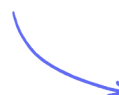


Rounding, Estimation & Bounds

Rounding & Estimation / Upper & Lower Bounds

Easy (18 questions)	/37
Medium (18 questions)	/56
Hard (17 questions)	/67
Very Hard (9 questions)	/39
Total Marks	/199

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Easy Questions

- 1 A number, n , is rounded to 2 decimal places.
The result is 4.76

Using inequalities, write down the error interval for n .

(2 marks)

- 2 The length, L cm, of a line is measured as 13 cm correct to the nearest centimetre.

Complete the following statement to show the range of possible values of L

..... $\leq L <$

(2 marks)

- 3 (a) Find the value of the reciprocal of 1.6
Give your answer as a decimal.

(1 mark)

- (b) Jess rounds a number, x , to one decimal place.
The result is 9.8

Write down the error interval for x .

(2 marks)

- 4 Jim rounds a number, x , to one decimal place.
The result is 7.2

Write down the error interval for x .

(2 marks)

- 5 When rounded to 3 significant figures, $x = 6.37$

Choose the correct error interval.

- A. $6.365 \leq x < 6.375$
- B. $6.36 \leq x < 6.38$
- C. $6.369 \leq x < 6.379$
- D. $6.365 \leq x < 6.3749$

(1 mark)

- 6 The height of a tree is 12 metres, correct to the nearest metre.

Choose the error interval.

- A. $11.5 \text{ m} \leq \text{height} < 12.5 \text{ m}$
- B. $11.5 \text{ m} \leq \text{height} \leq 12.5 \text{ m}$
- C. $11.5 \text{ m} < \text{height} \leq 12.5 \text{ m}$
- D. $11.5 \text{ m} < \text{height} < 12.5 \text{ m}$

(1 mark)

- 7 To the nearest 1000, there are 18 000 people at a festival.

i) Write down the minimum possible number of people at the festival.

[1]

ii) Write down the maximum possible number of people at the festival.

[1]

(2 marks)

- 8 The length of a table is 110 cm to the nearest cm

Complete the error interval.

$$\text{.....cm} \leq \text{length} < \text{.....cm}$$

(2 marks)

- 9 (a) The length of each side of a regular pentagon is 8.4 cm to 1 decimal place.

Complete the error interval for the length of one side.

$$\text{.....cm} \leq \text{length} < \text{.....cm}$$

(2 marks)

- (b) Complete the error interval for the perimeter.

$$\text{.....cm} \leq \text{perimeter} < \text{.....cm}$$

(1 mark)

- 10 Each side of a regular octagon has a length of 18 mm, correct to the nearest 0.5 mm

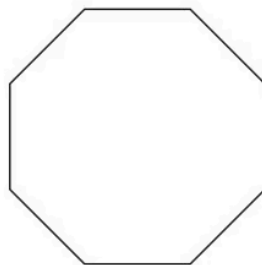


Diagram **NOT**
accurately drawn

- i) Write down the lower bound of the length of each side of the octagon.

[1]

- ii) Write down the upper bound of the length of each side of the octagon.

[1]

(2 marks)

11 The mass of a cat is 4.3 kg correct to 2 significant figures.

i) Write down the upper bound of the weight of the cat.

..... kg [1]

ii) Write down the lower bound of the weight of the cat.

..... kg [1]

(2 marks)

12 The length of a book is 33.8 cm, correct to one decimal place.

i) Write down the lower bound of the length of the book.

..... cm [1]

ii) Write down the upper bound of the length of the book.

..... cm [1]

(2 marks)

13 By writing each number correct to 1 significant figure, find an estimate for this calculation.

$$\frac{606.3 \times 0.312}{19.93}$$

(3 marks)

14 Use the symbols $<$, $\leq$, $=$, $>$, $\geq$ or to complete this statement.

If $x = 4.7$, **truncated** to 1 decimal place, then $4.7 \dots\dots\dots x \dots\dots\dots 4.8$

(2 marks)

15 The length, d , of Jamal's car is 4.72 m, correct to 2 decimal places.

Complete the error interval for the length, d .

$\dots\dots\dots \leq d < \dots\dots\dots$

(2 marks)

16 Asha worked out $\frac{326.8 \times (6.94 - 3.4)}{59.4}$

She got an answer of 19.5, correct to 3 significant figures.

Write each number correct to 1 significant figure to decide if Asha's answer is reasonable.

(3 marks)

17 The length, L , of a steel rod is 8.3 m, correct to 1 decimal place. Complete the error interval for length L .

$\dots\dots\dots \leq L < \dots\dots\dots$

(2 marks)

18 Write 8565 correct to 3 significant figures.

(1 mark)

Medium Questions

- 1 (a)** 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

Write down the lower bound for p .

(1 mark)

(b)
$$r = p + \frac{1}{q}$$

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

(3 marks)

2
$$I = 5(v - u)$$

$v = 14$ 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.

(3 marks)

3
$$a = \frac{v - u}{t}$$

$v = 37.6$ 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.

(3 marks)

4 $D = \frac{x}{y}$

$x = 99.7$ correct to 1 decimal place.

$y = 67$ correct to 2 significant figures.

Work out an upper bound for D .

(3 marks)

5 There are 892 litres of oil in Mr Aston's oil tank.

He uses 18.7 litres of oil each day.

Estimate the number of days it will take him to use all the oil in the tank.

(2 marks)

6 Work out an estimate for $\frac{31 \times 9.87}{0.509}$

(3 marks)

7 (a) Work out an estimate for the value of $\sqrt{63.5 \times 101.7}$.

(2 marks)

(b) $(2.3)^6 = 148$ correct to 3 significant figures.

Find the value of $(0.23)^6$ correct to 3 significant figures.

(1 mark)

(c) Find the value of 5^{-2} .

(1 mark)

8 Sally used her calculator to work out the value of a number y .
The answer on her calculator display began

8.3

Complete the error interval for y .

..... $\leq y <$
(2 marks)

9 To the nearest pound, Jon has £9

To the nearest 50p, Ellie has £6.50

Work out the maximum possible total amount of money.

£.....

(3 marks)

- 10 Use approximations to estimate the answer to $\frac{\sqrt{97} + 2.014^3}{0.49}$

(3 marks)

- 11 (a) The length of a pipe is 6 metres to the nearest metre.

Complete the error interval for the length of the pipe.

.....m $\leq$ length <m

(2 marks)

- (b) The length of a different pipe is 4 metres to the nearest metre.

Olly says,

"The total length of the two pipes is 11 metres to the nearest metre."

Give an example to show that he could be correct.

(2 marks)

12 $k = \frac{t}{a - h}$

$t = 14$ correct to 2 significant figures

$a = 7.8$ correct to 2 significant figures

$h = 3.4$ correct to 2 significant figures

Work out the lower bound for the value of k .

Show your working clearly.

(3 marks)

13 Nav has worked out $\frac{68.3 \times 42.8}{0.021}$ on his calculator.

His answer is 139 201.9048

Using suitable approximations, check that his answer is sensible.
Show your working clearly.

(2 marks)

14 (a) $P = ef$

$e = 4.8$ correct to 2 significant figures.

$f = 0.26$ correct to 2 significant figures.

Work out the lower bound for the value of P .

Show your working clearly.

Give your answer correct to 3 significant figures.

(2 marks)

(b) $Q = \frac{t}{w}$

$t = 2.73$ correct to 3 significant figures.

$w = 0.04$ correct to 1 significant figure.

Work out the upper bound for the value of Q .

Show your working clearly.

Give your answer correct to 2 significant figures.

(2 marks)

- 15 By writing each number correct to 1 significant figure, use estimation to show that

$$\frac{39.6 \times 20.2}{\sqrt{99.2}} \approx 80$$

(3 marks)

- 16 Last year, Katie earned £16200.
Her total loan repayments were £6400.
Katie estimates that the ratio of her loan repayments to her earnings is approximately 3 : 8.

Is she correct?

Show your reasoning.

(3 marks)

- 17 Safety rules on a campsite require Sarah to set up her barbecue at least 4 m from her tent.
She decides to measure this distance using her stride length. Sarah knows that her stride length is 0.8 m, rounded to the nearest 0.1 m.

Find the minimum number of strides Sarah will need to take to **guarantee** that her barbecue is a safe distance from her tent.

18 Anja is a Type 1 Diabetic.

She must take 1 unit of insulin for **approximately** every 7 grams of carbohydrates she consumes.

If a meal or snack consists of less than 7 grams of carbohydrates, Anja does not take insulin for it.

Here is a day from Anja's food journal.

Meal	What I Ate	Carbs	Units of Insulin
Breakfast	Toast	26g	
	Orange Juice	36g	
Snack 1	Cheese and Olives	2g	
Lunch	Chicken Sandwich	50g	
Snack 2	Rice Cakes	12g	
Dinner	Lasagne	38g	

Complete the table above by **estimating** how many units of insulin is required with each meal.

(4 marks)

Hard Questions

- 1 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 .

(4 marks)

- 2 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.

(4 marks)

- 3 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.

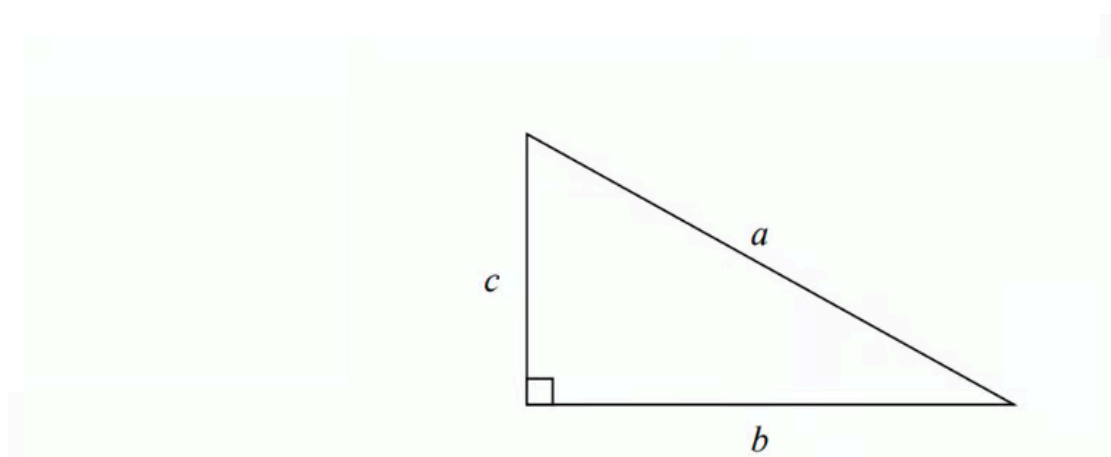
$b = 5.2$ cm correct to the nearest mm.

$C = 63^\circ$ correct to the nearest degree.

Calculate the lower bound for the area of the triangle.

(3 marks)

4



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.

(4 marks)

- 5 (a)** A train travelled along a track in 110 minutes, correct to the nearest 5 minutes.

Jake finds out that the track is 270 km long.

He assumes that the track has been measured correct to the nearest 10 km.

Could the average speed of the train have been greater than 160 km/h?

You must show how you get your answer.

(4 marks)

- (b)** Jake's assumption was wrong.

The track was measured correct to the nearest 5 km.

Explain how this could affect your decision in part (a).

(1 mark)

- 6** 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,

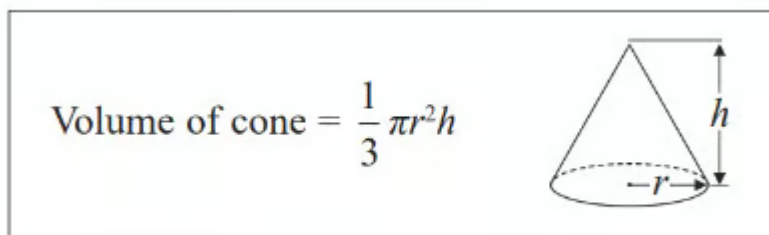
"My car used less than 8 litres of petrol per 100 kilometres."

Could Nathan be wrong?

You must show how you get your answer.

(3 marks)

- 7 (a)** A cone has a volume of 98 cm^3 .
The radius of the cone is 5.13 cm .



Work out an estimate for the height of the cone.

(3 marks)

- (b)** John uses a calculator to work out the height of the cone to 2 decimal places.

Will your estimate be more than John's answer or less than John's answer?
Give reasons for your answer.

(1 mark)

- 8** Work out an estimate for $\sqrt{4.98 + 2.16 \times 7.35}$

(3 marks)

9 Margaret has some goats.

The goats produce an average total of 21.7 litres of milk per day for 280 days.

Margaret sells the milk in $\frac{1}{2}$ litre bottles.

Work out an estimate for the total number of bottles that Margaret will be able to fill with the milk.

You must show clearly how you got your estimate.

(3 marks)

10

Competition
a prize every 2014 seconds

In a competition, a prize is won every 2014 seconds.

Work out an estimate for the number of prizes won in 24 hours. You must show your working.

(4 marks)

11 (a) The mass of Jupiter is 1.899×10^{27} kg.

The mass of Saturn is 0.3 times the mass of Jupiter.

Work out an estimate for the mass of Saturn.

Give your answer in standard form.

(3 marks)

- (b)** Give evidence to show whether your answer to (a) is an underestimate or an overestimate.

(1 mark)

12 (a) $D = \frac{u^2}{2a}$

$u = 26.2$ correct to 3 significant figures

$a = 4.3$ correct to 2 significant figures

Calculate the upper bound for the value of D .

Give your answer correct to 6 significant figures.

You must show all your working.

(3 marks)

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

By considering bounds, write down the value of D to a suitable degree of accuracy.

You must give a reason for your answer.

(2 marks)

13 Edith's van can safely carry a maximum load of 920 kilograms. She wants to use her van to carry

- 30 sacks of potatoes, each of mass 25 kilograms to the nearest kilogram
- and 20 sacks of carrots, each of mass 7.5 kilograms to 1 decimal place.

Can she definitely use her van safely in one journey?

You **must** show your working.

(4 marks)

- 14** The length of a roll of ribbon is 30 metres, correct to the nearest half-metre.

A piece of length 5.8 metres, correct to the nearest 10 centimetres, is cut from the roll.

Work out the maximum possible length of ribbon left on the roll.

.....metres

(3 marks)

- 15** Claudine cycled a distance of 53 km in 2.7 hours.

The distance is measured correct to the nearest km.

The time is given correct to 1 decimal place.

Calculate the lower and upper bounds of her average speed.

Give your answers correct to 2 decimal places.

Lower bound = km/h

Upper bound = km/h

(6 marks)

- 16** Sunil makes 7.5 litres of soup, correct to the nearest 0.5 litre.
He serves the soup in 300 ml portions, correct to the nearest 10 ml.
24 people order this soup.

Does Sunil definitely have enough soup to serve the 24 people? Show how you decide.

(4 marks)

- 17** The distance between Bristol and Leeds is 210 miles to the nearest 10 miles.

Derrick's average driving speed is 60 mph to the nearest mph.

Calculate the upper bound for the time it takes Derrick to travel from Bristol to Leeds.

Give your answer in hours and minutes, to the nearest minute.

(4 marks)

Very Hard Questions

1 $m = \frac{\sqrt{s}}{t}$

$s = 3.47$ correct to 2 decimal places

$t = 8.132$ correct to 3 decimal places

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

(5 marks)

- 2 A road is 4530 m long, correct to the nearest 10 metres.
Kirsty drove along the road in 205 seconds, correct to the nearest 5 seconds.

The average speed limit for the road is 80 km/h.

Could Kirsty's average speed have been greater than 80 km/h?

You must show your working.

(4 marks)

- 3 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

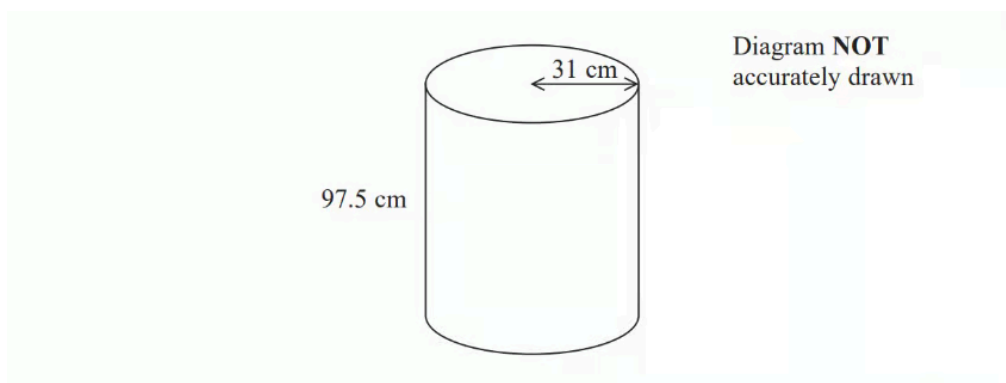
He measures the mass as 1970 g, correct to the nearest 5 g.

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.

(5 marks)

- 4 Sanders has a water tank for storing rainwater.



The tank is in the shape of a cylinder.
The radius of the cylinder is 31 cm.

The height of the cylinder is 97.5 cm.

The tank is full of water.

Work out an estimate for the volume of water in the tank.

Give your answer in litres.

You must show your working.

Use $1000 \text{ cm}^3 = 1 \text{ litre}$.

(3 marks)

5 (a) A cycle race across America is 3069.25 miles in length.

Juan knows his average speed for his previous races is 15.12 miles per hour.

For the next race across America he will cycle for 8 hours per day.

Estimate how many days Juan will take to complete the race.

(3 marks)

(b) Juan trains for the race.

The average speed he can cycle at increases.

It is now 16.27 miles per hour.

How does this affect your answer to part (a)?

(1 mark)

- 6 (a) One uranium atom has a mass of 3.95×10^{-22} grams.

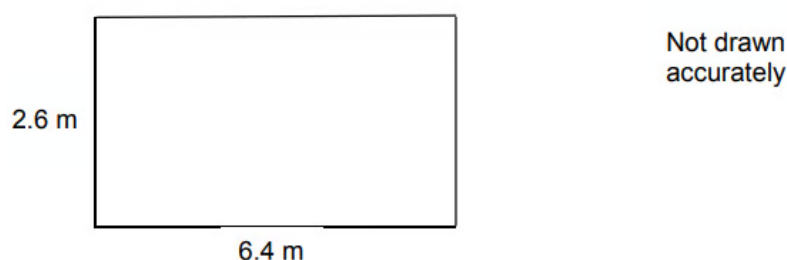
Work out an estimate for the number of uranium atoms in 1 kg of uranium.

(3 marks)

- (b) Is your answer to (a) an underestimate or an overestimate?
Give a reason for your answer.

(1 mark)

- 7 The dimensions of a rectangular floor are to the nearest 0.1 metres.



A force of 345 Newtons is applied to the floor.
The force is to the nearest 5 Newtons.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the upper bound of the pressure.
Give your answer to 4 significant figures.
You **must** show your working.

.....N/m²

(5 marks)

- 8 A £1 coin weighs 8.75 g, correct to the nearest 0.01 g.
Mitul weighs the contents of a large bag of £1 coins.
The coins weigh 2.63 kg, correct to the nearest 10 g.

Mitul says

"I am sure that the bag contains exactly £300 because, using bounds,
 $2625 \div 8.755 = 299.8$ to 1 decimal place."

Show that Mitul may not be correct.

(3 marks)

- 9 A metal block is measured to have a mass of 3.2 kg, correct to the nearest 0.1 kg.
The volume of the block is measured to be 400 cm^3 , correct to the nearest 10 cm^3 .
The density of the metal is $D \text{ g/cm}^3$.

By considering bounds, calculate the value of D to a suitable degree of accuracy.

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

(6 marks)