

Significant Digits

The examples below illustrate the proper use of significant digits for the Chemistry 30 Diploma Examination in a response.

Example 1

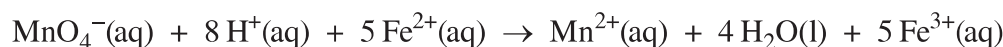
A 10.0 mL sample of a $\text{Fe}^{2+}(\text{aq})$ solution of unknown concentration is titrated with a standardized 0.120 mol/L $\text{KMnO}_4(\text{aq})$ solution. The following data are recorded.

2 decimal places
(10.10–1.00)
according to the
addition/subtraction
rules leaves
3 significant digits

Trial	I	II	III
Final burette reading (mL)	10.10	19.22	28.33
Initial burette reading (mL)	1.00	10.10	19.22
Titrant added (mL)	9.10*	9.12	9.11

The concentration of the $\text{Fe}^{2+}(\text{aq})$ is _____.

Reaction Equation



Average volume of titrant added is 9.11 mL

$$[\text{Fe}^{2+}(\text{aq})] = 9.11 \text{ mL MnO}_4^-(\text{aq}) \times 0.120 \text{ mol/L MnO}_4^-(\text{aq}) \times \frac{5 \text{ mol Fe}^{2+}(\text{aq})}{1 \text{ mol MnO}_4^-(\text{aq})} \times \frac{1}{10.0 \text{ mL Fe}^{2+}(\text{aq})}$$

$$[\text{Fe}^{2+}(\text{aq})] = 0.547 \text{ mol/L}$$

* Final answer has 3 significant digits (least number present according to the multiplication/division rule)

Exact number,
therefore does **not**
change the
final number of
significant digits

Example 2

K_a value has 2 significant digits

The pH of a 0.100 mol/L solution of ethanoic acid is _____.

$$K_a = 1.8 \times 10^{-5} = \frac{x^2}{(0.100 \text{ mol/L} - x)}$$

The value of x can be ignored when compared to 0.100 mol/L in the case of such a weak acid.

$$K_a \text{ is approximately } \frac{x^2}{0.100 \text{ mol/L}}$$

$$x = [\text{H}_3\text{O}^+(\text{aq})] = 0.001342$$
$$\text{pH} = -\log(0.001342 \text{ mol/L})$$

$$= 2.87$$

Additional digits
carried through on
an interim basis

Final answer has
2 significant digits

Example 3

A student conducts a calorimetry experiment to determine the energy transferred when Solution A is mixed with Solution B. The data collected are shown below. Assume the specific heat capacity for each solution is the same as that of water.

Mass of Solution A (g)	100.0
Mass of Solution B (g)	100.0
Mass of final solution mixture (g)	200.0
Initial temperature of solutions A and B (°C)	20.0
Final temperature of the solution mixture (°C)	23.0

The original data are limited to 3 significant digits.

$$\Delta H = mc\Delta t$$

$$\Delta H = (200.0 \text{ g}) (4.19 \text{ J/g}\cdot\text{°C}) (3.0 \text{ °C})$$

The resulting temperature has 2 significant digits.

$$\Delta H = 2.5 \text{ kJ}$$

The final answer should be rounded to the same number of significant digits contained in the input data for the calculation $\Delta H = mc\Delta t$ that has the fewest number of significant digits.

The final answer has 2 significant digits because the input data for the $\Delta H = mc\Delta t$ calculation is limited by the temperature difference of 3.0 °C, which has 2 significant digits.