Chapter 11

Rounding estimation and significant figures

Learn the ideas below, follow each worked example, then attempt the practice before checking the answers.

11.1 Rounding to a place value

Choose the place you are rounding to, then look at the next digit. If that digit is 5 or more, increase the retained digit by 1. Otherwise keep it. Replace later whole number places with zeros and remove unnecessary later decimal places. This course uses the usual school rounding convention.

Worked example 47,682 to the nearest thousand is 48,000 because the hundreds digit is 6. To the nearest hundred it is 47,700 because the tens digit is 8.

11.2 Decimal places

Decimal places count digits after the decimal point, including zeros. Round by examining the next place. When the requested accuracy needs a trailing zero, retain it to show precision. Carrying can change digits farther to the left.

Worked example 6.295 to two decimal places is 6.30. The third decimal digit is 5, so the hundredths increase from 9 and create a carry. The final zero shows two decimal places.

11.3 Significant figures

Count significant figures from the first nonzero digit. Zeros between significant digits count. Leading zeros do not count. Trailing zeros after a decimal point count when they show stated precision. Use scientific notation when whole number trailing zeros would be ambiguous.

Worked example 0.004072 to three significant figures is 0.00407. The significant digits begin at 4. The number 6.20 has three significant figures, while 6.2 has two.

11.4 Estimating calculations

Replace values with nearby easy numbers before calculating. An estimate checks whether an exact result has a sensible size. One significant figure often gives a quick estimate. Use $\approx$ for approximately equal, because rounding changes the original values.

Worked example $\dfrac{198 \times 4.9}{0.51} \approx \dfrac{200 \times 5}{0.5} = 2{,}000$. An exact calculator result near 2,000 is plausible; a result near 20 is not.

11.5 Accuracy and bounds

A rounded measurement represents an interval. For positive values rounded to the nearest unit, the lower bound is half a unit below and the upper bound is half a unit above. Under ordinary school conventions, include the lower bound and exclude the upper bound. State the unit and rounding step.

Worked example A length recorded as 12.4 cm to the nearest 0.1 cm satisfies $12.35 \text{ cm} \leq \text{length} < 12.45 \text{ cm}$. The half step is 0.05 cm. A length of 12.45 cm would round to 12.5 cm.

Chapter 11 practice

Work in your notebook. Show your method and include units where needed.

1. Round 38,749 to the nearest hundred.
2. Round 8.976 to two decimal places.
3. Round 0.006384 to two significant figures.
4. Estimate 49.8×19.7.
5. A mass is 27 g to the nearest gram. State its bounds.

Answers with methods

1. 38,700 because the tens digit is 4.

2. 8.98 because the third decimal digit is 6.

3. 0.0064 because the first two significant digits are 6 and 3, followed by 8.

4. $50 \times 20 = 1{,}000$, so the result should be close to 1,000.

5. $26.5 \text{ g} \leq \text{mass} < 27.5 \text{ g}$.

Common mistake to avoid

Decimal places and significant figures are different. 0.00456 has five decimal places but only three significant figures.