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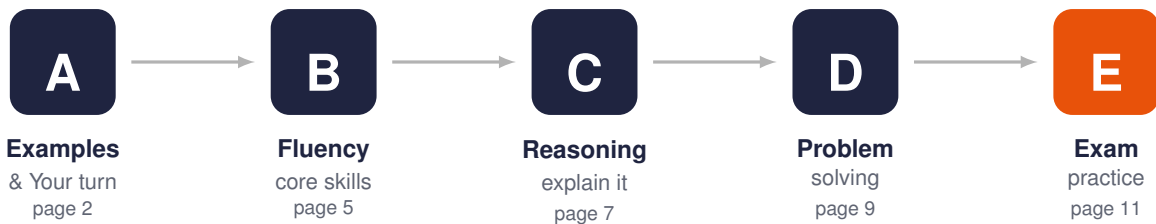
GCSE MATHEMATICS • NUMBER

Rounding and Estimation

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Free Rounding and Estimation worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: round to decimal places and significant figures, and truncate • estimate calculations by rounding to 1 significant figure • use estimates to check answers • *Higher*: decide whether an estimate is an overestimate or an underestimate, estimate roots of any number, and estimate with formulae.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Judging whether an estimate is too big or too small, estimating roots, estimating inside formulae, and knowing when 1 significant figure is a poor choice.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	11	15	12
Higher marks	13	14	17	17
My score				

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A**Worked examples & Your turn**

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1: significant figures

Write each number correct to 2 significant figures.

(a) 0.064 72 (b) 38 471

The first significant figure is the first digit that is not zero. Look at the digit after the 2nd significant figure.

(a) 0.06472 7 rounds the 4 up

(b) 38471 4 leaves the 8, then fill with zeros

(a) 0.065 (b) 38 000

Your turn A1

Write each number correct to 2 significant figures.

(a) 0.003 851 (b) 7249

Worked example A2: estimating

Work out an estimate for $\frac{31.2 \times 4.87}{9.8}$

Round every number to 1 significant figure.

$$\frac{30 \times 5}{10}$$

Now it can be done in your head.

$$\frac{150}{10} = 15$$

15

Your turn A2

Work out an estimate for $\frac{58.7 \times 2.13}{5.9}$

Worked example A3: dividing by a decimal less than 1

Work out an estimate for $\frac{412 + 189}{0.52}$

Round to 1 significant figure. 0.52 rounds to 0.5, not to 1.

$$\frac{400 + 200}{0.5} = \frac{600}{0.5}$$

Dividing by 0.5 is the same as multiplying by 2.

$$600 \div 0.5 = 1200$$

1200

Your turn A3

Work out an estimate for $\frac{78.3 - 19.6}{0.21}$



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HIGHER*Higher strategies: these are new ways of thinking, not longer sums***Worked example A4: is the estimate too big or too small?**

An estimate for $\frac{38.6}{4.2}$ is $\frac{40}{4} = 10$

Is this an overestimate or an underestimate? Give a reason.

Track the direction of each rounding.

The top was rounded **up**: this makes the answer bigger.

The bottom was rounded **down**: dividing by a smaller number also makes the answer bigger.

Both changes push the same way.

overestimate

Your turn A4

An estimate for $\frac{81.4}{38.7}$ is $\frac{80}{40} = 2$

Is this an overestimate or an underestimate? Give a reason.

Worked example A5: estimating a square root

Estimate the value of $\sqrt{87}$ correct to 1 decimal place.

Find the square numbers on each side.

$9^2 = 81$ and $10^2 = 100$, so $\sqrt{87}$ is between 9 and 10

How far along is it? 87 is 6 above 81, and the gap from 81 to 100 is 19.

$\frac{6}{19}$ is about 0.3

$\sqrt{87} \approx 9.3$

Your turn A5

Estimate the value of $\sqrt{55}$ correct to 1 decimal place.



Worked example A6: estimating inside a formula

The volume of a cylinder is $V = \pi r^2 h$

Estimate V when $r = 4.9$ cm and $h = 19.6$ cm.

Round everything to 1 significant figure, including $\pi \approx 3$.

$$V \approx 3 \times 5^2 \times 20$$

Power first.

$$3 \times 25 \times 20 = 1500$$

1500 cm^3

Your turn A6

A metal block is a cuboid measuring 4.1 cm by 4.9 cm by 9.8 cm. Its mass is 592 g.

density = mass $\div$ volume

Estimate the density of the metal.

Worked example A7: when 1 significant figure is a poor choice

Work out a good estimate for 14.8×6.2

To 1 significant figure this is $10 \times 6 = 60$. But 14.8 has lost a third of its size, so the estimate will be far too small.

*Round to numbers that are close **and** easy.*

$$15 \times 6 = 90$$

90

Your turn A7

Work out a good estimate for 24.7×3.9

Explain why you did not round 24.7 to 1 significant figure.



B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer? No calculator.

FOUNDATION*Everyone starts here***B1** Round**(a)** 3746 to the nearest 10**(b)** 3746 to the nearest 100**(c)** 3746 to the nearest 1000**(d)** 3996 to the nearest 10**[4 marks]****B2** Round**(a)** 6.2849 to 1 decimal place**(b)** 6.2849 to 2 decimal places**(c)** 6.2849 to 3 decimal places**(d)** 4.997 to 2 decimal places**[4 marks]****B3** Write**(a)** 48 362 correct to 1 significant figure**(b)** 48 362 correct to 3 significant figures**(c)** 0.070 56 correct to 1 significant figure**(d)** 0.070 56 correct to 3 significant figures**[4 marks]****B4** Round or truncate each number as instructed.**(a)** Round 7.869 to 1 decimal place**(b)** Truncate 7.869 to 1 decimal place**(c)** Truncate 0.4382 to 2 decimal places**(d)** Round 59.96 to 1 decimal place**[4 marks]****B5** By rounding each number to 1 significant figure, work out an estimate for**(a)** 38×52 **(b)** $612 \div 28$ **(c)** 7.8^2 **(d)** 203×0.48 **[4 marks]****B6** Work out an estimate for**(a)** $\frac{6.1 \times 3.9}{2.2}$ **(b)** $\frac{89.3 + 10.8}{4.7}$ **(c)** $\frac{297}{0.31 \times 9.6}$ **[3 marks]**

HIGHER*Higher tier only*

- B7** For each root, write down the two consecutive whole numbers it lies between, then estimate its value to 1 decimal place.

(a) $\sqrt{30}$

(b) $\sqrt{150}$

(c) $\sqrt[3]{70}$

[6 marks]

- B8** Each calculation has been estimated by rounding to 1 significant figure.

Decide whether each estimate is an overestimate or an underestimate. In part (d), explain why you need more than the direction of rounding.

(a) $4.8 \times 6.9 \approx 5 \times 7$

(b) $82.1 - 37.8 \approx 80 - 40$

(c) $9.3 \div 2.7 \approx 9 \div 3$

(d) $61 \times 0.48 \approx 60 \times 0.5$

[4 marks]

- B9** Work out an estimate for

(a) 3.1^3

(b) $\frac{\sqrt{98.7}}{0.21}$

(c) $\frac{19.8^2}{\sqrt[3]{8.3}}$

[3 marks]



C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Kai writes $19.7 \times 5.1 = 1004.7$
Without working out the exact answer, explain how you know Kai is wrong. [2 marks]
- C2** Ben rounds 2499 to the nearest 1000. He says, "2499 rounds to 2500, and 2500 rounds to 3000."
Explain why Ben is wrong. [2 marks]
- C3** Lia rounds 3.98 to 1 decimal place and writes 4
Explain why she should write 4.0 [2 marks]
- C4** 150 students are going on a trip. Each minibus holds 16 students.
Dan works out $150 \div 16 = 9.375$ and says 9 minibuses are needed.
Is Dan correct? Give a reason. [2 marks]
- C5** A number has 3 decimal places. It rounds to 5.4 correct to 1 decimal place and to 5.35 correct to 2 decimal places.
(a) Write down one possible value of the number. (b) Write down the largest possible value. [3 marks]



HIGHER*Higher tier only*

- C6** An estimate for $\frac{594}{0.31}$ is $\frac{600}{0.3} = 2000$

Is 2000 an overestimate or an underestimate? You must give a reason.

[2 marks]

- C7** Sam says, “40 is about halfway between 36 and 49, so $\sqrt{40}$ is about 6.5”

(a) Show that 6.5 is an overestimate for $\sqrt{40}$ (b) Work out a better estimate, correct to 1 decimal place.

[3 marks]

- C8** How many whole numbers round to 4000 when written correct to 1 significant figure?

You must show your working.

[3 marks]

- C9** Noor uses her calculator to work out $\frac{412 \times 6.85}{0.49 \times 71.2}$

Her calculator display shows 8.09

Use estimation to decide whether this is reasonable. Suggest what may have gone wrong.

[3 marks]

- C10** Eva estimates 1.49×1.49 by rounding each number to 1 significant figure.

(a) Show that Eva’s estimate is less than half of the exact value.

(b) Suggest a better way to estimate this calculation, and work it out.

[3 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step. No calculator.

FOUNDATION

Everyone starts here

- D1** Tickets for a show cost £18.75 each. 42 people buy a ticket.
Work out an estimate for the total cost. [2 marks]
- D2** A wall is 5.8 m long and 2.9 m high. One tin of paint covers 9.6 m^2 . The wall needs two coats of paint.
Work out an estimate for the number of tins needed. You must show your working. [4 marks]
- D3** A car travels 297 miles and uses 41.2 litres of fuel.
Estimate the number of miles the car travels for each litre of fuel. [2 marks]
- D4** Maria is paid £11.85 for each hour she works. She works 38.5 hours each week for 49 weeks of the year.
Work out an estimate for the amount Maria is paid in a year. [3 marks]
- D5** A cyclist rides at a steady speed of 19.2 kilometres per hour.
(a) Work out an estimate for the number of minutes the cyclist takes to ride 1 kilometre.
(b) Is your answer to part (a) an overestimate or an underestimate? Give a reason for your answer. [4 marks]



HIGHER*Higher tier only*

- D6** The volume of a sphere is $V = \frac{4}{3}\pi r^3$

Work out an estimate for the volume of a sphere with radius 2.9 cm.

[3 marks]

- D7** A country has a population of 67.8 million and an area of 243 000 km².

Work out an estimate for the number of people per square kilometre.

[3 marks]

- D8** A square field has an area of 8300 m².

Work out an estimate for the perimeter of the field. You must show how you estimated the square root.

[4 marks]

- D9** Jon wants to estimate 24.6×35.2

(a) Work out Jon's estimate if he rounds each number to 1 significant figure.

(b) Work out Jon's estimate if he rounds each number to the nearest 5

(c) The exact answer is 865.92 Which estimate is better? Explain why rounding to 1 significant figure works badly here.

[4 marks]

- D10** The time, T seconds, for one swing of a pendulum of length L metres is $T = 2\pi\sqrt{\frac{L}{g}}$

Work out an estimate for T when $L = 0.88$ and $g = 9.81$

[3 marks]



E**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark. No calculator.

FOUNDATION*Foundation and Higher crossover*

E1 (a) Write 7846 correct to the nearest hundred.

.....
(1)

(b) Write 3.4962 correct to 2 decimal places.

.....
(1)

(c) Write 0.004 072 correct to 2 significant figures.

.....
(1)

(d) Write 52 614 correct to 1 significant figure.

.....
(1)

(Total for Question E1 is 4 marks)

E2 Work out an estimate for $\frac{4.92 \times 30.4}{0.197}$

.....
(Total for Question E2 is 3 marks)



E3 A builder buys 289 tiles. Each tile costs £4.85

(a) Work out an estimate for the total cost of the tiles.

£

(2)

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

(1)

(Total for Question E3 is 3 marks)

E4 By rounding each number correct to 1 significant figure, show that an estimate for $\frac{11.2 + 18.9}{0.29 \times 5.1}$ is 20

You must show all your working.

(Total for Question E4 is 2 marks)



HIGHER*Higher tier only*

E5 A lorry travels 286 miles at an average speed of 52.4 miles per hour.

(a) Work out an estimate for the time the journey takes.

..... hours

(2)

(b) Is your answer to part (a) an overestimate or an underestimate? You must give a reason.

(2)

(Total for Question E5 is 4 marks)

E6 Work out an estimate for $\sqrt{7.92^2 + 6.13^2}$

.....

(Total for Question E6 is 3 marks)

E7 Tom works out $\frac{39.6 \times (8.12 - 3.9)}{0.52}$ and gets the answer 32.1

By writing each number correct to 1 significant figure, decide whether Tom's answer is reasonable.

(Total for Question E7 is 3 marks)



E8 Work out an estimate for $\sqrt[3]{65.2} \times \sqrt{0.0391}$

.....
(Total for Question E8 is 3 marks)

E9 n is a whole number.
 n is 350 when written correct to 2 significant figures.
 n is 300 when written correct to 1 significant figure.
 n is a multiple of 4
Find the value of n . You must show your working.

$n =$

(Total for Question E9 is 4 marks)

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