Solutions

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

2.1

- by **heating** it (transferring thermal energy to it)
- and by **doing work** on it

2.2

- $W = p\Delta V$

2.3

- $W = p\Delta V$

$$W = (1.0 \times 10^5 \text{ Pa})(3.0 \times 10^{-3} \text{ m}^3) = \mathbf{300} \text{ J}$$

2.4

- **positive**

3.1 C

- work done **on** the gas is **positive** in this sign convention
- **A** would be work done *by* the gas; **B** would mean no volume change; **D** is not how the convention works

3.2

- $\Delta U = q + W$

$$\Delta U = 500 \text{ J} + 200 \text{ J} = \mathbf{700} \text{ J}$$

3.3

- compressed → work done **on** the gas is positive: $W = p|\Delta V|$

$$W = (2.0 \times 10^5 \text{ Pa})(3.0 \times 10^{-3} \text{ m}^3) = 600 \text{ J}$$

- cooling removes energy, so $q = -800$ J

$$\Delta U = q + W = -800 \text{ J} + 600 \text{ J} = -\mathbf{200} \text{ J}$$

3.4

- the air is compressed quickly, so little heat leaves ($q \approx 0$)
- work is done **on** the gas, so W is positive
- by $\Delta U = q + W$, $\Delta U > 0$, so the internal energy and temperature **rise** — the pump feels warm