

Upper and lower bounds

Exam questions

Foundation and Higher tiers

Please write clearly in block capitals.

Name

Class

Teacher

Time allowed: 125 minutes

Materials

For this booklet you need a black pen, a pencil, a ruler, a rubber and a calculator for Section B.

Instructions

- Use black ink or black ballpoint pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer all questions in the spaces provided.
- **Section A** (questions 1 to 6): you must not use a calculator.
- **Section B** (questions 7 to 32): you may use a calculator.
- Do all rough work in this booklet. Cross through any work you do not want marked.

Information

- The marks for each question are shown in brackets.
- The maximum mark for this booklet is 109.

Advice

- Read each question carefully.
- In all calculations, show clearly how you work out your answer.

For teacher’s use

Q	Mark	Q	Mark
1		17	
2		18	
3		19	
4		20	
5		21	
6		22	
7		23	
8		24	
9		25	
10		26	
11		27	
12		28	
13		29	
14		30	
15		31	
16		32	
TOTAL			

Section A



You must not use a calculator

Do not
write
outside
the box

- 1** The number of people at a concert is 2400, correct to the nearest 100

(a) Write down the least possible number of people at the concert.

Answer _____ [1 mark]

(b) Write down the greatest possible number of people at the concert.

Answer _____ [1 mark]

- 2** The mass of a parcel is 3.4 kg, correct to 1 decimal place.

(a) Write down the least possible mass of the parcel.

Answer _____ kg [1 mark]

(b) Kiran says,
"The greatest possible mass of the parcel is 3.44 kg"
 Explain why Kiran is wrong.

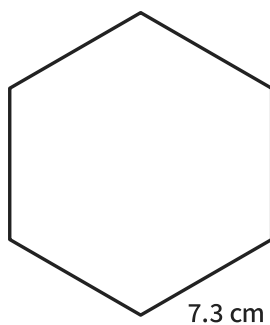
[1 mark]

- 3** A box is 44.6 cm wide, correct to 1 decimal place.
 It is to go into a gap in a cupboard.
 The gap is 45 cm wide, correct to the nearest centimetre.

Will the box always fit into the gap?
 You must show your working.

[2 marks]

- 4** The diagram shows a regular hexagon.
Each side is 7.3 cm, correct to 1 decimal place.



Not drawn accurately

Work out the upper bound of the perimeter of the hexagon.

Answer _____ cm

[2 marks]

- 5** $p = 9.4$ correct to 1 decimal place.
 $q = 3.8$ correct to 1 decimal place.

(a) Work out the upper bound of $p - q$.

Answer _____

[2 marks]

- (b)** Ella says,
“The lower bound of $p - q$ is $9.35 - 3.75 = 5.6$ ”
Explain why Ella is wrong.

[1 mark]

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- 6** A block of wood has a mass of 840 g, correct to the nearest 10 g
Its volume is 1200 cm^3 , correct to the nearest 100 cm^3

Work out the lower bound of the density of the wood.

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the box

Answer _____ g/cm^3
[3 marks]

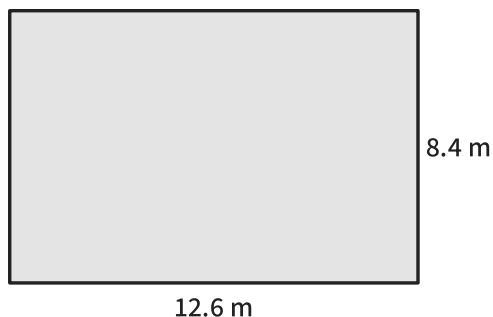
Section B



You may use a calculator

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the box

- 7 A rectangular lawn is 12.6 m long and 8.4 m wide.
Both measurements are correct to 1 decimal place.



Not drawn accurately

Work out the lower bound of the area of the lawn.

Answer _____ m^2
[2 marks]

- 8 A wooden toy block is a cube.
Each edge of the block is 6.4 cm, correct to 1 decimal place.

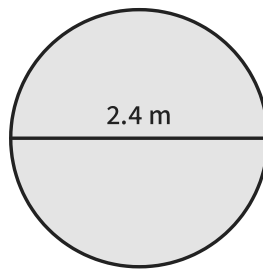
(a) Work out the lower bound of the volume of the block.

Answer _____ cm^3
[2 marks]

- (b) Sasha says,
“The volume of the block must be more than 260 cm^3 ”
Is Sasha correct? Give a reason for your answer.

[1 mark]

- 9** A circular rug has a diameter of 2.4 m, correct to 1 decimal place.
Amir needs a rug that covers at least 4.4 m^2 of floor.



Not drawn accurately

Can Amir be sure that this rug covers at least 4.4 m^2 ?
You must show your working.

[3 marks]

- 10** Lena cycles round a circular track.
The radius of the track is 32 m, correct to the nearest metre.
She cycles 25 laps of the track.

Work out the lower bound of the distance Lena cycles.
Give your answer to the nearest metre.

Answer _____ m

[3 marks]

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- 11** A length of copper wire is 5.3 m, correct to 1 decimal place.
The wire is cut into 8 pieces of equal length.

(a) Work out the error interval for p , the length in metres of one piece.

Answer _____

[2 marks]

- (b) Each piece needs to be at least 65 cm long.
Will every piece definitely be long enough? Give a reason for your answer.

[1 mark]

- 12** Jodie cycles 42.6 km, correct to 1 decimal place.
She takes 1.5 hours, correct to 1 decimal place.

Work out the lower bound of her average speed.
Give your answer to 1 decimal place.

Answer _____ km/h

[3 marks]

- 13** A van can carry a load of up to 850 kg, correct to the nearest 50 kg
Each box of tiles weighs 32 kg, correct to the nearest kg
- Work out the greatest number of boxes the van can definitely carry in one load.

Answer _____

[3 marks]

- 14** A ferry crosses a lake. The crossing is 18.4 km, correct to 1 decimal place.
The ferry's average speed is 22 km/h, correct to the nearest km/h
The timetable allows 52 minutes for the crossing.
- Will the crossing definitely take no longer than 52 minutes?
You must show your working.

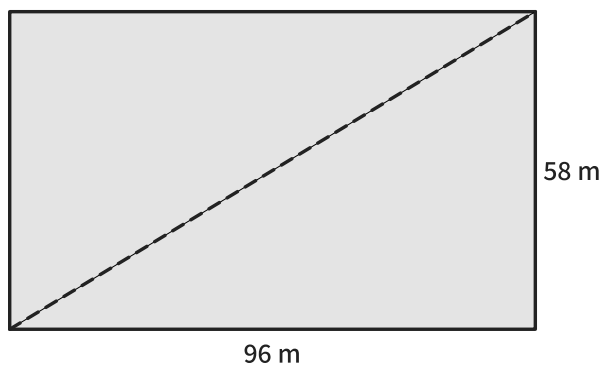
[4 marks]

15

A football pitch is a rectangle 96 m long and 58 m wide.

Both measurements are correct to the nearest metre.

A groundsperson paints a straight line from one corner of the pitch to the opposite corner.



Not drawn accurately

Work out the lower bound of the length of the line.

Give your answer to 1 decimal place.

Answer _____ m

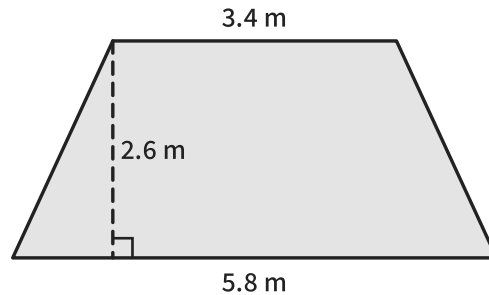
[3 marks]

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- 16** Megan is covering a flower bed with compost. The flower bed is a trapezium. All three lengths on the diagram are correct to 1 decimal place. One bag of compost covers 4.0 m^2 , correct to 1 decimal place.

Work out the least number of bags Megan should buy to be sure of covering the whole flower bed.

You must show your working.



Not drawn accurately

Answer _____

[4 marks]

- 17** A square patio is made from 36 identical square tiles, in 6 rows of 6. The perimeter of the patio is 14.4 m, correct to 1 decimal place.

Work out the lower bound of the area of one tile.

Give your answer in cm^2 to the nearest whole number.

Answer _____ cm^2

[4 marks]

- 18** A garden pond is filled with a hose. The pond also leaks.
The time, t hours, to fill the pond is given by

$$t = \frac{V}{q - r}$$

where $V \text{ m}^3$ is the volume of the pond, water flows in at $q \text{ m}^3$ per hour and water leaks out at $r \text{ m}^3$ per hour.

$V = 12$ correct to the nearest whole number.

$q = 2.6$ correct to 1 decimal place.

$r = 0.3$ correct to 1 decimal place.

Work out the upper bound of t .

Give your answer to 3 significant figures.

Answer _____ hours

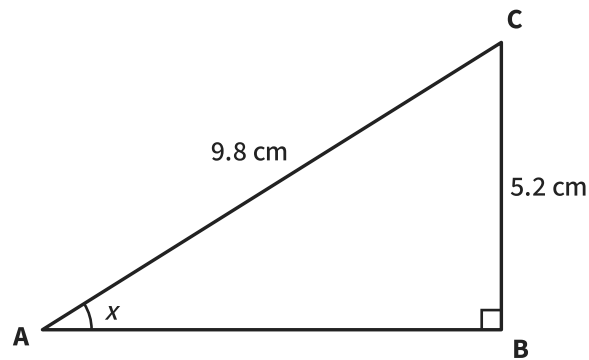
[3 marks]

19

ABC is a right-angled triangle.

BC = 5.2 cm, correct to 1 decimal place.

AC = 9.8 cm, correct to 1 decimal place.



Not drawn accurately

Work out the upper bound of angle x .

Give your answer to 1 decimal place.

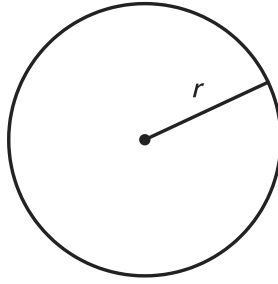
Answer _____ degrees

[3 marks]

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20

The area of a circle is 50 cm^2 , correct to the nearest cm^2



Not drawn accurately

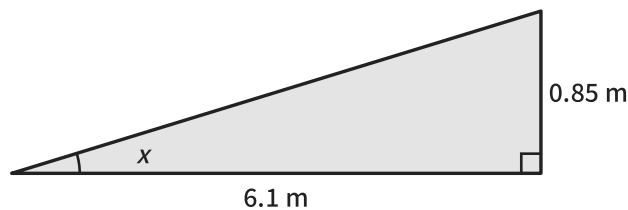
Work out the upper bound of the radius of the circle.
Give your answer to 3 significant figures.

Answer _____ cm

[3 marks]

21

A ramp is built up to a doorway. The ramp rises 0.85 m , correct to 2 decimal places.
The horizontal distance it covers is 6.1 m , correct to 1 decimal place.
The rules say the angle of the ramp must not be more than 8°



Not drawn accurately

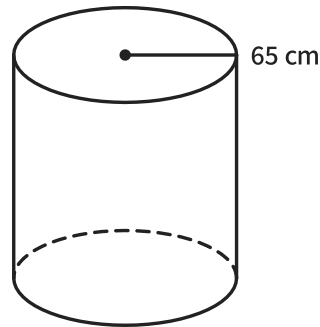
Can the builder be sure that the ramp keeps to the rules?
You must show your working.

[4 marks]

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outside
the box

22

A water tank is a cylinder standing on its circular base.
 The radius of the tank is 65 cm, correct to the nearest cm
 The tank holds 1800 litres of water, correct to the nearest 50 litres.



Not drawn accurately

Work out the lower bound of the depth of the water.
 Give your answer to 2 decimal places.

Answer _____ cm

[4 marks]**23**

A museum had 2400 visitors in March and 3100 visitors in April.
 Both numbers are correct to the nearest 100

Work out the upper bound of the percentage increase in the number of visitors from March to April.
 Give your answer to 1 decimal place.

Answer _____ %

[3 marks]

24

The distance from the Earth to the star Sirius is 8.1×10^{13} km, correct to 2 significant figures.

Light travels at 3.00×10^5 km per second, correct to 3 significant figures.

Ali says,

“Light from Sirius takes less than 9 years to reach the Earth.”

Use 1 year = 365 days to show that Ali is correct.

[4 marks]**25**

A metal ball has a mass of 395 g, correct to the nearest 5 g
Its diameter is 4.6 cm, correct to 1 decimal place.

Brass has a density between 8.4 g/cm^3 and 8.7 g/cm^3

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

Could the ball be made of brass?

You must show your working.

[4 marks]

26

A coach travels 248 km, correct to the nearest km
Its average speed is 62 km/h, correct to the nearest km/h

Work out the time the journey takes to a suitable degree of accuracy.
You must show your working and give a reason for your final answer.

Answer _____ hours

[5 marks]

27

An empty glass flask has a mass of 186 g
When the flask is filled with olive oil, the total mass is 642 g
Both masses are correct to the nearest gram.
The flask holds 500 cm^3 of oil, correct to the nearest cm^3

(a) Work out the upper bound of the mass of the oil.

Answer _____ g

[1 mark]

(b) Work out the density of the olive oil to a suitable degree of accuracy.
You must show your working and give a reason for your final answer.

Answer _____ g/cm^3

[4 marks]

28

Ravi uses a pendulum to find g , the acceleration due to gravity, in m/s^2 .
 T seconds is the time for one complete swing, there and back, of a pendulum of length L metres.

$$g = \frac{4\pi^2 L}{T^2}$$

The length of Ravi's pendulum is 0.850 m, correct to the nearest millimetre.
He times 20 complete swings. The total time is 37.1 seconds, correct to 1 decimal place.

(a) Show that Ravi's measurements give a value of g that must be less than 9.81

[4 marks]

(b) Give one reason why Ravi timed 20 swings instead of one swing.

[1 mark]

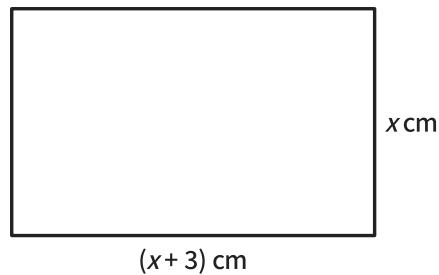
29

A rectangle has width x cm and length $(x + 3)$ cm.

The area of the rectangle is 40 cm^2 , correct to the nearest cm^2

Work out the upper bound of x .

Give your answer to 3 significant figures.



Not drawn accurately

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$x =$ _____

[4 marks]

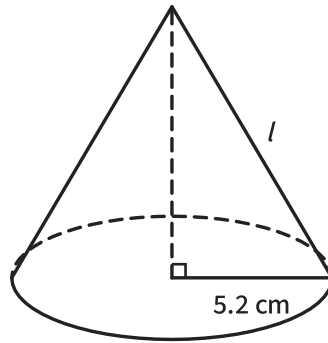
30

A solid cone has a volume of 250 cm^3 , correct to the nearest 10 cm^3 .
The radius of its base is 5.2 cm , correct to 1 decimal place.
 l is the slant height of the cone.

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

Work out the lower bound of l .

Give your answer to 3 significant figures.



Not drawn accurately

Answer _____ cm

[5 marks]

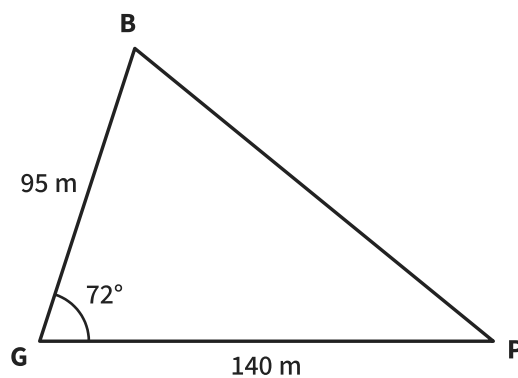
- 31** Two straight paths meet at a gate, G . One path goes to a bench, B , and the other to a pond, P .

$GB = 95$ m and $GP = 140$ m, both correct to the nearest metre.

Angle $BGP = 72^\circ$, correct to the nearest degree.

Work out the upper bound of the distance BP .

Give your answer to 1 decimal place.



Not drawn accurately

Answer _____ m

[4 marks]

- 32** Nina measures the diameter of a ball as 22 cm, correct to the nearest cm. She uses 22 cm to work out the volume of the ball.

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{percentage error} = \frac{\text{difference between her volume and the true volume}}{\text{true volume}} \times 100$$

Work out the greatest possible percentage error in Nina's volume.

Give your answer to 1 decimal place.

You must show your working.

Answer _____ %

[4 marks]

END OF QUESTIONS