Multiplying and Dividing with Significant Figures

Grade 10 – 11 science · calculations

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One rule, and one thing it is not

When measurements are multiplied or divided, the answer keeps as many **significant figures** as the input that has the fewest. The reasoning is plain enough: an answer cannot be more trustworthy than the weakest measurement that went into it.

The mistake to avoid is importing the addition rule. Decimal places have nothing to do with multiplication. In 4.321 × 3.14 the answer has three significant figures because 3.14 has three, not because anything has two decimal places.

Two details decide most of the marks. **Exact** numbers — things counted, and defined conversions — carry no uncertainty, so they are skipped when deciding the limit. And rounding happens **once**, at the end; rounding each step adds error that compounds.

The rules

- Count the **significant figures** in each measurement.
- The answer keeps the **smallest** of those counts.
- This is **not** the addition rule. Decimal places are irrelevant here.
- **Exact** numbers — counts and definitions — are skipped when deciding the limit.
- Round **once**, at the end. Carry the full value between steps.
- A **power** or a **root** keeps the figures of the value it acts on.

Part A — Calculate and round say which value set the limit (20 marks)

Calculate	Which value limits it?	Answer
4.321 × 3.14		
5.452 ÷ 1.67		
2.5 × 3.42		
0.0450 × 12.0		
144 ÷ 0.72		
$6.022 \times 10^{23} \times 2.0$		

$(3.0)^2$		
$\sqrt{2.0}$		
18.4 × 0.5		
1.00 ÷ 3.0		

Part B — Word problems show your working (6 marks)

1. A block has a mass of 24.52 g and a volume of 7.3 cm^3. Calculate its density.

2. A car travels 185.0 km in 2.25 hours. Calculate its average speed.

3. A rectangular plate measures 12.0 cm by 4.5 cm. Calculate its area.

4. A sample of 36.0 g is divided equally between 4 dishes. Find the mass in each dish.

Multiplying and Dividing with Significant Figures — Answer Key

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Part A — Calculate and round

1. $4.321 \times 3.14 =$ **13.6**
   3.14 has 3 s.f.
2. $5.452 \div 1.67 =$ **3.26**
   1.67 has 3 s.f.
3. $2.5 \times 3.42 =$ **8.6**
   2.5 has 2 s.f.
4. $0.0450 \times 12.0 =$ **0.540**
   both have 3 s.f.; keep the trailing zero
5. $144 \div 0.72 =$ **2.0×10^{2}**
   0.72 has 2 s.f., so 200 would be ambiguous
6. $6.022 \times 10^{23} \times 2.0 =$ **1.2×10^{24}**
   2.0 has 2 s.f.
7. $(3.0)^{2} =$ **9.0**
   a power keeps the base's 2 s.f.
8. $\sqrt{2.0} =$ **1.4**
   a root keeps the 2 s.f. under it
9. $18.4 \times 0.5 =$ **9**
   0.5 has 1 s.f.
10. $1.00 \div 3.0 =$ **0.33**
    3.0 has 2 s.f.

Part B — Word problems

1. **$3.4\ g/cm^{3}$**
   24.52 ÷ 7.3 = 3.3589… The volume has only 2 s.f., so the density gets 2.
2. **82.2 km/h**
   185.0 ÷ 2.25 = 82.222… Both values have 4 and 3 s.f., so the answer keeps 3.
3. **$54\ cm^{2}$**
   12.0 × 4.5 = 54.0, but 4.5 has 2 s.f., so the answer is 54.
4. **9.00 g**
   The 4 dishes are counted, so the 4 is exact and does not limit anything. 36.0 has 3 s.f., so the answer keeps 3.