Mark scheme for Support Worksheet – Topic 3, Worksheet 2

1 From $pV = nRT$ we have $n = \frac{pV}{RT} = \frac{2.4\times10^{6}\times4.1\times10^{-3}}{8.31\times320} = 3.7$ [1]

2 From $\frac{p_1V_1}{n_1T_1} = \frac{p_2V_2}{n_2T_2}$ and cancelling out terms that remain constant we see that $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

i.e. $\frac{V_1}{273+47} = \frac{2V_1}{T_2} \Rightarrow T_2 = 640\text{ K}$ (You must convert to kelvin.) [1]

3 From $Q = \Delta U + W$, $(-2.8) = \Delta U + (-2.2)$; and so $\Delta U = +0.6\text{ kJ}$ [2]

4 In an isothermal expansion the temperature of the system stays the same; in an adiabatic expansion no heat enters or leaves the system. [2]

5 The work done by the gas in the isothermal case is 2500 J. The work done in the adiabatic case must be less since the adiabatic curve will be steeper (and so has less area under the curve) and so the work done is less than 2500 J, so **B**. [1]

6 A cyclic change corresponds to a closed loop in the diagram. The area of the diagram is the net work done. [1]

7 The molecules colliding with the piston wall as it moves outwards will bounce back from the piston with a smaller speed than the incident speed; since temperature is a measure of the average kinetic energy of the molecules, the temperature will be reduced. [2]

8 The energy required is the same in both cases; this is because the energy is given by $Q = nc_V\Delta T$ where *n* is the number of moles and c_V the molar heat capacity at constant volume. [2]

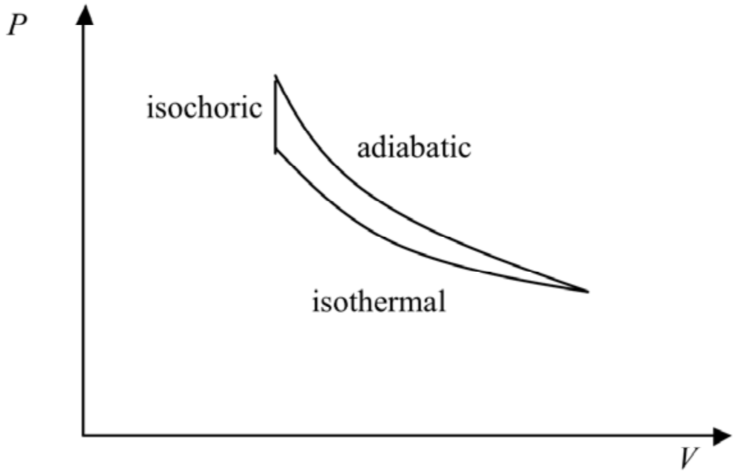
9 For the gas at constant volume $Q = \Delta U_V + 0$ since no work is being done (volume is constant); for the gas at constant pressure, $Q = \Delta U_P + W$ with $W > 0$; hence $\Delta U_V > \Delta U_P$ and so the temperature of the gas at constant volume increases more. [3]

10 The temperature will be reduced upon the expansion; hence since the molecules have longer to travel in between collisions and because they move slower on average the pressure will decrease. [2]

11 **a** Along AB, $Q = \Delta U + W$ and $W > 0$ (gas expands) and $\Delta U > 0$ (temperature increases) so $Q > 0$ so heat is provided. [1]

b Along CD, $Q = \Delta U + W$ and $W = 0$ and $\Delta U < 0$ (temperature decreases) so $Q < 0$ and heat is extracted. [1]

12 See diagram, [1] for each leg.



[3]