

CHAPTER 3

Approximation and Estimation

Legend : d.p. : _____
s.f. : _____

1) Rounding off whole numbers and decimals (Recap of primary school)

Step 1 : Find the digit at the place you are rounding to.

Step 2 : Look at the next digit to its _____.

Step 3 : • If it is 5 or more $\rightarrow$ add _____ to the _____ digit (round _____).

• If it is less than 5 $\rightarrow$ Keep the _____ digit the _____ (round _____).

Step 4 : Remove the remaining digits (for _____) or add zero (for _____).

Eg: Round 5.3761 to 2 decimal places.

$\rightarrow$ Find the 2nd decimal place, which is _____.
 $\rightarrow$ The digit right after it is ____ $\rightarrow$ round _____.
 $\rightarrow$ Remove _____ digits

Eg: Round 673213 to the nearest 100.

$\rightarrow$ Find the digit in the hundreds place $\rightarrow$ _____.
 $\rightarrow$ The digit right after it is ____ $\rightarrow$ round _____.
 $\rightarrow$ Add _____ at the back

2) 5 rules of significant figures:

Rule 1 eg:	All non-zero digits _____. 323 (____), 78.23 (_____)
Rule 2 eg:	All zeros between non-zero digits _____. 303 (____), 700.43 (_____)
Rule 3 eg:	In a decimal, all zeros before a non-zero digit _____. 0.0037 (____), 0.203 (_____)
Rule 4 eg:	In a decimal, all zeros after a non-zero digit _____. 0.00730 (____), 0.1230400 (_____)
Rule 5	The zeros at the end of a whole number _____ significant, depending on how the number is rounded off
eg:	Consider 8397. If we round to 2 s.f. (or nearest hundred), we get _____. If we round to 3 s.f. (or nearest ten), we get _____. Hence, the number 8400 could have been either _____ or _____, depending on how it is rounded off.

3) Steps to round off numbers to given significant numbers

Step 1: Find the digit at the s.f. you are rounding to, starting from the first _____ digit.

Step 2: Look at the next digit to its _____.

Step 3: • If it is 5 or more $\rightarrow$ add _____ to the _____ digit (round _____).

• If it is less than 5 $\rightarrow$ Keep the _____ digit the _____ (round _____).

Step 4: Replace the _____ digits with _____ (if needed).

Eg 1: Correct 5.29837 to 3 significant figures.

$\rightarrow$ Significant digits : _____

$\rightarrow$ Next digit is _____ $\rightarrow$ round _____

Eg 2: Correct 0.00234017 to 2 significant figures.

$\rightarrow$ Significant digits : _____

$\rightarrow$ Next digit is _____ $\rightarrow$ round _____

Eg 3: Correct 79 243 to 3 significant figures.

TIP

After rounding, make sure the value is still _____ to the _____ value.

The number should _____ roughly the _____.

Eg: Round 375 to 2 s.f.

$\times$ 38 (too _____; value _____ too much)

$\checkmark$ _____ (correct; Add _____)

4) Estimation

Step 1: Round off every number (use " $\square$ ")

• General rule: round to the nearest _____ or _____ (unless otherwise stated).

• For square roots $\square$ or cube roots $\square$, round the number inside to the nearest _____ or _____ eg: $\sqrt{24.7} \approx$

$\rightarrow$ perfect squares:

$\rightarrow$ perfect cubes:

} use your calculator to check!

Step 2: Calculate (use " $\square$ ")

• This step should be simple enough to do _____ a calculator.

Step 3: _____ final answer according to the question.

Eg 1: Estimate 30.2×0.48 .

Here, we round 0.48 to ____ as ____ is the same as ____, which is easy to mental calculate.

Eg 2: Estimate the value of $\frac{9.8^2 - \sqrt{147}}{1.9 \times \sqrt[3]{67.04}}$, giving your answer correct to 1 significant figure.

* Take note of presentation!

use for first step when estimating

and for the other steps.

Eg 3: Calculate the value of $\frac{9.8^2 - \sqrt{147}}{1.9 \times \sqrt[3]{67.04}}$, giving your answer correct to 3 significant figures.

"Calculate" means you can just key it into your calculator.

Eg 4: By rounding off each number correct to 1 significant figure, estimate the value of $80.4 - 3.31 \times 28.731$.

5) General Rule of Thumb on rounding in Mathematics

- Leave your intermediate and final answers in _____ (_____) when possible.
- If the question does not specify the required accuracy, follow these:

	Final Answer (round off)	Intermediate Steps (exact/truncate) → Truncate : _____
Money		At least
Angles	degrees	At least
	3 s.f. radians	At least 5 s.f.
Others		At least

* Only Sec 3 onwards

6) Common Specific Rounding Examples :

Round to nearest...	Given number	Rounded final answer
dollar	\$243.853	
\$10	\$243.853	
\$100	\$243.853	
cent	\$243.853	
10 cents	\$243.853	
second	54.319s	
10 seconds	54.319s	
hour	3.75 h	
whole number	6724.2089	
10 000 cm	268 492	
m ³	34 298.51m ³	
0.1 m	14.28 m	
$\frac{1}{100}$ Kg	0.456 Kg	