GCSE Maths – Number

Estimation and Approximation

Notes

WORKSHEET

Approximation

When a question asks you to approximate a number, generally all it really asks you to do is to **round** that number.

There are three main ways to round a number:

1) Rounding to the **nearest unit, ten, hundred, thousand**, etc.
2) Rounding to a certain number of **decimal places.**
3) Rounding to a certain number of **significant figures.**

General rounding rules:

- If the number you are rounding is followed by 0, 1, 2, 3, or 4: round the number down.
- If the number you are rounding is followed by 5, 6, 7, 8, or 9: round the number up.

Example: Round $24{,}693$ to the nearest 10

When rounding $24{,}693$ *to the nearest* 10*, we look at the* ***tens digit****, which in this case is* 9*:*

$24{,}693$

3 *is the number on the right of it, which is smaller than* 5*, so we keep the digit* 9 *there. This is called* ***rounding down****. Now we change all the numbers to the right of* 9 *to* 0*s.*

Final answer: $\mathbf{24{,}690}$

Example: Round $24{,}693$ to the nearest 100

When rounding $24{,}693$ *to the nearest* 100*, we look at the* ***hundreds digit****, which in this case is* 6*:*

$24{,}693$

9 *is the number on the right of it, which is bigger than* 5*, so we increase the hundreds digit by one (so from* 6 *to* 7*). This is called* ***rounding up****. Now we change all the numbers to the right of* 7 *to* 0*s.*

Final answer: $\mathbf{24{,}700}$

Example: Round $2{,}981$ to 2 significant figures

When rounding $2{,}981$ *to* 2 *significant figures, we look at the* ***second digit from the left****, which in this case is* 9*:*

$2{,}981$

8 *is the number on the right of it, which is bigger than* 5*, so we* ***increase the second digit by one****. However, the second digit is* 9*, so we change it to* 0 *and increase the digit to the left by one (*2 *to* 3*). Now we change all the numbers to the right of the second digit to* 0*s.*

Final answer: $\mathbf{3{,}000}$

Example: Round 0.0000349359 to 3 significant figures

When rounding long decimals, we ignore all the leading zeros as they are not significant figures. This means that significant figures are counted after the first non-zero digit.

When rounding 0.0000349359 *to* 3 *significant figures, we look at the* ***third digit from the left after the zeros****, which in this case is* 9*:*

$$0.0000349359$$

3 *is the number on the right of it, which is less than* 5*, so we* ***round down and keep the digit*** 9 ***as it is.*** *We can now ignore all the digits after* 9 *but we must keep the zeros on the left.*

Final answer: $\mathbf{0.0000349}$

Example: Round 0.00400935 to 3 significant figures

When rounding 0.00400935 *to* 3 *significant figures, we look at the* ***third digit from the left after the zeros****, which in this case is* 0*:*
0.00400935

9 *is the number on the right of it, which is more than* 5*, so we* ***round up and increase*** 0 ***by one.*** *We can now ignore all the digits after the highlighted* 0 *but we must replace the highlighted* 0 *with* 1*.*

Final answer: $\mathbf{0.00401}$

Estimation

When estimating a calculation, you first approximate each number to a sensible significant figure. Then, carry on the calculation normally.

When estimating use the symbol $\approx$ *which means* ***"approximately equal to"****.*

Example: Estimate 38×92

Rounding 38 *to 1 significant figure:*
$38 \approx 40$

Rounding 92 *to 1 significant figure:*
$92 \approx 90$

$$38 \times 92 \approx 40 \times 90 = 3600$$

Example: Estimate $\frac{312\times19}{2.84}$

Rounding 312 *to 1 significant figure:*
$312 \approx 300$

Rounding 19 *to 1 significant figure:*
$19 \approx 20$

$312 \times 19 \approx 300 \times 20 = 6000$

Rounding 2.84 *to 1 significant figure:*
$2.84 \approx 3$

$$\frac{312 \times 19}{2.84} \approx \frac{6000}{3} = 2000$$

Example: Estimate $\frac{6.45-34.03}{5.499}$

Rounding 6.45 *to 1 significant figure:*
$6.45 \approx 6$

Rounding 34.03 *to 1 significant figure:*
$34.03 \approx 30$

$6.45 - 34.03 \approx 6 - 30 = -24$

Rounding 5.499 *to 1 significant figure:*
$5.499 \approx 5$

$$\frac{6.45 - 34.03}{5.499} \approx \frac{-24}{5} = -4.8$$

Example: An apple costs 54p and an orange costs 69p. Vanessa buys 57 apples and 71 oranges. Vanessa says she will be able to pay with a £50 note. Is she correct?

Rounding 54p to 1 significant figure: $54p \approx 50p$
Rounding 69p to 1 significant figure: $69p \approx 70p$
Rounding 57 to 1 significant figure: $57 \approx 60$
Rounding 71 to 1 significant figure: $71 \approx 70$

$50p \times 60 = 3000p = £30.00$
$70p \times 70 = 4900p = £49.00$

Vanessa pays approximately $£30$ *for apples and* $£49$ *for oranges.*
$30 + 49 = 79$
Vanessa pays approximately $£79$ *total for the apples and oranges.*

Final answer: No, Vanessa cannot pay with a $£50$ *note.*

Approximation and Estimation - Practice Questions

1) Round 678450 to the nearest 1000

2) Round 0.048342 to 3 decimal places

3) Round 194.4532 to the nearest whole number

4) Round 0.00403093 to 3 significant figures

5) Estimate $24638 + 44282$

6) Estimate 44829×868

7) Estimate $679348 \div 723$

8) Estimate $908629 \div 0.0722$

Worked solutions for the practice questions can be found amongst the worked solutions for the corresponding worksheet file.