Solutions

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

2.1

- the change in internal energy equals the heat added plus the work done on the gas, $\Delta U = Q + W$

2.2

- heat added and work done **on** the gas are both positive:

$$\Delta U = Q + W = (+500\text{ J}) + (+200\text{ J})$$

- $\Delta U = +\mathbf{700}$ J

2.3

- $W = 0$ – no volume change means no work is done on or by the gas

3.1 B

- heat added.

3.2 A

- $Q = 0$.

3.3

(a)

- signs: heat released, so $Q = -100$ J; work done on the gas, so $W = +300$ J

$$\Delta U = Q + W = (-100\text{ J}) + (+300\text{ J})$$

- $\Delta U = +\mathbf{200}$ J

(b)

- it rises: $\Delta U > 0$, and the internal energy of an ideal gas is proportional to T

3.4

(a)

- $W = -P\Delta V = -(2.0 \times 10^5\text{ Pa})(3.0 - 1.0) \times 10^{-3}\text{ m}^3$
- $W = -\mathbf{400}$ J (the gas expands, so it does work on its surroundings)

(b)

- **0**: the volume does not change, so no work is done

(c)

- $\Delta U = \frac{3}{2}(P_B V_B - P_A V_A) = \frac{3}{2}(600 - 200) = \mathbf{600}$ J
- $Q = \Delta U - W = 600 - (-400) = \mathbf{1000}$ J

3.5 A

- atoms of an ideal gas do not interact, so there is no potential energy of configuration

3.6

- internal energy counts only the motion of the atoms relative to the system's centre of mass; moving the whole system does not change it