The display of numbers

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Answers to additional problems

1.1 The nearest standard factor is Peta 10^{15}. The number is therefore 60 000 P transistors, which might help explain why processed silicon is more valuable than gold, ounce for ounce.

1.2 Because this number is multiplied by 10^5, the mass is $1.302 \times 100\,000$. The mass is 130 200 g.

1.3 The first numeral is the tenth after the decimal point, so the distance is expressed in terms of 10^{-10} m.

The distance is 1.74×10^{-10} m.

1.4 The limiting number of significant figures is the mass, with 2 s.f.

$$\frac{\text{mass}}{\text{molar mass}} = \frac{0.37}{74.5}$$

To 2 s.f. the chemist has made 5.0×10^{-3} mol = 5.0 mmol.

1.5

To **1** s.f. $c = 300{,}000{,}000 \text{ m s}^{-1} = 3 \times 10^8 \text{ m s}^{-1}$

To **2** s.f. $c = 300{,}000{,}000 \text{ m s}^{-1} = 3.0 \times 10^8 \text{ m s}^{-1}$

To **3** s.f. $c = 300{,}000{,}000 \text{ m s}^{-1} = 3.00 \times 10^8 \text{ m s}^{-1}$

To **4** s.f. $c = 299{,}800{,}000 \text{ m s}^{-1} = 2.998 \times 10^8 \text{ m s}^{-1}$

The results to the first three answers (with 1, 2, or 3 s.f.) follow the requirement to round up. Rounding the fourth and third significant figure causes the third and second s.f. to change also.

1.6

$$i = \frac{I}{A} = \frac{23.4 \times 10^{-6}\text{ A}}{4.1 \times 10^{-4}\text{ m}^2} = 0.057\,073\text{ A m}^{-2}$$

We need to mentally superimpose the units of A m^{-2} onto the answer displayed on our calculator.

We express the electrode area A to 2 s.f., the current to 3 s.f. so we must express the current density i to the smaller number of 2 s.f.

Therefore, $i = 0.057 \text{ A m}^{-2}$ or $5.7 \times 10^{-2} \text{ A m}^{-2}$ to 2 s.f.

1.7 We define amount as, $\dfrac{\text{mass}}{\text{molar mass}}$

We define concentration as, $\dfrac{\text{amount}}{\text{volume}}$

$$\text{so concentration} = \frac{(\text{mass/molar mass})}{\text{volume}} = \frac{(1.5\text{ g}/238\text{ g mol}^{-1})}{140 \times 10^{-3}\text{dm}^3}$$

Remember that 'amount' is the IUPAC way of saying 'number of moles'.

Remember to convert cm^3 to dm^3. To do so, we multiply by 10^{-3}: 140 cm^3 = 0.140 dm^3.

A calculator display will read, 0.045018007.

1 s.f. The concentration is 0.05 mol dm^{-3} = 5×10^{-2} mol dm^{-3}

2 s.f. The concentration is 0.045 mol dm^{-3} = 4.5×10^{-2} mol dm^{-3}

3 s.f. The concentration is 0.0450 mol dm^{-3} = 4.50×10^{-2} mol dm^{-3}

1.8 $F = 6.022 \times 10^{23}\ \text{mol}^{-1} \times 1.602 \times 10^{-19}\ \text{C}$

A calculator display will read, $F = 96\,472.44$ (without the units of C mol^{-1}).

Since both N_A and q are cited to 4 s.f. We cite F as 96 470 C mol^{-1} (to 4 s.f.).

We define the gradient of a graph in Chapters 13 and 27.

1.9 Δy is given to 3 s.f. The limiting number of s.f. is that for Δx so we must cite the final answer to 2 s.f.

By definition, the value of a gradient $= \dfrac{\Delta y}{\Delta x} = \dfrac{0.000324}{41} = 7.902\,4 \times 10^{-6}$

so the value of the gradient $= 0.000\,007\,9$ or 7.9×10^{-6} (to 2 s.f.)

1.10 Probably the easiest way to answer this problem is to first rewrite the masses in the same format by converting to g. In this problem, the two sensible formats would be either scientific notation or simply as decimal numbers, as below.

Number	Scientific notation	Decimal number
3×10^{-3} g	3×10^{-3} g	0.003 g
500 μg	5×10^{-4} g	0.000 5 g
0.6 mg	6×10^{-4} g	0.000 6 g
110 cg	1.1 g	1.10 g
4 000 000 ng	4×10^{-3} g	0.004 g

It should therefore be clear that the order is,

$$110\ \text{cg} > 4\,000\,000\ \text{ng} > 3 \times 10^{-3}\ \text{g} > 0.6\ \text{mg} > 500\ \mu\text{g}$$