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GCSE MATHS

Number

Edexcel 1MA1 | Subtopic collection Topic 09

Upper and lower bounds

Higher tier

Past paper question booklet

38	2003-2025	Higher
question groups	available papers	tier

Before you begin

1. Show working and use units where appropriate.
2. Use extra paper if you need more space.
3. Print at actual size (100%) for measurement questions.

Name _____ **Date** _____

Whole questions are retained for context; some parts cover other points. Legacy sources are labelled.

16.

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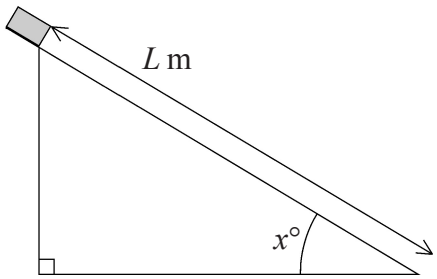


Elliot did an experiment to find the value of g m/s^2, the acceleration due to gravity. He measured the time, T seconds, that a block took to slide L m down a smooth slope of angle $x°$.

He then used the formula $g = \dfrac{2L}{T^2 \sin x°}$

to calculate an estimate for g.

$T = 1.3$ correct to 1 decimal place.
$L = 4.50$ correct to 2 decimal places.
$x = 30$ correct to the nearest integer.

(a) Calculate the lower bound and the upper bound for the value of g.
Give your answers correct to 3 decimal places.

Lower bound .....

Upper bound.....

(4)

(b) Use your answers to part (a) to write down the value of g to a suitable degree of accuracy. Explain your reasoning.

.....

.....

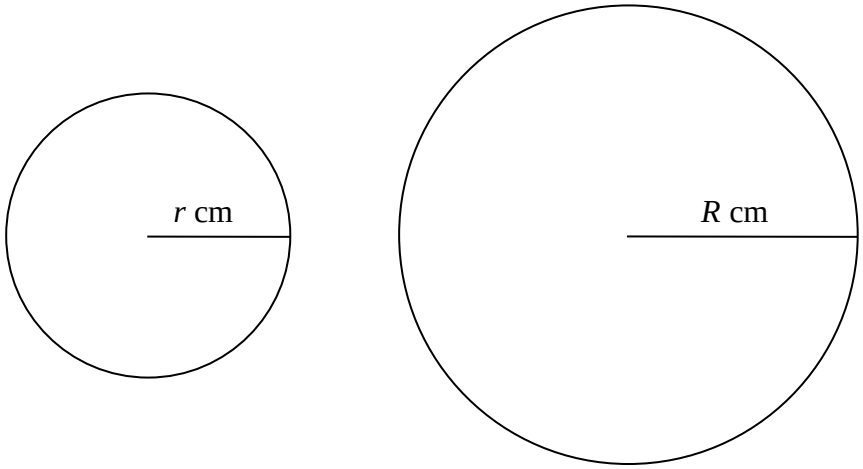
.....

(1)

Page Total

16.

Diagram **NOT** accurately drawn



The diagram represents two metal spheres of different sizes.

The radius of the smaller sphere is r cm.
The radius of the larger sphere is R cm.

$r = 1.7$ correct to 1 decimal place.

$R = 31.0$ correct to 3 significant figures.

(a) Write down the upper and lower bounds of r and R.

Upper bound of r = ...

Lower bound of r = ...

Upper bound of R = ...

Lower bound of R = ...

(2)

(b) Find the smallest possible value of $R - r$.

.....

(1)

The larger sphere of radius R cm was melted down and used to make smaller spheres of radius r cm.

(c) Calculate the smallest possible number of spheres that could be made.

.....

(4)

8. Each side of a regular pentagon has a length of 101 mm, correct to the nearest millimetre.

(i) Write down the **least** possible length of each side.

..... mm

(ii) Write down the **greatest** possible length of each side.

..... mm

(2)

Blank

11. The length of a line is 63 centimetres, correct to the nearest centimetre.

(a) Write down the **least** possible length of the line.

..... centimetres
(1)

(b) Write down the **greatest** possible length of the line.

..... centimetres
(1)

Q11

(Total 2 marks)

21. A field is in the shape of a rectangle.
The width of the field is 28 metres, measured to the nearest metre.

(a) Work out the upper bound of the width of the field.

..... metres
(1)

The length of the field is 145 metres, measured to the nearest 5 metres.

(b) Work out the upper bound for the perimeter of the field.

..... metres
(3)

(Total 4 marks)

Q21

24.

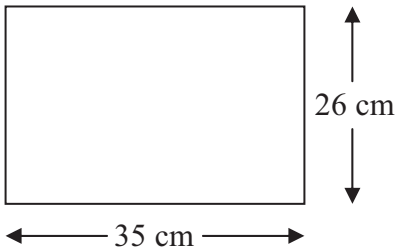


Diagram **NOT** accurately drawn

The length of the rectangle is 35 cm correct to the nearest cm.
The width of the rectangle is 26 cm correct to the nearest cm.

Calculate the upper bound for the area of the rectangle.
Write down all the figures on your calculator display.

.....cm^2 **Q24**

(Total 3 marks)

26. The voltage V of an electronic circuit is given by the formula

$$V = IR$$

where I is the current in amps
and R is the resistance in ohms.

Given that $V = 218$ correct to 3 significant figures,
$R = 12.6$ correct to 3 significant figures,

calculate the lower bound of I.

.....

Q26

(Total 3 marks)

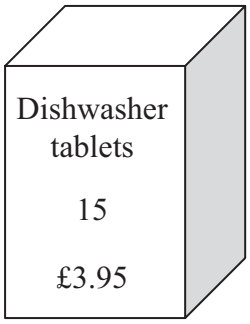
25. Steve measured the length and the width of a rectangle.
He measured the length to be 645 mm correct to the nearest 5 mm.
He measured the width to be 400 mm correct to the nearest 5 mm.

Calculate the lower bound for the area of this rectangle.
Give your answer correct to 3 significant figures.

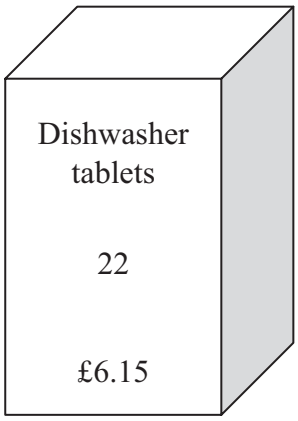
..... mm^2 **Q25**

(Total 3 marks)

6 Dishwasher tablets are sold in two sizes of box.



Small box



Large box

A small box contains 15 tablets and costs £3.95
A large box contains 22 tablets and costs £6.15

*(a) Which size of box gives the better value for money?
You must show all your working.

(4)

The weight of the large box is 357 grams, to the nearest gram.

(b) (i) What is the minimum possible weight of the box?

..... grams

(ii) What is the maximum possible weight of the box?

..... grams

(2)

(Total for Question 6 is 6 marks)

7 A piece of wood has a length of 65 centimetres to the nearest centimetre.

(a) What is the least possible length of the piece of wood?

.....cm

(1)

(b) What is the greatest possible length of the piece of wood?

.....cm

(1)

(Total for Question 7 is 2 marks)

21 A solid sphere has

a mass of 1180 g measured to the nearest gram
and a radius of 6.2 cm measured to the nearest millimetre.

Given that

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

find the upper bound for the density of the sphere.
Give your answer to 3 significant figures.

..... g/cm^3

(Total for Question 21 is 4 marks)

23 Dan does an experiment to find the value of π.
He measures the circumference and the diameter of a circle.

He measures the circumference, C, as 170 mm to the nearest millimetre.
He measures the diameter, d, as 54 mm to the nearest millimetre.

Dan uses $\pi = \frac{C}{d}$ to find the value of π.

Calculate the upper bound and the lower bound for Dan's value of π.

upper bound = ...

lower bound = ...

(Total for Question 23 is 4 marks)

6 A pencil has a length of 17 cm measured to the nearest centimetre.

(a) Write down the least possible length of the pencil.

..... cm

(1)

(b) Write down the greatest possible length of the pencil.

..... cm

(1)

(Total for Question 6 is 2 marks)

21 Sasha drops a ball from a height of d metres onto the ground.

The time, t seconds, that the ball takes to reach the ground is given by

$$t = \sqrt{\frac{2d}{g}}$$

where g m/s^2 is the acceleration due to gravity.

$d = 35.6$ correct to 3 significant figures.
$g = 9.8$ correct to 2 significant figures.

(a) Write down the lower bound of d.

.....

(1)

(b) Calculate the lower bound of t.
You must show all your working.

.....

(3)

(Total for Question 21 is 4 marks)

7 Chelsea's height is 168 cm to the nearest cm.

(a) What is Chelsea's minimum possible height?

..... cm

(1)

(b) What is Chelsea's maximum possible height?

..... cm

(1)

(Total for Question 7 is 2 marks)

Question 16

6 Dionne has 60 golf balls.
Each of these golf balls weighs 42 grams to the nearest gram.

Work out the greatest possible total weight of all 60 golf balls.
Give your answer in kilograms.

..... kg

(Total for Question 6 is 3 marks)

20 Jerry wants to cover a triangular field, *ABC*, with fertiliser.

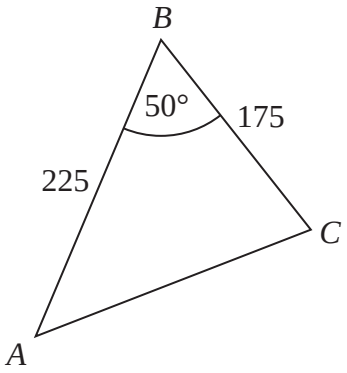


Diagram **NOT** accurately drawn

Here are the measurements Jerry makes

angle *ABC* = 50° correct to the nearest degree,
BA = 225 m correct to the nearest 5 m,
BC = 175 m correct to the nearest 5 m.

Work out the upper bound for the area of the field.
You must show your working.

..... m^2

(Total for Question 20 is 3 marks)

13 A nail weighs 4 g correct to the nearest gram.
Alice buys exactly 1 kg of nails.

Work out the least number of nails Alice could get.

.....

(Total for Question 13 is 3 marks)

20 The volume of a sphere is 70 cm^3 correct to the nearest cm^3.

Calculate the upper bound for the surface area of the sphere.
Give your answer correct to 1 decimal place.
You must show all your working.

.....cm^2

(Total for Question 20 is 4 marks)

24 Steve travelled from Ashton to Barnfield.

He travelled 235 miles, correct to the nearest 5 miles.
The journey took him 200 minutes, correct to the nearest 5 minutes.

Calculate the lower bound for the average speed of the journey.
Give your answer in **miles per hour**, correct to 3 significant figures.
You must show all your working.

..... mph

(Total for Question 24 is 4 marks)

4 The length of a field is 54 metres correct to the nearest metre.

(a) Write down the least possible length of the field.

.....m

(1)

(b) Write down the greatest possible length of the field.

.....m

(1)

(Total for Question 4 is 2 marks)

19 $a = 40$ correct to 1 significant figure.
$b = 0.2$ correct to 1 significant figure.

Calculate the upper bound of $\frac{a}{b}$

.....

(Total for Question 19 is 3 marks)

19 The value of p is 4.3
The value of q is 0.4

Both p and q are given correct to the nearest 0.1

(a) Write down the lower bound for p.

.....

(1)

$$r = p + \frac{1}{q}$$

(b) Work out the upper bound for r.
You must show all your working.

.....

(3)

(Total for Question 19 is 4 marks)

20 $I = \dfrac{V}{R}$

V = 250 correct to the nearest 5

R = 3900 correct to the nearest 100

Work out the lower bound for the value of I.
Give your answer correct to 3 decimal places.
You must show your working.

.....

(Total for Question 20 is 3 marks)

21 $I = 5(v - u)$

$v = 14$ correct to 2 significant figures
$u = 8.7$ correct to 2 significant figures

Work out the upper bound for the value of I.
You must show your working.

.....

(Total for Question 21 is 3 marks)

4 A piece of wood has a width of 37 millimetres, correct to the nearest millimetre.

(a) Write down the least possible width of the piece of wood.

..... mm

(1)

(b) Write down the greatest possible width of the piece of wood.

..... mm

(1)

(Total for Question 4 is 2 marks)

20 Jarek uses the formula

$$\text{Area} = \frac{1}{2}ab\sin C$$

to work out the area of a triangle.

For this triangle,

a = 7.8 cm correct to the nearest mm.
b = 5.2 cm correct to the nearest mm.
C = 63° correct to the nearest degree.

Calculate the lower bound for the area of the triangle.

..... cm^2

(Total for Question 20 is 3 marks)

23 A machine puts drinks into cups.
The volume of a cup is 200 m*l*, correct to the nearest 0.5 m*l*.

(a) Write down the lower bound for the volume of a cup.

..... m*l*

(1)

The machine puts tea and milk into each cup.
It puts into each cup

175 m*l* of tea measured correct to the nearest m*l*
24 m*l* of milk measured correct to the nearest m*l*

*(b) Is it possible that the total volume of tea and milk put in a cup is greater than the volume of the cup?
You must show how you get your answer.

(3)

(Total for Question 23 is 4 marks)

22 $a = \dfrac{v - u}{t}$

$v = 37.6$ correct to 3 significant figures.
$u = 11.3$ correct to 3 significant figures.
$t = 8.4$ correct to 2 significant figures.

Work out the upper bound for the value of a.
Show your working clearly.

.....

(Total for Question 22 is 3 marks)

13 A factory makes 450 pies every day.
The pies are chicken pies or steak pies.

Each day Milo takes a sample of 15 pies to check.

The proportion of the pies in his sample that are chicken is the same as the proportion of the pies made that day that are chicken.

On Monday Milo calculated that he needed exactly 4 chicken pies in his sample.

(a) Work out the total number of chicken pies that were made on Monday.

.....

(2)

On Tuesday, the number of steak pies Milo needs in his sample is 6 correct to the nearest whole number.

Milo takes at random a pie from the 450 pies made on Tuesday.

(b) Work out the lower bound of the probability that the pie is a steak pie.

.....

(2)

(Total for Question 13 is 4 marks)

19 $D = \dfrac{u^2}{2a}$

$u = 26.2$ correct to 3 significant figures

$a = 4.3$ correct to 2 significant figures

(a) Calculate the upper bound for the value of D.
Give your answer correct to 6 significant figures.
You must show all your working.

.....

(3)

The lower bound for the value of D is 78.6003 correct to 6 significant figures.

(b) By considering bounds, write down the value of D to a suitable degree of accuracy.
You must give a reason for your answer.

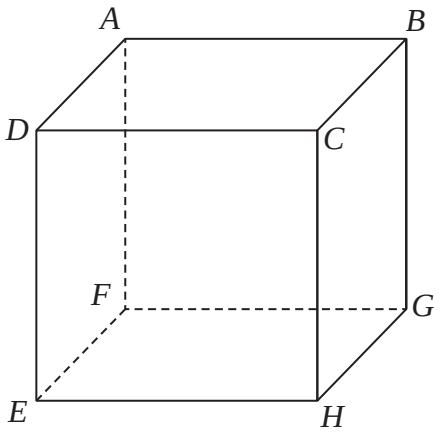
.....

.....

(2)

(Total for Question 19 is 5 marks)

18 The diagram shows a cube.



AH = 11.3 cm correct to the nearest mm.

Calculate the lower bound for the length of an edge of the cube.
You must show all your working.

..... cm

(Total for Question 18 is 4 marks)

21 The time period, T seconds, of a simple pendulum of length l cm is given by the formula

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Katie uses a simple pendulum in an experiment to find an estimate for the value of g.

Here are her results.

l = 52.0 correct to 3 significant figures.
T = 1.45 correct to 3 significant figures.

Work out the upper bound and the lower bound for the value of g.
Use π = 3.142
You must show all your working.

upper bound = ...

lower bound = ...

(Total for Question 21 is 4 marks)

16 $p = \sqrt{\frac{2e}{f}}$

$e = 6.8$ correct to 1 decimal place.

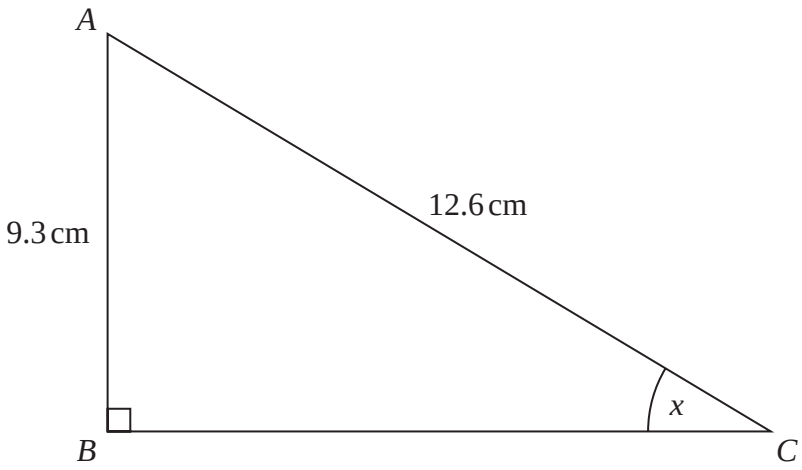
$f = 0.05$ correct to 1 significant figure.

Work out the upper bound for the value of p.
Give your answer correct to 3 significant figures.
You must show all your working.

.....

(Total for Question 16 is 3 marks)

19 *ABC* is a right-angled triangle.



AB = 9.3 cm correct to the nearest mm.
AC = 12.6 cm correct to the nearest mm.

Calculate the lower bound for the size of the angle marked *x*.
You must show all your working.

.....°

(Total for Question 19 is 3 marks)

9 A number N is rounded to 2 significant figures.
The result is 7.3

(a) Write down the least possible value of N.

.....

(1)

Leila says,

"The value of N cannot be greater than 7.349 because 7.350 would round up to 7.4"

(b) Is Leila correct?
You must give a reason for your answer.

.....

.....

.....

(1)

(Total for Question 9 is 2 marks)

19 $R = \dfrac{P}{Q}$

$P = 5.88 \times 10^8$ correct to 3 significant figures.
$Q = 3.6 \times 10^5$ correct to 2 significant figures.

Work out the lower bound for R.
Give your answer as an ordinary number correct to the nearest integer.
You must show all your working.

.....

(Total for Question 19 is 3 marks)

19 There are some sheets of paper in a pile.

The height of the pile is 10.4 cm, correct to the nearest mm.
The thickness of each sheet of paper is 0.17 mm, correct to 2 significant figures.

Calculate the upper bound for the number of sheets of paper in the pile.
You must show all your working.

.....

(Total for Question 19 is 3 marks)