Significant Digits

Most numbers involved in technical and scientific work are approximate, having been arrived at through some process of measurement. However, certain other numbers are exact, having been arrived at through some definition or counting process.

Significant Digits

- o   All nonzero digits are significant.
- o   Zeros used as placeholders for proper positioning of the decimal point are not significant.
    - o   Leading zeros (after the decimal point) are not significant.
    - o   Trailing zeros before the decimal point are not significant.
- o   All other zeros are significant.

Number	Number of Significant Digits	Comment
87 000	2	The trailing zeros are placeholders and are not counted as significant digits
408 000	3	The zero farthest to the left is not a placeholder, but the other three zeros are placeholders and are not counted as significant digits
4.0005	5	Any zeros between nonzero digits are always significant
0.004	1	The leading zeros are placeholders and are not significant
4.000	4	The zeros are not required as placeholders. They are there to show the precision of the measurement, and are therefore significant
0.000 503	3	The leading zeros (farthest left) are placeholders and are not significant. The last three digits are significant

Calculating with Significant Figures
An answer cannot be more precise than the least precise measurement.

Rounding after the last significant digit
< 5 – round off
> 5 – round up
$= 5$ – round to the even number

Examples: round the numbers below to 3 significant figures
2.344 → 2.34 → < 5 – round off
2.346 → 2.35 → > 5 – round up
2.345 → 2.34 → $= 5$
            – round to the even number
2.345 001 → 2.35 → > 5 – round up

Multiplication & Division with Significant Figures
The answer has the same number of digits as the least significant figure (regardless of placement).

Example: 7.55 x 0.34 = 2.567 → 2.6

Reason: 0.34 has only 2 significant digits, therefore the answer can have only 2 significant digits.

Addition & Subtraction with Significant Digits
According to the placement of the digits in the least precise measurement.

Example:
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   12.521
  349.0
+   8.24
  369.761   →   369.8
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Reason: 349.0 is significant to only 1 place past the decimal, this is the least precise measurement, therefore, it determines the number of decimal places in the answer.

Significant Figures

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

   a) 23 cm
   b) 1.498 g
   c) 248.3 s
   d) 9.855 mL
   e) 76.414 kG
   f) 32.8 m
   g) 107 mm

   h) 0.238 km
   i) 8.0335 cm
   j) 0.055 87 m
   k) 307 g
   l) 1.400 82 cm
   m) 0.000 589 00 g
   n) 4500 km

   o) 350 000 cm
   p) 180.00 s
   q) $3.50 \cdot 10^3$ cm
   r) $1.604 \cdot 10^4$ m
   s) 14.380 s
   t) 0.0804 s
   u) 3.450 00 m

2. Express the answer to each of the following calculations with the correct numbers of significant figures.

   a) 1.2 cm x 1.3 cm
   b) 2.1 m x 1.8 m
   c) 1.45 m x 2.2 m
   d) 2.5 mm x 1.33 mm
   e) 4.3324 km x 1.2 km
   f) 3.0 cm x 4.000 cm
   g) 2.005 cm x 5.0 cm

   h) 400 m x 87 488 m
   i) $2.3 \cdot 10^6$ m x $1.45 \cdot 10^2$ m
   j) $8.71 \cdot 10^2$ mm x $1.0 \cdot 10^2$ mm
   k) 32.88 m^2 ÷ 4.388 m
   l) 16.5 km^2 ÷ 1.8 km
   m) 84.99 m^2 ÷ 2.63 m
   n) 9.9 mm^2 ÷ 3.4484 mm

   o) 3.085 cm^2 ÷ 2.774 48 cm
   p) 0.0045 mm^2 ÷ 0.90 mm
   q) 120 km^2 ÷ 8.56 km
   r) 0.7600 mm^3 ÷ 1.50 mm
   s) $4.80 \cdot 10^5$ m^2 ÷ $8.5 \cdot 103$ m
   t) $6.30 \cdot 10^0$ m^3 ÷ 0.0804 m
   u) 3.4500 cm^2 ÷ 450 cm

3. Express the answer to each of the following calculations with the correct number of significant figures.

   a) 3.42 cm + 8.13 cm
   b) 4.939 g + 3.822 g
   c) 17.8 cm + 12.11 cm
   d) 4.552 kg + 3.14 kg
   e) 1.966 s + 3.4422 s
   f) 80 cm + 13.0 cm
   g) 72.60 m + 0.0950 m

   h) 13.89 cm + 6.8932 cm
   i) $1.30 \cdot 10^2$ cm + $2.4 \cdot 10^4$ cm
   j) $8.19 \cdot 10^3$ m + $1.400 \cdot 10^4$ m
   k) 3.882 g – 2.114 g
   l) 4.894 cm – 2.33 cm
   m) 15.6674 m – 12.838 m
   n) 11.22 g – 8.8 g

   o) 133 L – 6.45 L
   p) 750 cm – 677.4 cm
   q) 10 000 m – 94 m
   r) 0.0890 cm – 0.0666 cm
   s) $0.340 \cdot 10^1$ g – $1.20 \cdot 10^2$ g
   t) $4.5 \cdot 10^5$ km – $3.10 \cdot 10^3$ km