Name ANSWERS	Class

MATHS TEACHER HUB

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Bounds

(9 – 1) Topic booklet

Higher

These questions have been collated from previous years GCSE Mathematics papers.

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.	Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Diagrams are NOT accurately drawn, unless otherwise indicated.
- You must **show all your working out.**
- If the question is a **1H** question you are not allowed to use a calculator.
- If the question is a **2H** or a **3H** question, you may use a calculator to help you answer.

Information

- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Answer ALL questions
Write your answers in the space provided.
You must write down all the stages in your working.

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

$e = 6.8$ correct to 1 decimal place.

$f = 0.05$ correct to 1 significant figure.

$6.75 \leqslant e < 6.85$

$0.045 \leqslant f < 0.055$

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

upper bound of $p = \sqrt{\frac{2 \times 6.85}{0.045}} = 17.4$

17.4

June 2022 – Paper 3H

(Total for Question 16 is 3 marks)

16 The petrol consumption of a car, in litres per 100 kilometres, is given by the formula

$$\text{Petrol consumption} = \frac{100 \times \text{Number of litres of petrol used}}{\text{Number of kilometres travelled}}$$

Nathan's car travelled 148 kilometres, correct to 3 significant figures.
The car used 11.8 litres of petrol, correct to 3 significant figures.

Nathan says,

"My car used less than 8 litres of petrol per 100 kilometres."

Could Nathan be wrong?
You must show how you get your answer.

$147.5 \leqslant d < 148.5$

$11.75 \leqslant p < 11.85$

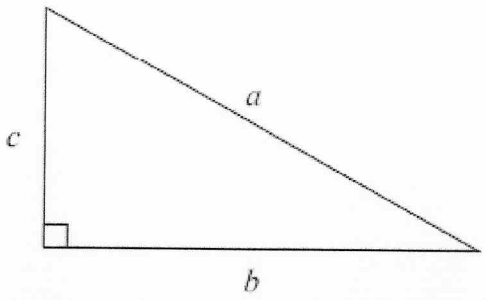
Upper petrol consumption $= \frac{100 \times 11.85}{147.5} = 8.0338983$

$= 8.03$

Nathan could be wrong.

(Total for Question 16 is 3 marks)

17



a is 8.3 cm correct to the nearest mm
b is 6.1 cm correct to the nearest mm

Calculate the upper bound for c.
You must show your working.

$8.25 \leqslant a < 8.35$
$6.05 \leqslant b < 6.15$

upper bound for $c = \sqrt{8.35^2 - 6.05^2}$

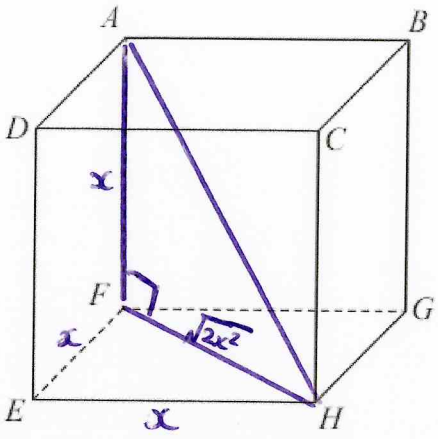
$= 5.754997828$

$= 5.75$

5.75 cm

(Total for Question 17 is 4 marks)

18 The diagram shows a cube.



$11.25 \leq AH < 11.35$

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.

$FH = \sqrt{x^2 + x^2}$

$= \sqrt{2x^2}$

$AH = \sqrt{x^2 + (\sqrt{2x^2})^2}$

$= \sqrt{x^2 + 2x^2}$

$= \sqrt{3x^2}$

$\sqrt{3x^2} = 11.25$

$3x^2 = 126.5625$

$x^2 = 42.1875$

$x = 6.495190528$

$\sqrt{2x^2} \times \sqrt{2x^2} = 2x^2$

6.5 (2 significant figures) cm

(Total for Question 18 is 4 marks)

18 A high speed train travels a distance of 487 km in 3 hours. = 180 minutes

The distance is measured correct to the nearest kilometre.
The time is measured correct to the nearest minute.

By considering bounds, work out the average speed, in km/minute, of the train to a suitable degree of accuracy.
You must show all your working and give a reason for your answer.

$4865 \leqslant d < 487.5$

$179.5 \leqslant m < 180.5$

Speed

Upper bound $= \frac{487.5}{179.5} = 2.715877437$

Lower bound $= \frac{4865}{180.5} = 2.695290859$

Both values round to 2.7 to 1 decimal place.

2.7 km/minute

(Total for Question 18 is 5 marks)

18 $m = \dfrac{\sqrt{s}}{t}$ $s = 3.47$ correct to 3 significant figures

$t = 8.132$ correct to 4 significant figures

By considering bounds, work out the value of m to a suitable degree of accuracy.
Give a reason for your answer.

$3.465 \leqslant s < 3.475$

$8.1315 \leqslant t < 8.1325$

upper bound $= \dfrac{\sqrt{3.475}}{8.1315} = 0.2292486243$

lower bound $= \dfrac{\sqrt{3.465}}{8.1325} = 0.2288903839$

Both values round to 0.229 to 3 significant figures

(Total for Question 18 is 5 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.

$5.875 \times 10^8 \leq P < 5.885 \times 10^8$

$3.55 \times 10^5 \leq Q < 3.65 \times 10^5$

Lower bound of $R = \dfrac{5.875 \times 10^8}{3.65 \times 10^5}$

$= 1610$

1610

(Total for Question 19 is 3 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.

$26.15 \leqslant u < 26.25$

$4.25 \leqslant a < 4.35$

Upper bound of $D = \dfrac{26.25^2}{2(4.25)} = 81.0661764705882$

81.0662

(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.

Both values round to 80 to 1 significant figure.

(2)

(Total for Question 19 is 5 marks)

20 $d = \frac{1}{8}c^3$

$c = 10.9$ correct to 3 significant figures.

By considering bounds, work out the value of d to a suitable degree of accuracy.
Give a reason for your answer.

$10.85 \leqslant c < 10.95$

Upper bound of $d = \frac{1}{8}(10.95)^3 = 164.1165469$

lower bound of $d = \frac{1}{8}(10.85)^3 = 159.6611406$

Both values round to 160 to 2 significant figures

(Total for Question 20 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.

$51.95 \leqslant l < 52.05$
$1.445 \leqslant T < 1.455$

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

Change the subject to g:

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

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

$\left(\frac{T}{2\pi}\right)^2 = \frac{l}{g}$

$g\left(\frac{T}{2\pi}\right)^2 = l$

$g = \frac{l}{\left(\frac{T}{2\pi}\right)^2}$

Upper bound $g = \frac{52.05}{\left(\frac{1.445}{2\pi}\right)^2}$

$= 984.3677853$

Lower bound $g = \frac{51.95}{\left(\frac{1.455}{2\pi}\right)^2}$

$= 969.0181643$

upper bound = 984

lower bound = 969

(Total for Question 21 is 4 marks)

21 Jackson is trying to find the density, in g/cm^3, of a block of wood.
The block of wood is in the shape of a cuboid.

He measures

the length as 13.2 cm, correct to the nearest mm
the width as 16.0 cm, correct to the nearest mm
the height as 21.7 cm, correct to the nearest mm

$13.15 \leq L < 13.25$
$15.95 \leq W < 16.05$
$21.65 \leq h < 21.75$

He measures the mass as 1970 g, correct to the nearest 5 g.

$1967.5 \leq m < 1972.5$

By considering bounds, work out the density of the wood.
Give your answer to a suitable degree of accuracy.

You must show all your working and give a reason for your final answer.

Upper volume = $13.25 \times 16.05 \times 21.75 = 4625.409375$

Lower volume = $13.15 \times 15.95 \times 21.65 = 4540.925125$

Upper bound density = $\frac{1972.5}{4540.925125} = 0.4343828506$

Lower bound density = $\frac{1967.5}{4625.409375} = 0.4253677546$

Both values round to 0.43 to 2 decimal places

0.43 g/cm^3

(Total for Question 21 is 5 marks)

22 Ebony makes some bracelets to sell.

The materials to make all the bracelets cost £190, correct to the nearest £5
Ebony sells all the bracelets for a total of £875, correct to the nearest £5

The total time taken to make and sell all these bracelets was 72 hours, correct to the nearest hour.

Ebony uses this method to calculate her hourly rate of pay

$$\text{Hourly rate of pay} = \frac{\text{total selling price} - \text{total cost of materials}}{\text{total time taken}}$$

The minimum hourly rate of pay for someone of Ebony's age is £8.20

By considering bounds, determine if Ebony's hourly rate of pay was definitely more than £8.20
You must show all your working.

$187.5 \leqslant x < 192.5$

$872.5 \leqslant y < 877.5$

$71.5 \leqslant h < 72.5$

Lower bound $= \frac{872.5 - 192.5}{72.5} = 9.379310344$

$= £9.38$

Yes £9.38 is more than £8.20

(Total for Question 22 is 4 marks)

22 $D = \dfrac{x}{y}$

$x = 99.7$ correct to 1 decimal place.
$y = 67$ correct to 2 significant figures.

Work out an upper bound for D.

$99.65 \leq x < 99.75$

$66.5 \leq y < 67.5$

Upper bound for $D = \dfrac{99.75}{66.5}$

$= 1.5$

1.5

(Total for Question 22 is 3 marks)

23 A race is measured to have a distance of 10.6 km, correct to the nearest 0.1 km.
Sam runs the race in a time of 31 minutes 48 seconds, correct to the nearest second.

Sam's average speed in this race is V km/hour.

By considering bounds, calculate the value of V to a suitable degree of accuracy.
You must show all your working and give a reason for your answer.

$10.55 \leqslant d < 10.65$

$31m\ 47.5 \leqslant t < 31m\ 48.5$

1907.5 seconds 1908.5 seconds

$\frac{1907.5}{3600}$ $\frac{1908.5}{3600}$

$= 0.529861$ hours 0.530138 hours

upper speed $= \frac{10.65}{0.529861} = 20.09961103$

Lower speed $= \frac{10.55}{0.530138} = 19.90047874$

Both values round to 20 to 2 significant figures

20km/h

(Total for Question 23 is 5 marks)