Solutions

Each answer shows the steps, then the **result**.

2.1

- the **mantissa** holds the **significant digits**
- the **exponent** is the **power of 2** to multiply by

2.2

- `0.1000000` $= 0.5$; exponent $= 3$
- $0.5 \times 2^3 = \mathbf{4}$

2.3

- the first significant bit is **immediately after the binary point** (`0.1`… for a positive number) — no wasted leading zeros, so precision is maximised

2.4

- some denary fractions (e.g. 0.1) are **repeating/infinite** in binary, so they must be **truncated** to fit the mantissa

3.1

- sign bit `0` $\to$ positive
- `.1010000` $= \frac{1}{2} + \frac{1}{8} = 0.625$, exponent $= 2$
- $0.625 \times 2^2 = \mathbf{2.5}$

3.2

- `6` $= 110.0_2$
- normalise to 0.110×2^3
- mantissa `01100000`
- exponent `00000011`

3.3

- `00011000` $= 0.0011 \times 2^5$; shift mantissa **left 2**, exponent $5 - 2 = 3$
- new mantissa `01100000`
- new exponent `00000011`

3.4

- `0.1` and `0.2` cannot be stored **exactly** in binary (they are repeating fractions)
- the small stored errors **add up**, so the result is very close to but **not exactly** `0.3`

3.5

- sign bit `1` $\to$ negative
- `1.0110000` $= -1 + \frac{1}{4} + \frac{1}{8} = -0.625$, exponent $= 2$
- $-0.625 \times 2^2 = \mathbf{-2.5}$