

# E1.9 Estimation

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_ **Total: 12 marks**

**KEY WORDS** estimate 估算 • significant figure 有效数字 • decimal place 小数位  
• round 四舍五入 • upper bound 上界

## Objective

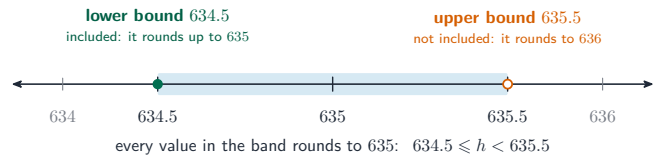
Build the skills to answer Extended exam questions on **estimation** 估算 — **rounding** 四舍五入 to a given number of **significant figures** 有效数字 or **decimal places** 小数位, estimating a calculation by rounding each value to **1 significant figure** 一位有效数字, and judging whether an answer is sensible.

**You must be able to:**

- round a number to a given number of significant figures or decimal places
- estimate the value of a calculation by rounding each number to 1 significant figure
- decide whether a calculated answer is reasonable

## 1 Worked examples

### ■ Round each number to 1 significant figure, then calculate



*Rounding throws information away — the estimate is deliberately rough*

- **Significant figures start at the first non-zero digit:** 0.0472 to 2 s.f. is 0.047; the leading zeros do not count.
- **Estimate:**  $4.7 \times 19.6 \approx 5 \times 20 = 100$  (the exact value is 92.12, so the estimate is close).
- **Division:** round the bottom too.  $\frac{9.87 \times 4.13}{0.48} \approx \frac{10 \times 4}{0.5} = 80$ .
- **Roots:** round to a number whose root you know —  $\sqrt{38.2} \approx \sqrt{36} = 6$ .

**Answer shapes** (marked by **method marks** — M1 for a correct method, A1 for the correct answer): writing the rounded numbers down is the method mark; an estimate

with no rounding shown earns nothing even if the number is right.

## 2 Practice

**2.1** Write 0.004869 correct to 2 significant figures. [1]

**2.2** By writing each number correct to 1 significant figure, estimate the value of  $61.4 \times 3.82$ . [2]

**2.3** By writing each number correct to 1 significant figure, estimate the value of  $\frac{9.87 \times 4.13}{0.48}$ . [2]

## 3 Exam-style questions

**3.1** (a) By writing each number correct to 1 significant figure, estimate the value of  $\frac{18.6 \times 4.32}{0.51}$ . [2]

(b) Use a calculator to find the exact value, correct to 2 decimal places, and say whether your estimate was reasonable. [2]

**3.2** A rectangle measures 8.3 cm by 5.7 cm, each correct to 1 decimal place.

(a) Estimate the area by rounding each length to 1 significant figure. [1]

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(b) Calculate the upper bound of the area. [2]

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## Solutions

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Marking: **M1** a correct method, **A1** the correct answer.

Each answer shows the steps, then the **result**.

### 2.1

- the first significant figure is the 4, so keep two digits from there

$$\mathbf{0.0049}$$

### 2.2

- round each to 1 s.f.:  $61.4 \rightarrow 60$  and  $3.82 \rightarrow 4$

$$60 \times 4 = \mathbf{240}$$

### 2.3

- round each to 1 s.f.:  $\frac{10 \times 4}{0.5}$

$$= \frac{40}{0.5} = \mathbf{80}$$

### 3.1

(a)

- round each to 1 s.f.:  $\frac{20 \times 4}{0.5}$

$$= \frac{80}{0.5} = \mathbf{160}$$

(b)

- $\frac{18.6 \times 4.32}{0.51} = \frac{80.352}{0.51}$

$$= \mathbf{157.55}$$

- the estimate of 160 is within about 2% of this, so it was reasonable

### 3.2

(a)

- $8.3 \rightarrow 8$  and  $5.7 \rightarrow 6$

$$8 \times 6 = \mathbf{48 \text{ cm}^2}$$

(b)

- each length is correct to 0.05 cm, so the upper bounds are 8.35 cm and 5.75 cm

$$8.35 \times 5.75 = \mathbf{48.0125 \text{ cm}^2}$$