33

The 2nd term is $x$

The 4th term is 73

Work out the value of $x$.

**[3 marks]**

3rd term = $33 + x$ (1)

4th term = $73 = x + 33 + x$ (1)

$73 = 2x + 33$

$2x = 73 - 33$

$2x = 40$

$x = \frac{40}{2} = 20$ (1)

$x =$ 20

**7 (b)** An expression for the $n$th term of a different sequence is $n - n^2$

Ruth says,

"All the terms will be negative because $n^2$ is always greater than $n$."

Is she correct?

Tick a box.

☐ Yes ☑ No

Give a reason for your answer. (1)

**[1 mark]**

The first term is zero.

*Do not write outside the box*

**8** Here is some information about the members of clubs A and B.

| | Number of members | Mean height of members |
|---|---|---|
| **Club A** | 24 | 1.8 m |
| **Club B** | 20 | 1.92 m |

Work out $\dfrac{\text{total height of the members of club A}}{\text{total height of the members of club B}}$

Give your answer as a decimal.

**[2 marks]**

Club A : $24 \times 1.8\ m = 43.2\ m$ (1)

Club B : $20 \times 1.92\ m = 38.4\ m$

$$\frac{43.2}{38.4} = 1.125$$

Answer 1.125 (1)

**Turn over for the next question**

6

Do not write outside the box

**9** *P* and *Q* are points.

The $x$-coordinate of *Q* is 4 **more** than the $x$-coordinate of *P*.

The $y$-coordinate of *Q* is 5 **less** than the $y$-coordinate of *P*.

Work out the gradient of the straight line through *P* and *Q*.

**[2 marks]**

let P(0,0) , then Q(4,-5)

gradient : $\frac{-5-0}{4-0} = -\frac{5}{4}$

Answer $-\frac{5}{4}$ (2)

*Do not write outside the box*

**10** Here are the results after 250 spins of a coin.

| | |
|---|---|
| **Heads** | 128 |
| **Tails** | 122 |

The coin is spun an extra 50 times.

After all 300 spins, the relative frequency of Heads is 0.49

For the **extra 50 spins**, work out number of Heads : number of Tails

**[3 marks]**

After 300 spins :

(Heads) $0.49 \times 300 = 147$ (1)

(Tails) $0.51 \times 300 = 153$

For extra 50 spins: (Heads) : $147 - 128 = 19$ (1)

(Tails) : $153 - 122 = 31$

Answer 19 : 31 (1)

**Turn over for the next question**

5

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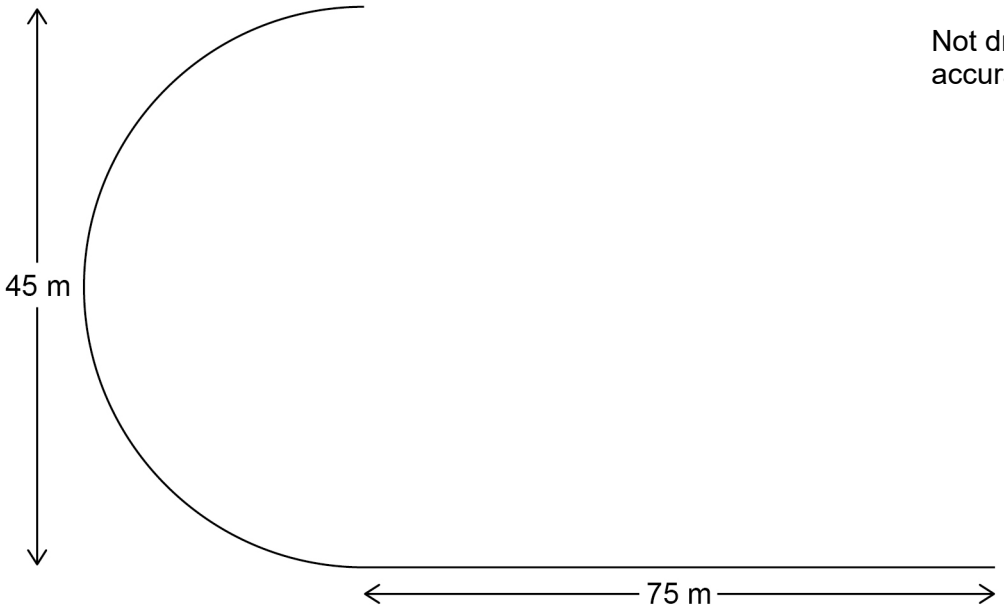
**11** Part of a running track is the arc of a semicircle joined to a straight line.

The semicircle has diameter 45 metres.

The straight line has length 75 metres.

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Abby runs once along this part of the track in 18 seconds.

Work out her average speed.

Give your answer to 2 significant figures.

**[4 marks]**

Arc length = $\frac{1}{2} \times \pi \times 45 = 22.5\pi$ (1)

Total length = $22.5\pi + 75$

$= 145.695$ (1)

Average speed = $\frac{145.695}{18}$ (1) $= 8.09$

$= 8.1$ (1)

Answer 8.1 m/s

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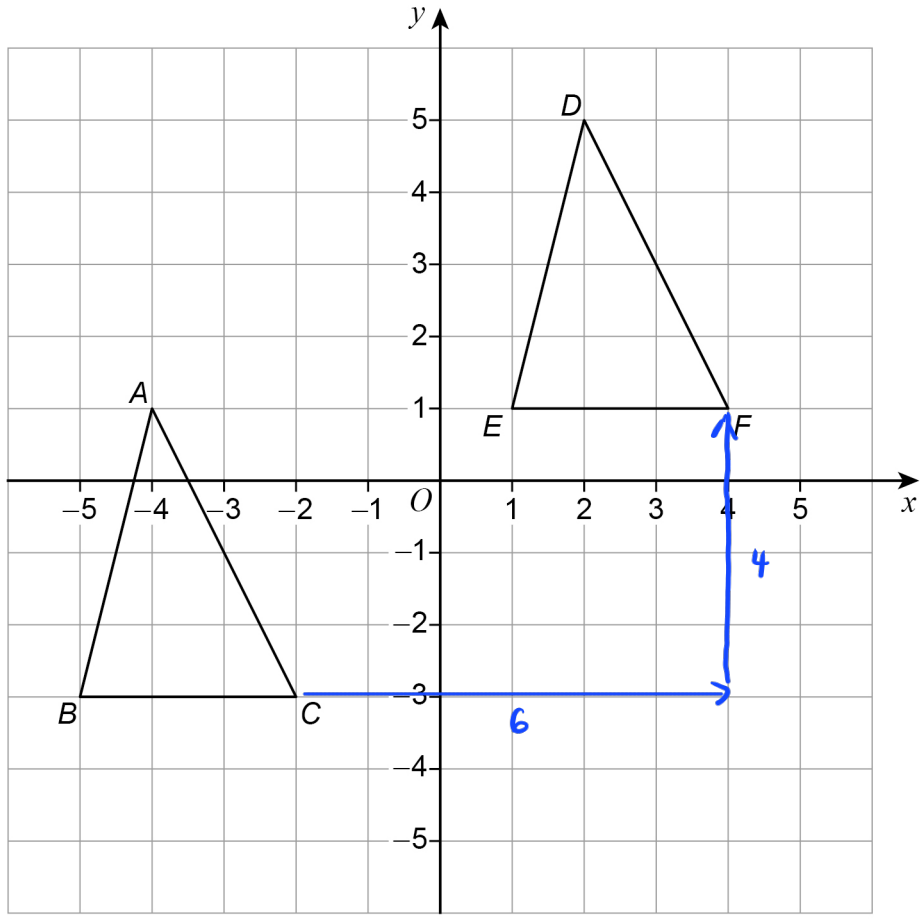
**12** Triangles *ABC* and *DEF* are shown on a grid.




Describe a single transformation that shows the triangles are congruent.

**[2 marks]**

Translation of vector $\begin{pmatrix} 6 \\ 4 \end{pmatrix}$

(1) (1)

6

Turn over ►

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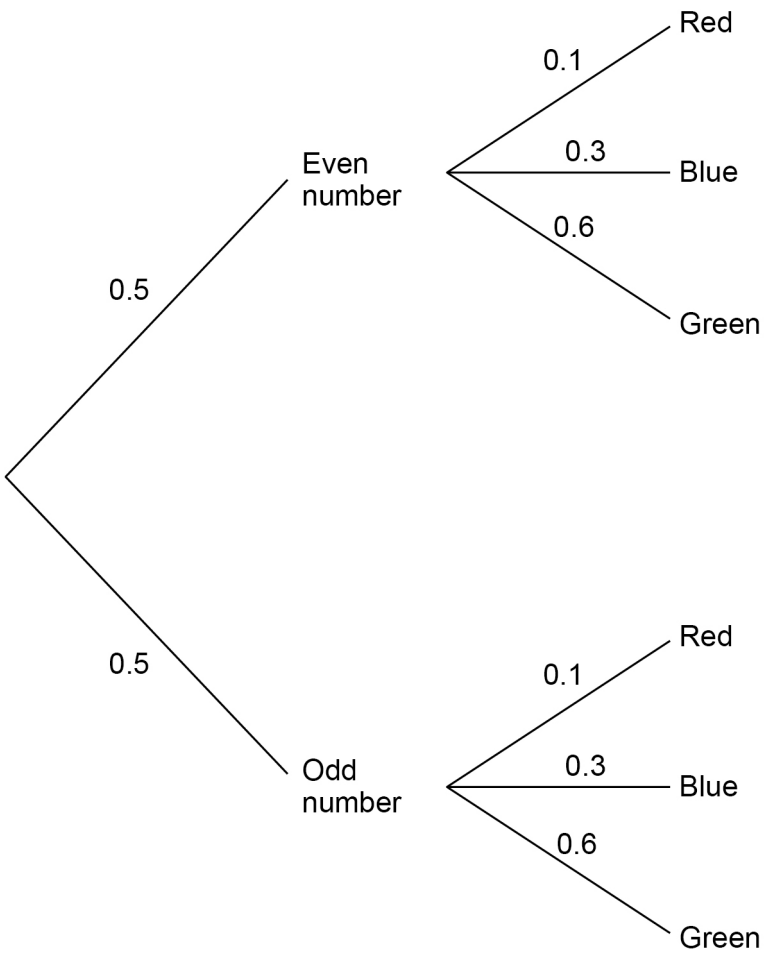
**13** A fair, ordinary dice is rolled and a counter is taken at random from a bag.

The tree diagram shows the probabilities.



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**13 (a)** How do the probabilities show that **all** the counters in the bag are red, blue or green?

**[1 mark]**

0.1 + 0.3 + 0.6 = 1 (1)

**13 (b)** Circle the probability that the counter is red **or** blue.

0.1 + 0.3 = 0.4

**[1 mark]**

0.0009 | 0.8 | 0.03 | (0.4) (1)

**13 (c)** Circle the probability that the dice lands on an even number **and** the counter is blue.

0.5 × 0.3 = 0.15

**[1 mark]**

(0.15) (1) | 0.3 | 0.35 | 0.8

**Turn over for the next question**

3

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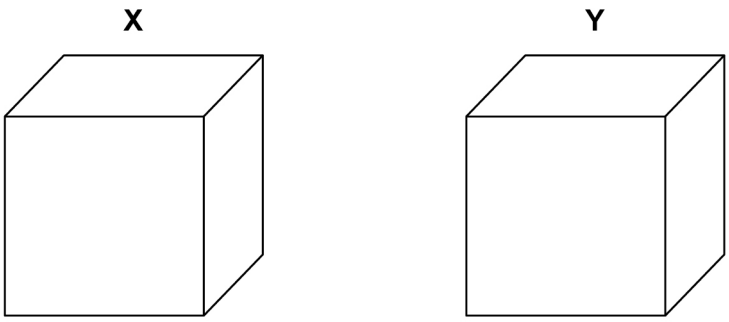
**14** Here are two solid cubes, X and Y.

The mass of X is 10.976 kg

The area of **each face** of X is 784 $cm^2$




mass 10.976 kg

**14 (a)** Zayan wants to know the density of Y.

He assumes that Y is identical to X.

What density should he get for Y?

Give your answer in **grams per cubic centimetre**.

**[4 marks]**

length of one side = $\sqrt{784}$

= 28 (1)

volume of X = $28^3$ = 21952 $cm^3$ (1)

mass of X = 10.976 x 1000 = 10976 g

density = $\frac{10976}{21952}$ (1) = 0.5 $gcm^{-3}$ (1)

Answer 0.5 g/$cm^3$

*Do not write outside the box*

**14 (b)** In fact,

the mass of Y is less than the mass of X

the area of each face of Y is greater than the area of each face of X.

What does this mean about the actual density of Y?

Tick **one** box.

**[1 mark]**

- [✓] (1) It is less than the answer to part (a)
- [ ] It is equal to the answer to part (a)
- [ ] It is greater than the answer to part (a)
- [ ] It is not possible to tell

**Turn over for the next question**

5

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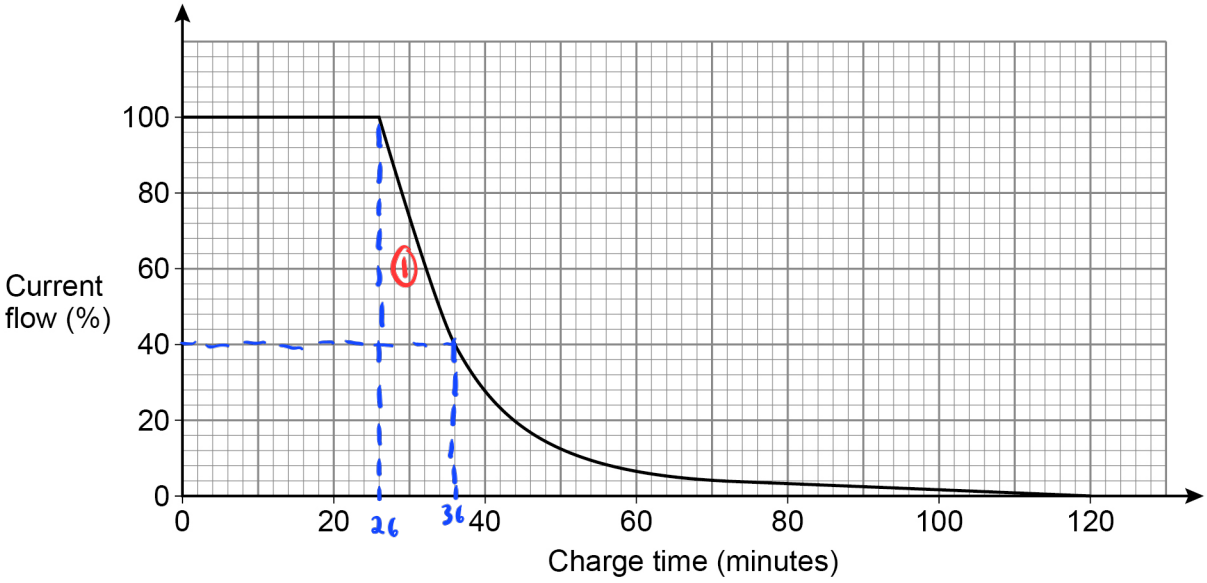
**15** A mobile phone takes 2 hours to charge from empty.

When the phone is being charged, the current flow into the phone

- starts at full current flow (100%)
- continues at full current flow for a period of time
- gradually decreases until the phone is fully charged.

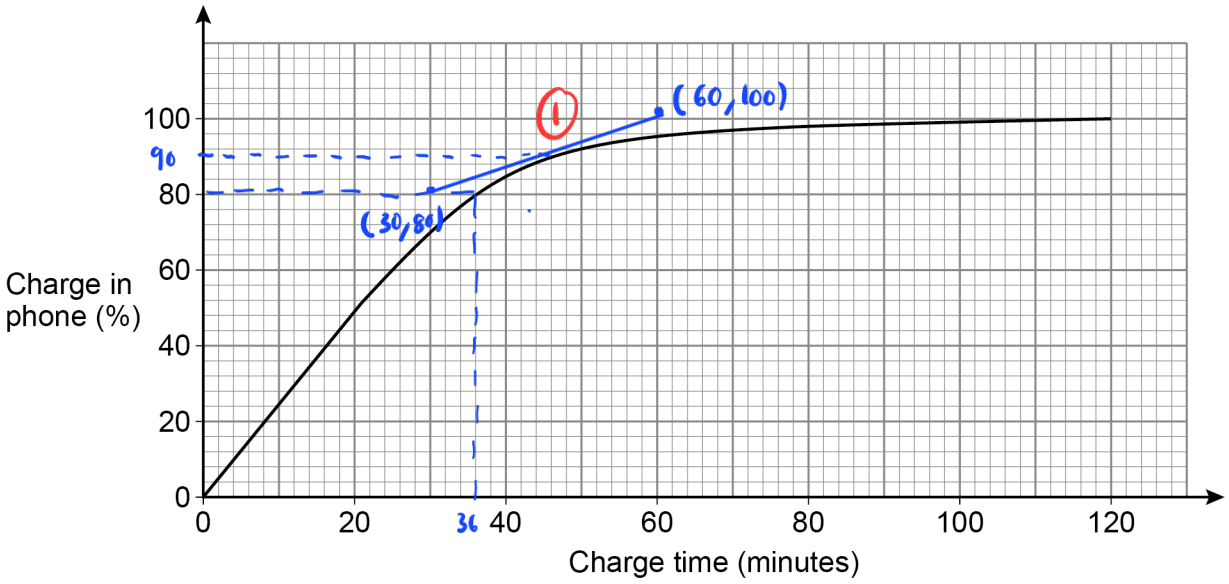
This is shown on **Graph A** below.

**Graph A**




**Graph B** shows the percentage charge in the phone when charging from empty.

**Graph B**



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Megan's phone is empty of charge.

She starts to charge her phone at 10.00 am

**15 (a)** Using **Graph A**,

estimate the time when the current flow starts to decrease.

**[2 marks]**

10 am + 26 mins = 10.26 am

Answer 10.26 (1) am

**15 (b)** Using **Graph A and Graph B**,

estimate the percentage charge in the phone when the current flow is 40%

**[1 mark]**

Answer 80 (1) %

**15 (c)** Using **Graph B**,

estimate the rate of increase in the percentage charge when the phone has 90% charge.

**[2 marks]**

$\frac{100 - 80}{60 - 30} = \frac{20}{30} \times 100\% = 66.67\%$

Answer 66.7 (1) percent per minute

5

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**16** $H$ is inversely proportional to the cube root of $L$.

$H = 7$ when $L = 64$

**16 (a)** Work out an equation connecting $H$ and $L$.

**[3 marks]**

$H = \frac{k}{\sqrt[3]{L}}$ (1)

$7 = \frac{k}{\sqrt[3]{64}}$

$7 = \frac{k}{4}$

$k = 28$ (1)

Answer $H = \frac{28}{\sqrt[3]{L}}$ (1)

**16 (b)** Work out the value of $H$ when $L = 2744$

**[2 marks]**

$H = \frac{28}{\sqrt[3]{2744}}$ (1)

$H = \frac{28}{14} = 2$ (1)

$H =$ 2

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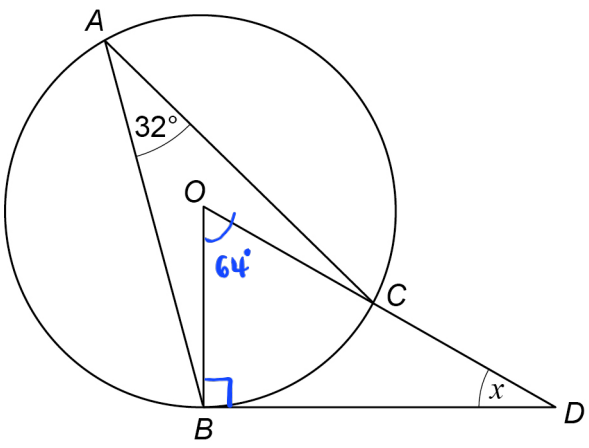
**17** *A*, *B* and *C* are points on a circle, centre *O*.

*BD* is a tangent to the circle.

*OCD* is a straight line.

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Work out the size of angle $x$.

**[3 marks]**

BOD = 32 x 2 = 64° (1)

x + 64° + 90° = 180° (1)

x = 180° − 90° − 64°

= 26° (1)

$x =$ 26 degrees

8

*Do not write outside the box*

**18** Rearrange $9m + 4(2m - 1) = p^2 + pm$ to make $m$ the subject.

**[4 marks]**

$9m + 8m - 4$ (1) $= p^2 + pm$

$9m + 8m - pm = p^2 + 4$

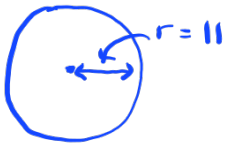
$17m - pm = p^2 + 4$ (1)

$m(17 - p) = p^2 + 4$ (1)

$m = \frac{p^2 + 4}{17 - p}$ (1)

Answer $m = \frac{p^2 + 4}{17 - p}$

**19** A circle has centre (0, 0) and passes through (0, 11)




Write down the equation of the circle.

**[1 mark]**

Answer $x^2 + y^2 = 11^2$ (1)

*Do not write outside the box*

**20** There should be a train leaving a station every hour from 7 am

No trains leave early.

P(the **first train** leaves on time) = 0.9

For all the **other trains**,

if the previous train did leave on time, P(this train leaves on time) = 0.8

if the previous train did **not** leave on time, P(this train leaves on time) = 0.65

**20 (a)** Work out P(the first three trains leave on time)

**[2 marks]**

$0.9 \times 0.8 \times 0.8 = 0.576$ (1) (1)

Answer 0.576

**20 (b)** The 2 pm train does **not** leave on time.

Work out P(exactly one of the next two trains does **not** leave on time)

**[3 marks]**

(late, on time) $= 0.35 \times 0.65 = 0.2275$ (1)

(on time, late) $= 0.65 \times 0.2 = 0.13$ (1)

$P = 0.2275 + 0.13$

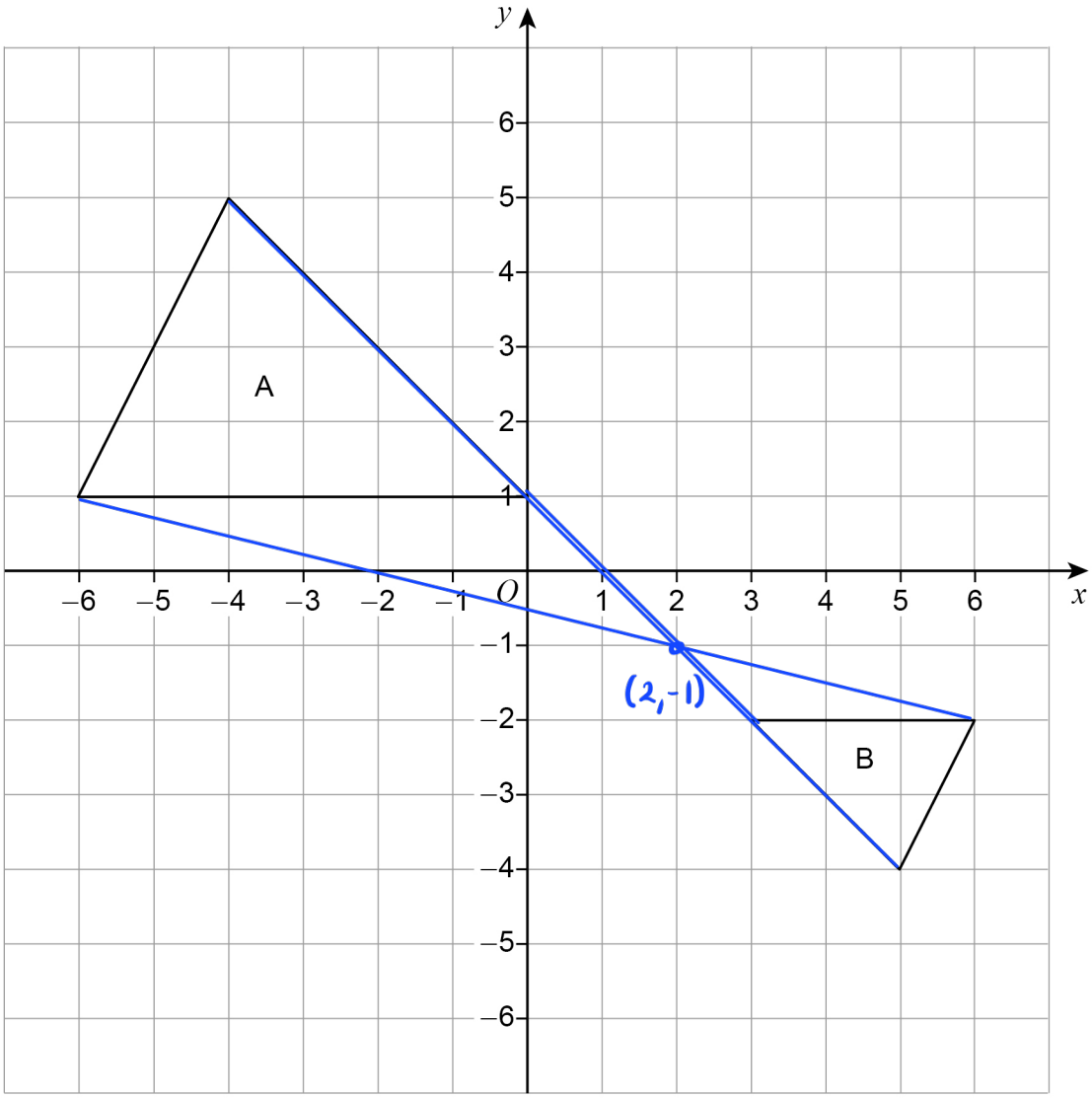
$= 0.3575$ (1)

Answer 0.3575

10

*Do not write outside the box*

**21** Shape A is enlarged to shape B.




**21 (a)** Circle the scale factor of the enlargement.

**[1 mark]**

$-\frac{1}{2}$ (1) $\quad -2 \quad \frac{1}{2} \quad 2$

**21 (b)** Write down the coordinates of the centre of enlargement.

**[1 mark]**

(1)

Answer ( 2 , -1 )

**22** Simplify fully $\frac{2}{x+1} + \frac{7-5x}{3} + 4x$

Give your answer as a single fraction.

**[4 marks]**

*Do not write outside the box*

① Solving numerator part (1)

$2(3) + (7-5x)(x+1) + 4x(x+1)(3)$ (1)

$= 6 + 7x + 7 - 5x^2 - 5x + 12x^2 + 12x$ (1)

$= -5x^2 + 12x^2 + 7x - 5x + 12x + 6 + 7$

$= 7x^2 + 14x + 13$

② Add solved numerator to the denominator $\frac{7x^2 + 14x + 13}{3(x+1)}$ (1)

Answer $\frac{7x^2 + 14x + 13}{3(x+1)}$

6

*Do not write outside the box*

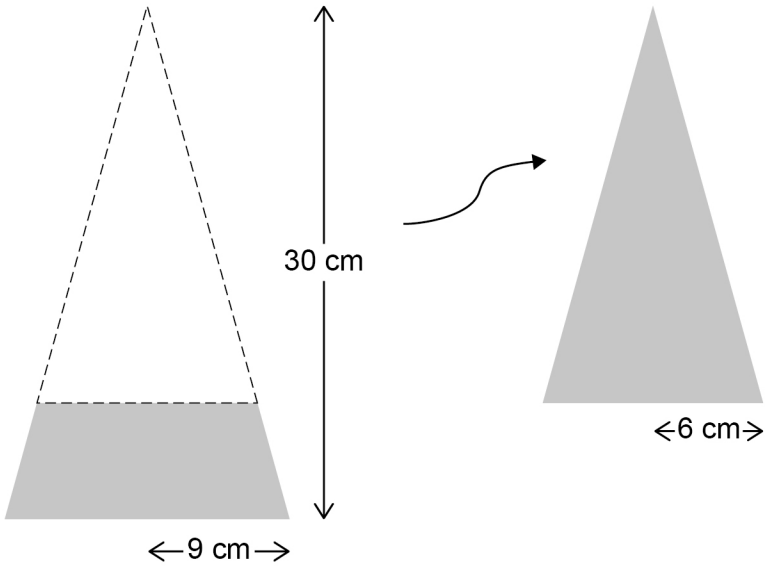
**23** Alec makes a bowl for dog food from a solid wooden cone.

The sketches show how the bowl is made.

The cone has radius 9 cm and perpendicular height 30 cm

A smaller cone, with radius 6 cm, is removed.

Not drawn accurately




Volume of a cone $= \frac{1}{3}\pi r^2 h$

where $r$ is the radius and $h$ is the perpendicular height

A hemisphere with radius 6 cm is then removed.

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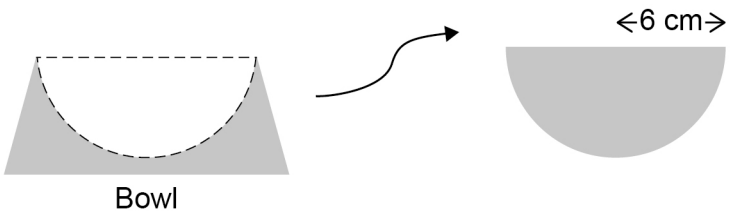


Volume of a hemisphere $= \frac{2}{3}\pi r^3$ where $r$ is the radius

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Work out the volume of the remaining wood that forms the bowl.

**[5 marks]**

Volume of large cone : $\frac{1}{3} \times \pi \times 9^2 \times 30 = 810\pi$ (1)

Volume of small cone : $\frac{1}{3} \times \pi \times 6^2 \times \left(\frac{30}{9} \times 6\right)$ (1)

$\frac{1}{3} \times \pi \times 36 \times 20 = 240\pi$

Volume of remaining cone : $810\pi - 240\pi = 570\pi$ (1)

Volume of hemisphere = $\frac{2}{3} \times \pi \times 6^3 = 144\pi$ (1)

Volume of bowl : $570\pi - 144\pi$

$= 426\pi$ (1)

Answer $426\pi$ $cm^3$

5

*Do not write outside the box*

**24** On the same day, Kate buys

a car for £14 000

and

a painting for £5000

The value of the car decreases by 35% in the first year, and then by 10% each year.

The value of the painting increases by 4% each year.

Show that the painting becomes worth more than the car during the fifth year.

**[5 marks]**

(1)

Car : First year : $0.65 \times 14000 = 9100$ (1)

The rest $= 9100 \times 0.9^4 = 5970.51$

(1)

Painting : $5000 \times 1.04^5 = 6083.26$ (1)

(1)

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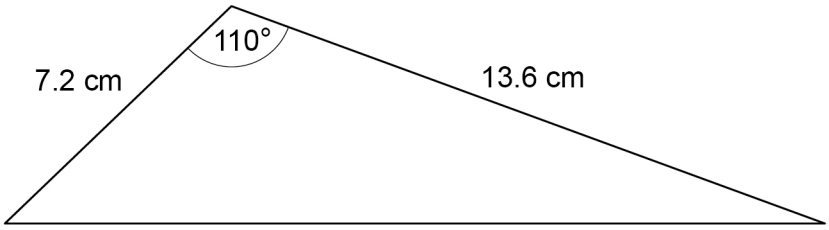
**25** Two sides of a triangle are measured to 1 decimal place.

The angle between the sides is measured to the nearest degree.

Not drawn accurately




Work out the upper bound for the area of the triangle.

You **must** show your working.

**[4 marks]**

UB : 7.25 , 110.5 , 13.65 (1)

LB : 7.15 , 109.5 , 13.55

(1)

$\text{Area}_{UB} = \frac{1}{2} \times 7.25 \times 13.65 \times \sin 109.5$ (1)

$= 46.64...$ (1)

Answer 46.64 $cm^2$

**Turn over for the next question**

9

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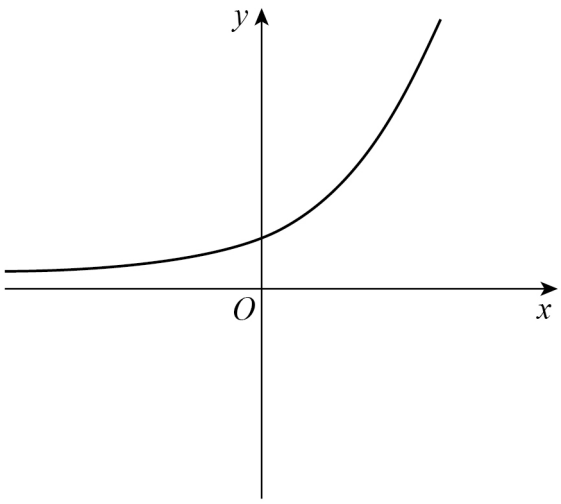
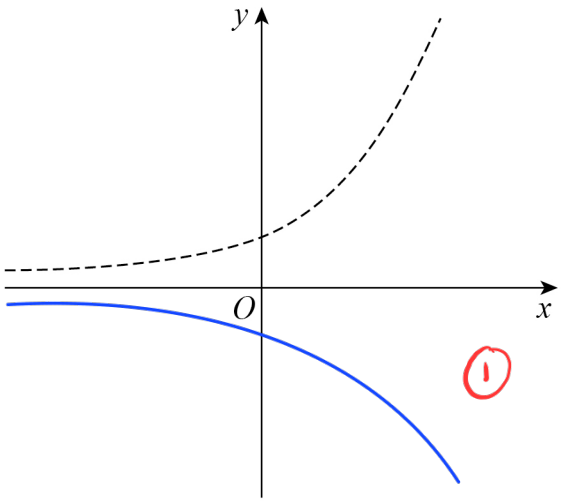
**26** Here is a sketch of the graph of $y = 5^x$




In parts (a) and (b) the sketch of $y = 5^x$ is shown as a dashed line.

**26 (a)** On the axes below, sketch the graph of $y = -5^x$

**[1 mark]**



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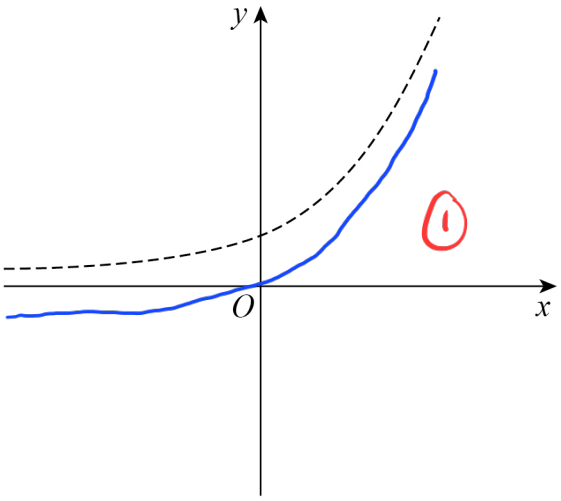
**26 (b)** On the axes below, sketch the graph of $y = 5^x - 1$

**[1 mark]**




**END OF QUESTIONS**

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**ANSWER IN THE SPACES PROVIDED**

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| Question number | **Additional page, if required.**<br>**Write the question numbers in the left-hand margin.** |
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| Question number | **Additional page, if required.**<br>**Write the question numbers in the left-hand margin.** |
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