Worksheet - Number: approximation, error intervals and calculators

Year: Year 9 · 20

Show your working.

Question 1

Question 1 – Rounding to decimal places *(Section A · Skills practice)*

Round each number to the number of decimal places (dp) given. Look at the next digit: 5 or more rounds up.

a. 3.4678 to 1 dp
b. 3.4678 to 2 dp
c. 12.0549 to 2 dp
d. 0.0996 to 2 dp

Question 2

Question 2 – Rounding to significant figures *(Section A · Skills practice)*

The first significant figure (sf) is the first non-zero digit. Round each number to the number of significant figures given.

a. $48\,726$ to 1 sf
b. $48\,726$ to 2 sf
c. $48\,726$ to 3 sf
d. 0.004582 to 2 sf

Question 3

Question 3 – Estimating calculations *(Section A · Skills practice)*

Estimate each answer by rounding every number to 1 significant figure. Then use a calculator to see how close you are.

a. 4.9×19.8
b. $312 \div 5.9$
c. $\dfrac{8.1 + 11.8}{3.9}$
d. $\sqrt{50}$ (hint: use a square number near 50)

Question 4

Question 4 – Writing error intervals *(Section A · Skills practice)*

An error interval shows all the values that round to a given number. Use inequalities to write each one: the lower bound is included ($\leq$) and the upper bound is not ().



a. $x = 7$ to the nearest whole number
b. $x = 3.4$ to 1 decimal place
c. $x = 250$ to the nearest 10
d. $x = 0.8$ to 1 significant figure

Question 5

Question 5 – Upper and lower bounds *(Section A · Skills practice)*

Each measurement has been rounded. Write down the lower bound and the upper bound.

a. A length of 12 cm to the nearest centimetre
b. A mass of 4.5 kg to the nearest 0.1 kg
c. A time of 9.8 s to the nearest 0.1 s
d. A volume of 200 ml to the nearest 10 ml

Question 6

Question 6 – Types of number *(Section A · Skills practice)*

A rational number can be written as a fraction of two integers, and its decimal either stops or repeats. An irrational number cannot, for example π and $\sqrt{2}$. Classify each number.

a. $\sqrt{16}$
b. $\sqrt{5}$
c. $\dfrac{22}{7}$
d. 0.2
e. π
f. -3

Question 7

Question 7 – The football crowd *(Section B · Real-life practice)*

The newspaper says that 38 500 fans watched the cup match at the stadium. This number was rounded to the nearest hundred. The club shop says the real number was 38 462.

a. Round 38 462 to the nearest hundred and to the nearest thousand.
b. Write the error interval for 38 500 rounded to the nearest hundred.
c. Show that 38 462 is inside this interval.
d. A fan says that 38 560 could be the true number. Is she right?
e. Each fan paid an average of £28.50. Estimate the money taken, using 40 000 fans and £30.

Question 8

Question 8 – Estimating the shopping *(Section B · Real-life practice)*

At the supermarket Kofi buys four items costing £2.95, £4.10, £0.99 and £6.05. He has £15 in his pocket and wants to check he has enough without a calculator.

a. Round each price to the nearest pound and estimate the total.
b. Work out the exact total.
c. Is his estimate an over-estimate or an under-estimate?
d. He also buys 7 packets of crisps at 49p each. Estimate the cost by rounding 49p to 50p, then find the exact cost.

Question 9

Question 9 – Fuel use *(Section B · Real-life practice)*

A car travels 312 miles on 38.6 litres of petrol. Dad wants to estimate the miles per litre.

a. Round both numbers to 1 significant figure and estimate the miles per litre.
b. Use a calculator to work out the exact value to 3 significant figures.
c. How much does the estimate differ from the exact answer?
d. Petrol costs £1.45 per litre. Work out the cost of the 38.6 litres, giving your answer to the nearest penny.

Question 10

Question 10 – Flooring the bedroom *(Section B · Real-life practice)*

Aisha's bedroom is 4.6 m long and 3.8 m wide. Both measurements are given to 1 decimal place.

a. Write the error interval for each measurement.
b. Work out the smallest possible area of the floor.
c. Work out the largest possible area of the floor.
d. Flooring is sold in whole square metres. How many square metres should she buy to be certain she has enough?
e. Flooring costs £13.50 per square metre. Find the cost of this flooring.

Question 11

Question 11 – Sprint speed *(Section B · Real-life practice)*

Eva ran 100 m (to the nearest metre) in 10.4 seconds (to the nearest tenth of a second). Her coach wants to know her speed.

a. Work out her speed using the given values, to 2 decimal places.
b. Write down the bounds for the distance and the time.
c. Find the upper bound for her speed.
d. Find the lower bound for her speed.
e. Give her speed to a suitable accuracy and justify it.

Question 12

Question 12 – Calculator use *(Section B · Real-life practice)*

Kamal uses his calculator in a maths lesson. He needs to remember the order of operations and use brackets.

a. Work out $\dfrac{7.2 + 3.85}{4.6 - 1.9}$ to 3 significant figures.
b. Work out $\sqrt{6.5^2 + 3.2^2}$ to 2 decimal places.
c. Kamal types $12.5 \div 2.5 + 3.5$ and gets 8.5. What is the correct answer to $12.5 \div (2.5 + 3.5)$?
d. Round your answer to part (c) to 2 decimal places.

Question 13

Question 13 – The town population *(Section B · Real-life practice)*

A road sign says the population of Millbrook is 24 600, correct to 3 significant figures.

a. Write the error interval for the population.
b. What is the smallest whole number that could be the population?
c. What is the greatest whole number that could be the population?
d. The council says that 1 in 8 people uses the bus. Estimate how many that is, using 25 000.

Question 14

Question 14 – Painting the wall *(Section B · Real-life practice)*

A decorator is painting a wall 5.2 m long and 2.8 m high. One litre of paint covers 11 m^2.

a. Estimate the area by rounding to 1 significant figure.
b. Work out the exact area.
c. Estimate the litres of paint needed using your estimate.

d. Work out the exact litres needed, and say how many 1-litre tins she must buy.

Question 15

Question 15 – The rounding table *(Section C · Problem solving)*

A table shows three numbers rounded in different ways. Complete it.

Number	1 dp	2 sf	Nearest 100
4 678.349	?	?	?
0.05437	?	?	?
12 996.5	?	?	?

a. Complete the table.
b. Which entry shows that rounding to 2 dp and 2 sf give different results for 0.05437? Give both.
c. Explain why rounding 12 996.5 to 2 sf looks like a big change.
d. Write the error interval for 13 000 rounded to 2 sf.

Question 16

Question 16 – Bounds of a rectangle *(Section C · Problem solving)*

A rectangle measures 8.4 cm by 5.2 cm, each to 1 decimal place.

	Length	Width
Lower bound	8.35	5.15
Upper bound	8.45	5.25

a. Find the lower and upper bounds of the area.
b. Find the lower and upper bounds of the perimeter.
c. Is it correct to give the area as 43.68 cm^2? Explain.
d. Give the area to a suitable degree of accuracy.

Question 17

Question 17 – Density in the science lab *(Section C · Problem solving)*

In a science experiment a pupil measures a metal block. The mass is 250 g to the nearest 10 g. The volume is 80 cm^3 to the nearest cm^3. Density = mass ÷ volume.

a. Write the bounds for the mass and for the volume.
b. Find the greatest possible density to 4 decimal places.
c. Find the least possible density to 4 decimal places.
d. What can you say about the density correct to 1 significant figure?
e. Explain which bounds you used for the greatest density.

Question 18

Question 18 – Error intervals for measurements *(Section C · Problem solving)*

Four quantities were measured and rounded.

Quantity	Value	Rounded to
a	45	the nearest 5
b	0.62	2 decimal places
c	1 200	2 significant figures
d	3.0	1 decimal place

a. Write the error interval for each quantity.
b. Work out the width of each interval (upper bound minus lower bound).
c. Which quantity has the biggest uncertainty?
d. Is $c = 1\,249$ possible? What about $c = 1\,250$?

Question 19

Question 19 – Rational or irrational? *(Section C · Problem solving)*

Look at these decimal expansions.

Number	Decimal
$\frac{1}{3}$	0.3333...
$\frac{1}{8}$	0.125
$\frac{1}{7}$	0.142857142857...
$\sqrt{2}$	1.41421356...
π	3.14159265...

a. Which numbers are rational? What is the pattern in their decimals?
b. Explain why $\sqrt{2}$ and π are irrational.
c. Is $2 + \sqrt{3}$ rational or irrational? Is $\sqrt{2} \times \sqrt{2}$ rational?
d. Show that $0.\dot{7} = \dfrac{7}{9}$ using $x = 0.777\ldots$ and $10x = 7.777\ldots$.

Question 20

Question 20 – Challenge: hidden bounds *(Section D · Challenge)*

A rectangle has an area of 24 cm^2, correct to the nearest cm^2, and a length of 6 cm, correct to the nearest cm.

a. Write the error intervals for the area and for the length.
b. Find the greatest possible width (use the greatest area and the least length).

c. Find the least possible width.
d. Could the width be exactly 4 cm?
e. Could the width be exactly 4.5 cm? Explain.