# AQA

# GCSE
# MATHEMATICS

**H**

**Higher Tier** **Paper 3 Calculator**
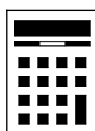
Monday 7 November 2022 Morning Time allowed: 1 hour 30 minutes

## 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.

**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 |

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

Circle your answer.

**[1 mark]**

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

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

$x$ is 200% of $y$

Circle the correct inequality.

**[1 mark]**

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

**Turn over for the next question**

**4**

**Turn over ▶**

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



14 cm

Not drawn accurately

*A*

*E*

10 cm

*D*

11 cm

7 cm

*B*

*C*

20 cm
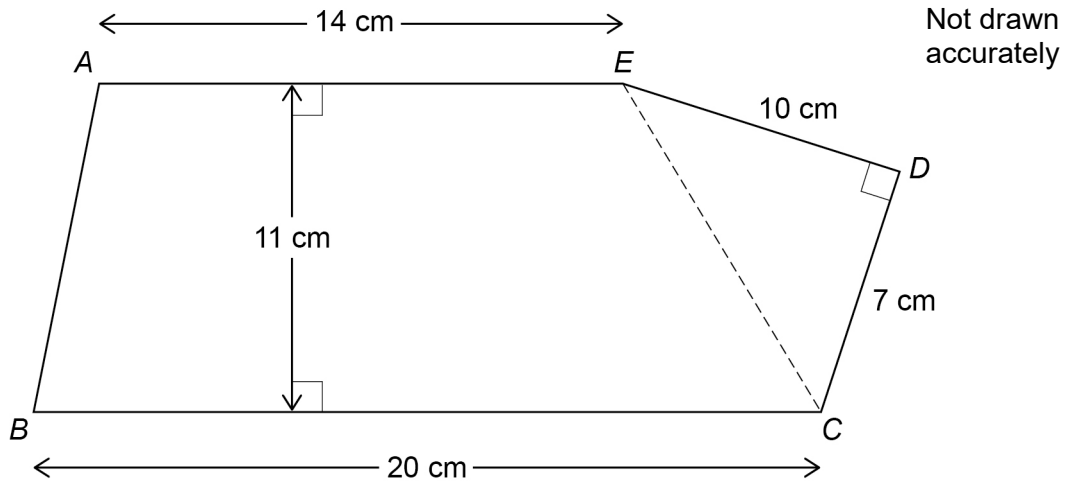
Work out the area of the pentagon.

**[3 marks]**

Answer _____ cm$^2$

**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]**

_____

_____

_____

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**Turn over for the next question**

**Turn over ▶**

**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]**

$x =$ _____

**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 mark]**

**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]

Answer _____

**Turn over for the next question**

6

**Turn over ▶**

**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]**

Answer _____

**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]**

Answer _____ : _____

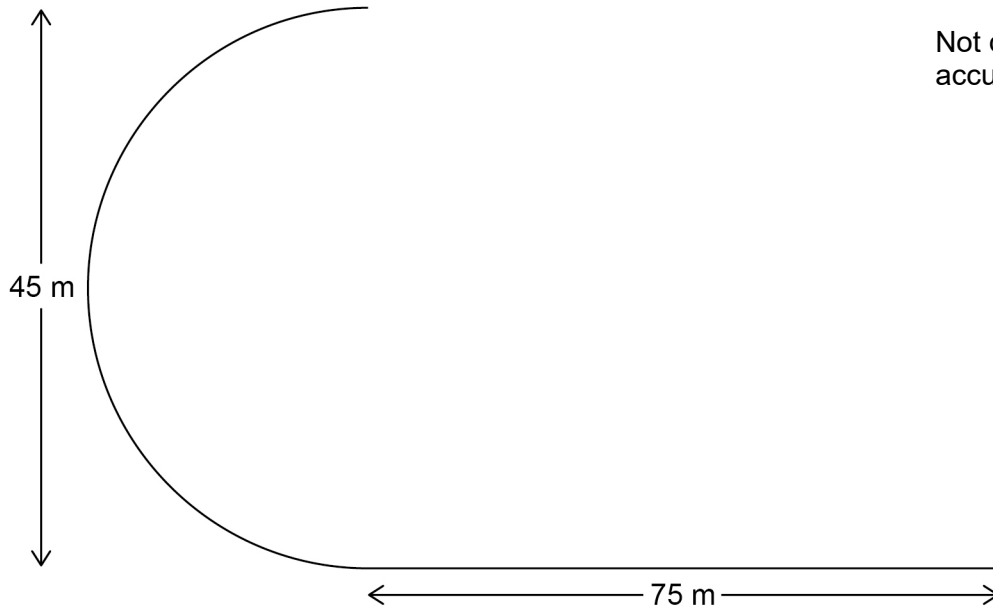**Turn over for the next question**

5

**Turn over ▶**

**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.

Not drawn accurately

45 m

75 m

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

Work out her average speed.
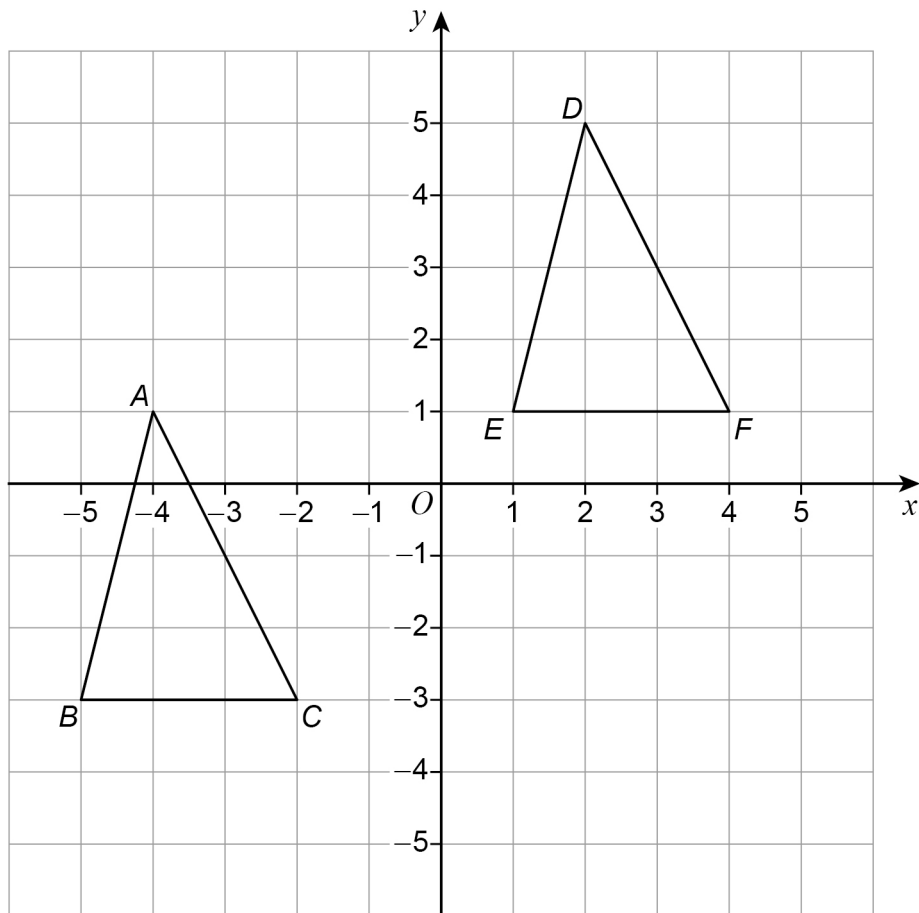
Give your answer to 2 significant figures.

**[4 marks]**

Answer _____ m/s

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



Describe a single transformation that shows the triangles are congruent.

[2 marks]

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

The tree diagram shows the probabilities.



**Dice**        **Counter**

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

**[1 mark]**

_____

_____

_____

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

**[1 mark]**

0.0009                    0.8                    0.03                    0.4

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

**[1 mark]**

0.15                    0.3                    0.35                    0.8

**Turn over for the next question**

**3**

**Turn over ▶**

**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]

☐ 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

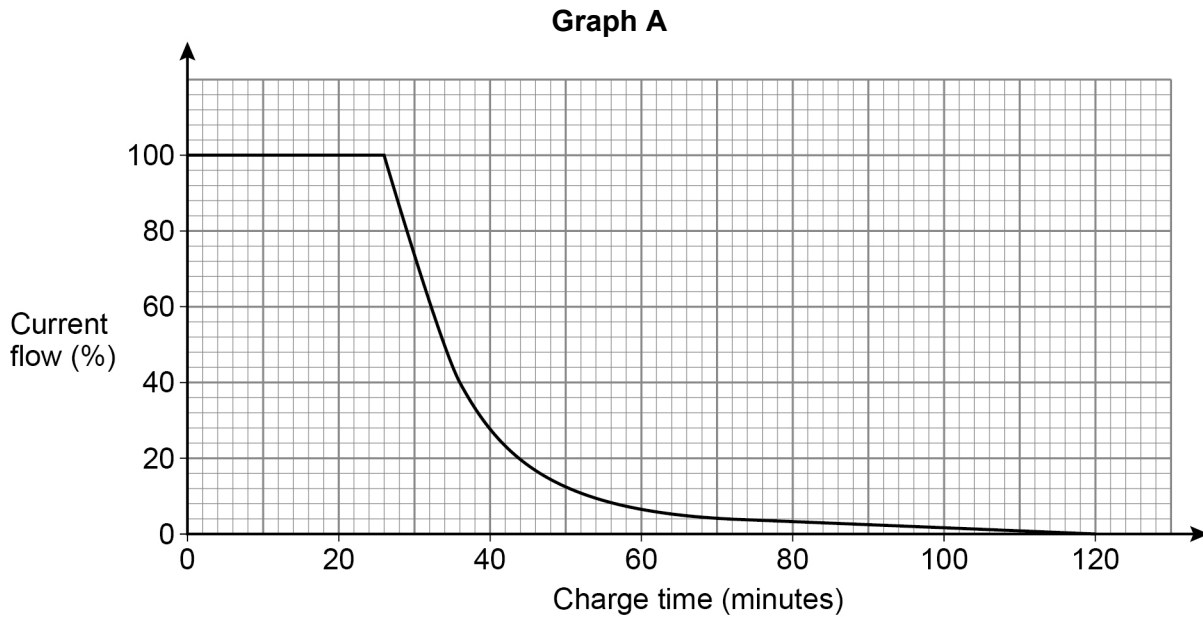**Turn over for the next question**

5

**Turn over ▶**

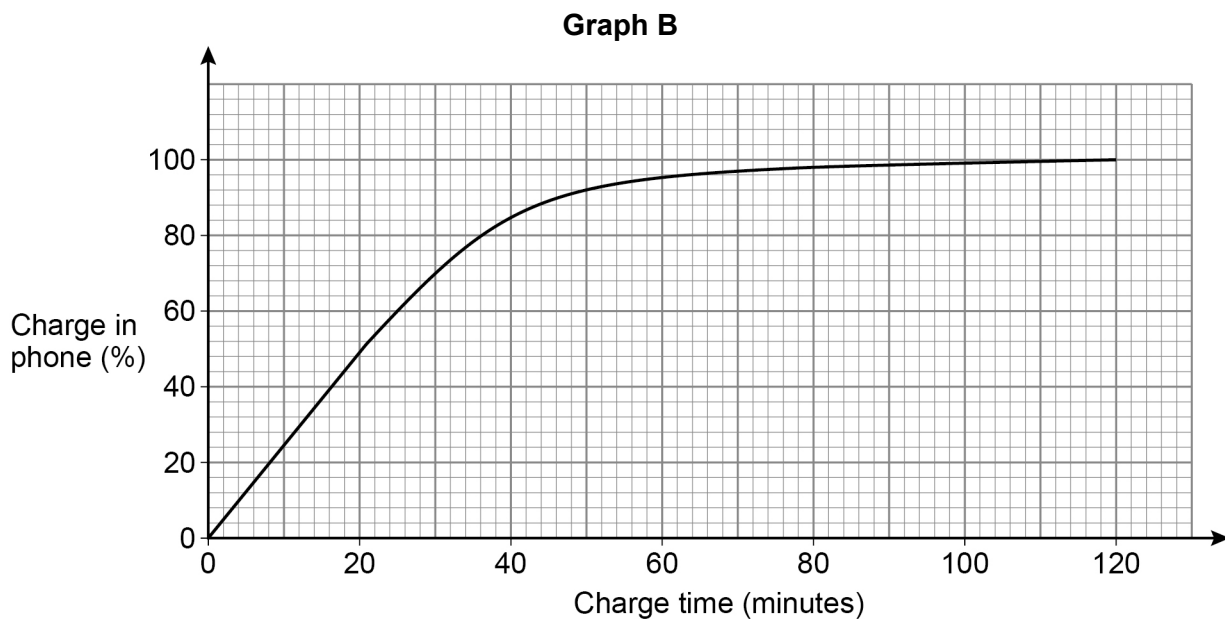**15** A mobile phone takes 2 hours to charge from empty.

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**

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]**

_____

_____

Answer _____ 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 _____ %

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

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

**[2 marks]**

_____

_____

_____

_____

Answer _____ percent per minute

5

**Turn over ▶**

**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]

Answer _____

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

[2 marks]

$H =$ _____

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

*BD* is a tangent to the circle.

*OCD* is a straight line.
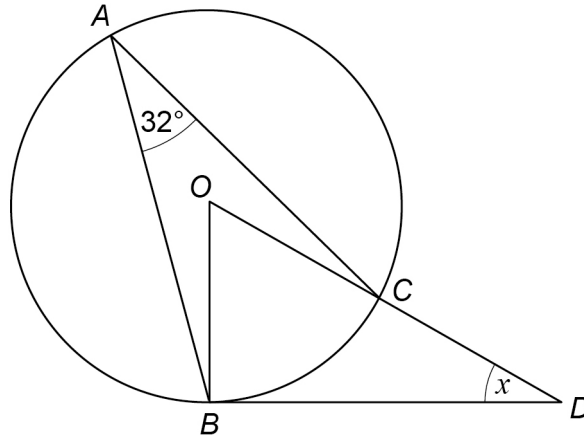
Not drawn
accurately



Work out the size of angle $x$.

**[3 marks]**

_____

_____

_____

_____

_____

_____

_____

_____

_____

$x =$ _____ degrees

8

**Turn over ▶**

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

[4 marks]

Answer _____

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

Write down the equation of the circle.

[1 mark]

Answer _____

**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]**

Answer _____

**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]**

Answer _____

10

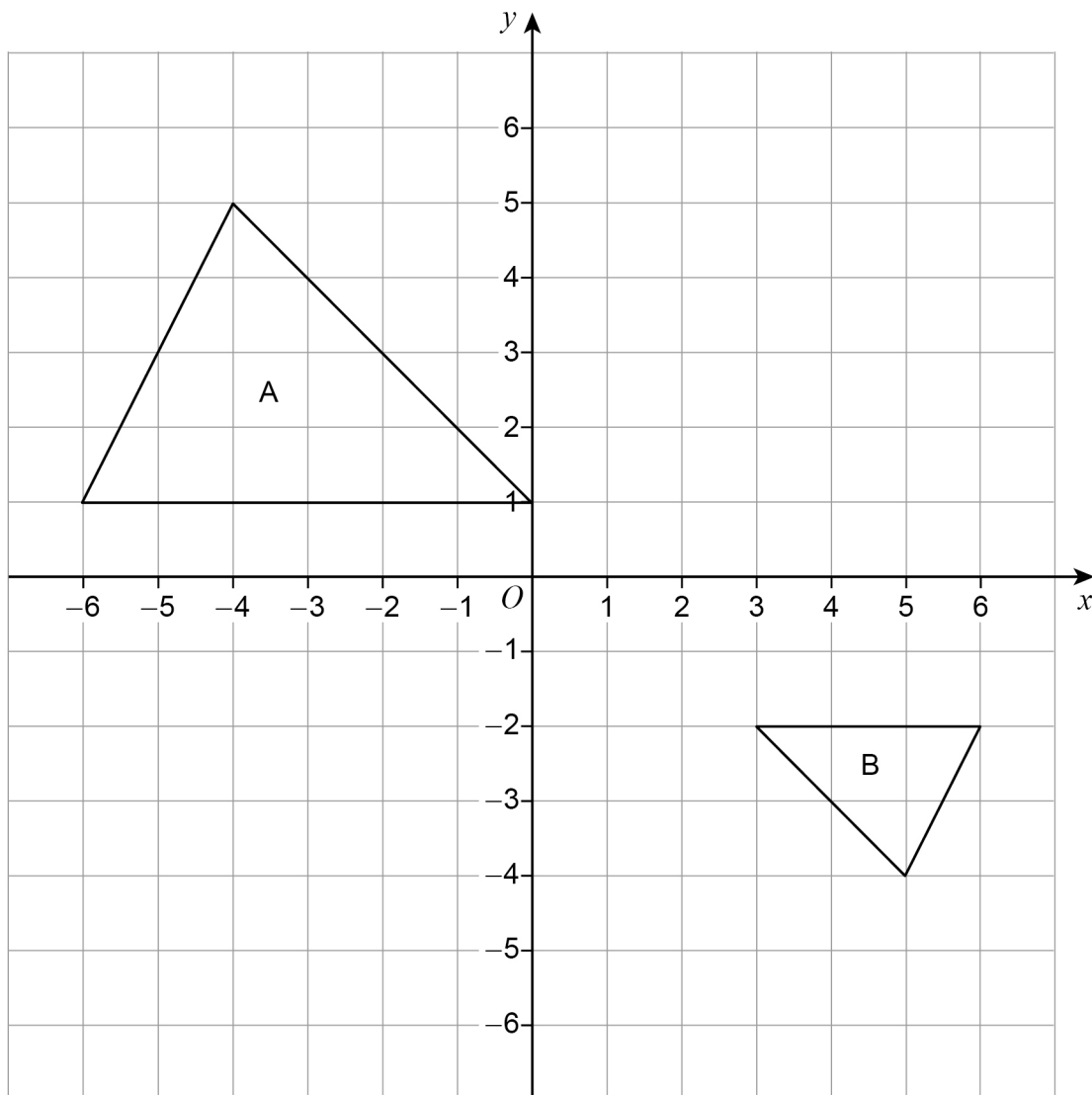**Turn over ►**

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



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

**[1 mark]**

$-\dfrac{1}{2}$ $-2$ $\dfrac{1}{2}$ $2$

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

**[1 mark]**

Answer ( _____ , _____ )

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

Give your answer as a single fraction.
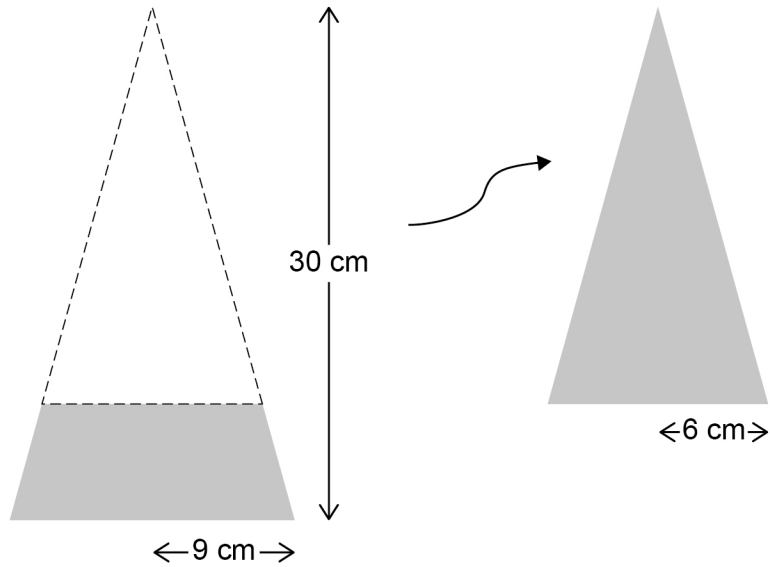
[4 marks]

Answer _____

**Turn over ▶**

**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

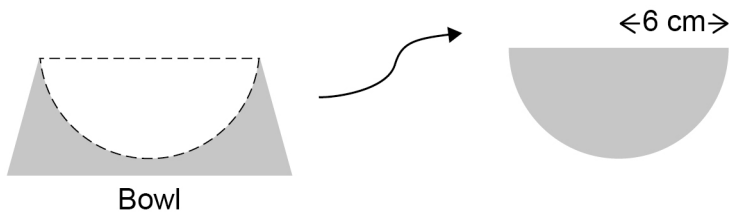A smaller cone, with radius 6 cm, is removed.

Not drawn accurately



30 cm

←9 cm→

←6 cm→

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.

Not drawn accurately

←6 cm→



Bowl

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

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

**[5 marks]**

Answer _____ cm³

**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]**

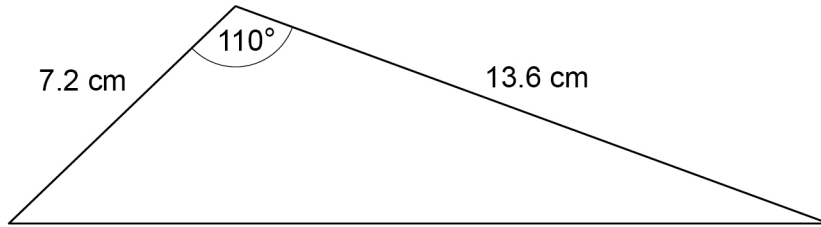**25** Two sides of a triangle are measured to 1 decimal place.

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

Not drawn accurately

```
      110°
7.2 cm /\        13.6 cm
      /  \_____
     /         \_____
    /_____\
```

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

You **must** show your working.

**[4 marks]**

_____

_____

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_____

Answer _____ cm$^2$

**Turn over for the next question**
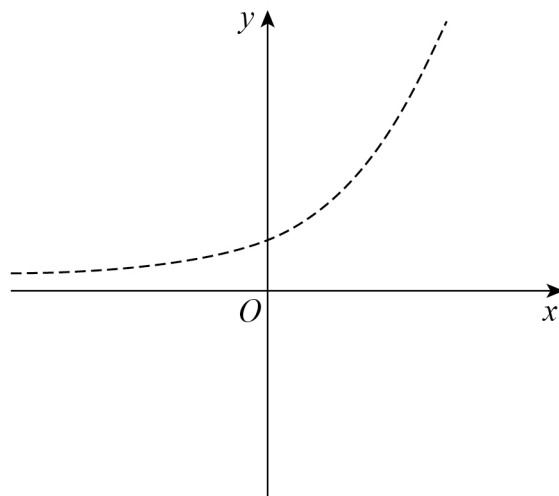
9

**Turn over ▶**

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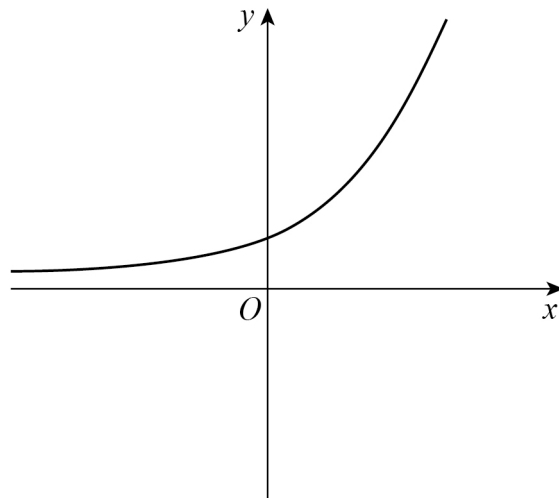


In parts (a) and (b) the sketch of $y = 5^x$ is shown as a dashed line.
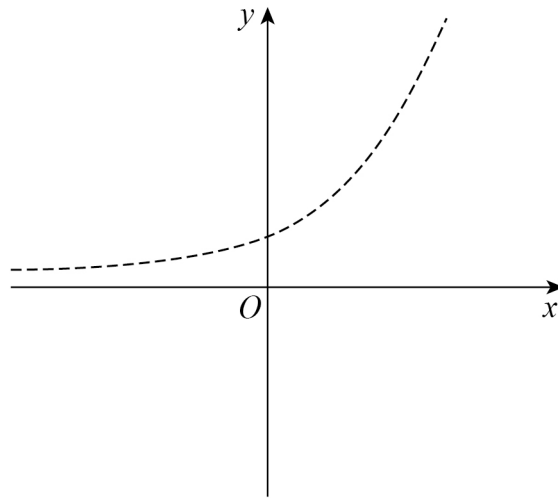
**26 (a)** On the axes below, sketch the graph of $y = -5^x$

**[1 mark]**

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

**[1 mark]**



**END OF QUESTIONS**

**There are no questions printed on this page**

**DO NOT WRITE ON THIS PAGE**
**ANSWER IN THE SPACES PROVIDED**

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

*Do not write outside the box*

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