GCSE Maths – Number

Estimation and Approximation

Worksheet

WORKED SOLUTIONS

This worksheet will show you how to work out different types of estimation and approximation questions. Each section contains a worked example, a question with hints and then questions for you to work through on your own.

Section A

Worked Example

Round 94,721 to the nearest 1000

Step 1: Identify which digits we need to look at for the required rounding.

When rounding to the nearest 1000, we look at the digit to the right of the thousand's column. This is the hundreds digit.

$$94,\mathbf{7}21$$

The 7 represents the hundreds digit.

Step 2: Now, determine whether we round up or down.

$$7 > 5$$

Therefore, we round up the 'thousands' digit. This means we round up 4 thousand to 5 thousand.

Step 3: Now we change all the numbers to the right of the rounded digit to 0s.

$94{,}721$ *to the nearest thousand is* $\mathbf{95{,}000}$.

Guided Example

Round 578,942,342 to the nearest million

Step 1: Identify which digits we need to look at for the required rounding.

578, 942,342

8 is the 'millions' digit

look at 9 for the rounding

Step 2: Now, determine whether we round up or down.

9 ≥ 5 so round up

...8942342 → ...9000000

Step 3: Now we change all the numbers to the right of the rounded digit to 0s.

578, 942, 342 → 579,000,000

round up

change to 0s

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

1. Round 678450 to the nearest 1000

thousands digit (8000) — rounding digit

4 < 5 so round down
...8450 → ...8000
678450 rounds to **678000**

2. Round 0.048342 to 3 decimal places

'thousanth' digit ($\frac{1}{1000}$) — rounding digit

3 < 5 so round down
... 834 → ... 800
0·048342 → **0·048000**

3. Round 194.4532 to the nearest whole number

'whole number' digit (4) — rounding digit

4 < 5 so round down
... 4.45... → ... 4
194.4532 → **194**
194.000... is the same as 194

4. Round 0.00403093 to 3 significant figures

These are the 3.s.f. — rounding digit — 3 place values after the first non-zero digit

0 < 5 so round down
... 3093 → ... 8000
0·00403093 → **0·00403**
extra place values aren't needed for decimals.

5. Round 0.0888991 to 4 significant figures

4.s.f — rounding digit

9 > 5 so round up

However, as the previous digit is also a 9, we cannot add 1.
Instead, replace this 9 with a 0, and add 1 to the previous digit (8).
This has the same effect as 9 + 1 = 10, as shown below:

0·0888991
+ 1
10
0·0889000

0·0888991 → **0·08890**
include this 0 because it is now a significant figure

Section B

Worked Example

Estimate 603×31

Step 1: Round each number to 1 significant figure.

Rounding 603 *to 1 significant figure:* $603 \approx 600$
Rounding 31 *to 1 significant figure:* $31 \approx 30$

Step 2: Substitute the rounded values into the equation.

$$603 \times 31 \approx 600 \times 30$$

Step 3: Perform the calculation of this new expression.

$$600 \times 30 = \mathbf{18000}$$

The estimation of 603×31 is 18,000

Guided Example

Estimate $742998 \div 709$

Step 1: Round each number to 1 significant figure.

$742998 \rightarrow 700000$
$4 < 5$
so round down

$709 \rightarrow 700$
$0 < 5$
so round down

Step 2: Substitute the rounded values into the equation.

$700000 \div 700 \approx$

Step 3: Perform the calculation of this new expression.

$700000 \div 700 = 1000$

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

6. Estimate $24638 + 44282$ $\approx 25000 + 44000 \approx$ **69000**

round to 2 significant figures as addition is simpler and this will be more accurate

$24638 \rightarrow 25000$ $44282 \rightarrow 44000$

6 > 5 so round up 2 < 5 so round down

7. Estimate 44829×868 $\approx 40\,000 \times 900 \approx$ **36,000,000**

round to 1 s.f.

$44829 \rightarrow 40000$ $868 \rightarrow 900$

4 < 5 = round down 6 > 5 = round up

8. Estimate $679348 \div 723$ $\approx 700000 \div 700 \approx$ **1000**

round to 1 s.f.

$679348 \rightarrow 700000$

7 > 5 = round up

$723 \rightarrow 700$

2 < 5 = round down

9. Estimate $908629 \div 0.0722$ $\approx 900000 \div 0.07 \approx$ **12857143**

round to 1 s.f.

$908629 \rightarrow 900000$ $0.0722 \rightarrow 0.07$

0 < 5 = round down 2 < 5 = round down

10. Estimate $\dfrac{60.3 \div 2.88}{4.94}$ $\approx \dfrac{60 \div 3}{5} \approx \dfrac{20}{5} \approx$ **4**

$60.3 \rightarrow 60$

3 < 5 = round down

$2.88 \rightarrow 3$

8 > 5 = round up

$4.94 \rightarrow 5$

9 > 5 = round up

11. Estimate $\frac{20.1 \times 698.3}{19.87 \times 5.28}$

$\approx \frac{20 \times 700}{20 \times 5} \approx \frac{14000}{100} \approx 140$

$20.1 \rightarrow 20$ (1 < 5 = round down)

$698.3 \rightarrow 700$ (9 > 5 = round up)

$19.87 \rightarrow 20$ (8 > 5 = round up)

$5.28 \rightarrow 5$ (2 < 5 = round down)

12. Estimate $\frac{8.8 \times 20.3}{8.996 - 6.03}$

$\approx \frac{9 \times 20}{9 - 6} \approx \frac{180}{3} \approx 60$

$8.8 \rightarrow 9$ (8 > 5 = round up)

$20.3 \rightarrow 20$ (3 < 5 = round down)

$8.996 \rightarrow 9$ (9 > 5 = round up)

$6.03 \rightarrow 6$ (0 < 5 = round down)

13. In a cinema there are 39 rows and in each row there are 28 seats.
Each cinema ticket costs £9.75
Work out an estimate for the total income from ticket sales.

$39 \rightarrow 40$ (9 > 5 = round up)

$28 \rightarrow 30$ (8 > 5 = round up)

£9.75 → £10 (7 > 5 = round up)

total seats $\approx 40 \times 30 \approx 1200$

total income $\approx 1200 \times £10 \approx$ £12 000

This is an over-estimate because we rounded all values up.

14. Eleanor wants to buy 6 rubbers and 4 pencils. The rubbers cost £0.94 each and the pencils cost 52p each.

Find an estimate for how much this will cost Eleanor in £.

£0.94 → £1 (9 > 5 = round up)

52p = £0.52 → £0.50 (2 < 5 = round down)

[don't round to 1.s.f as this won't be a very accurate estimate!]

cost $\approx (6 \times £1) + (4 \times £0.50)$

$\approx £6 + £2$

$\approx £8$

This is a slight overestimate because we rounded up more than down.