9) Ideal gas at constant pressure $P = 2.0 \times 10^5\ Pa$ is heated from $T_1 = -73°C = 200K$ to $T_2 = +27°C = 300K$. Initial volume of gas was $0.10\ m^3$. Heat energy supplied during process was $Q = 2.5 \times 10^4\ J$. What is the increase in internal energy of the gas?

P constant $\therefore \quad \frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad V_2 = \frac{T_2}{T_1} V_1 = \frac{300K}{200K}(0.10\ m^3)$

$= 0.15\ m^3$

$\Delta V = V_2 - V_1 = 0.15\ m^3 - 0.10\ m^3 = 0.05\ m^3$

$W = P\Delta V = 2.0 \times 10^5\ Pa \times 0.05\ m^3 = 1.0 \times 10^4\ J$

$\Delta U = Q - W = 2.5 \times 10^4 J - 1.0 \times 10^4 J = 1.5 \times 10^4 J = 15\ kJ$ (C)