Significant Figures

Scientific measurements are reported so that every digit is certain except the last, which is estimated. All digits of a measured quantity, including the certain one, are called ***significant figures***.

Counting Significant Figures	Examples
1. All non-zero digits are **always significant**.	1.54 (3 sig. figs.) 45 (2 sig. figs.)
2. Interior zeros (zeros between nonzero numbers) are **significant**.	0.025**0**3 (4 sig. figs.) 4**0**2 (3 sig. figs.) 3.**00**674 (6 sig. figs.)
3. Leading zeros (zeros at the beginning of a number) are **NOT significant.**	0.103 (3 sig. figs.) 0.000002 (1 sig. fig.)
4. Trailing zeros (zeros at the end of the number): ✓ are **significant** *if and only if* there is a decimal point present in the number OR they carry overbars. ✓ are **NOT** significant otherwise.	1.**05****0** (4 sig. figs.) 1.**00** x 10^3 (3 sig. figs.) 1**0** (2 sig. figs.) 1***000*** (1 sig. fig.) 19***0*** (2 sig. figs.)
5. Exact numbers have an unlimited number of significant figures.	10 dm = 1m (unlimited sig. figs.)

Significant Figures in Calculation

Multiplication and Division	**Addition and Subtraction**
When multiplying or dividing measurements with significant figures, the result has the same number of significant figures as the measurement with the ***lowest number of significant figures.***	When adding or subtracting measurements with significant figures, the result has the same number of decimal places as the measurement with the ***lowest number of decimal places.***
5.02 × 89.665 × 0.10 (3 sig. figs.) (5 sig. figs.) (**2** sig. figs.) = 45.0118 = **45** (round off to **2** sig. figs.) 5.892 ÷ 6.10 (4 sig. figs.) (**3** sig. figs.) = 0.96590 = **0.966** (round off to **3** sig. figs.)	2.0345 (4 d.p.) 0.07 (**2 d.p.**) **+** 2.9975 (4 d.p.) 5.4125 = 5.41 (**2 d.p.**) (3 sig. figs.) 5.9 (1 d.p.) **-** 2.221 (3 d.p.) 5.679 = 5.7 (**1 d.p.**) (1 sig. figs.)

Practice Problems

1. How many significant figures are in each of the following?

   a) 3.405
   b) 0.00289
   c) 1030
   d) 7.0040×10^{-3}
   e) 102.00
   f) 0.000980
   g) 9.80

2. Perform the following calculations to the correct number of significant figures

   a) 12.0550 + 9.05
   b) 257.2 – 19.789
   c) (6.21×10^{3}) (0.150)
   d) 0.0577 ÷ 0.753
   e) 27.5 x 1.82 ÷ 100.04
   f) $(2.290 \times 10^{6}) \div (6.7 \times 10^{4})$
   g) $[(28.7 \times 10^{5}) \div 48.533] + 144.99$

3. Round each of the following numbers to three significant figures:

   a) 342.79513
   b) 9,845.8749
   c) 0.000045389
   d) 2.45555567
   e) 76.89
   f) 56.9971

<u>References:</u>
Tro, Chemistry: A Molecular Approach 2nd ed., Pearson
Brown/LeMay/Bursten, Chemistry: The Central Science, 12th ed., Pearson

Answers

1. *a) 4; b) 3; c) 3; d) 5; e) 5; f) 3; g) 3*
2. *a) 21.11; b) 237.4; c) 652; d) 7.66 x 10^{-2}; e) 0.500; f) 34; g) 5.93 X 10^{4}*
3. *a) 343; b) 9850; c) 0.0000454; d) 2.46; e) 76.9; f) 57.0*