Question number	Answer	Marks	Guidance
1	$K_p = \frac{p^2SO_3(g)_{eqm}}{p^2SO_2(g)_{eqm} \times pO_2(g)_{eqm}}$ $K_p = \frac{5.0^2}{0.08^2 \times 0.9}$ $K_p = 4340.2\ atm^{-1}$ $K_p = 4300\ atm^{-1}$ (to 2 s.f.)	1 1 1	1 mark for numerical answer with unit. 1 mark for correct s.f.
2	$K_p = \frac{pN_2O_4(g)_{eqm}}{p^2NO_2(g)_{eqm}}$ $K_p = \frac{0.25}{0.80^2}$ $K_p = 0.3906\ atm^{-1}$ $K_p = 0.391\ atm^{-1}$ to 3 s.f.	1 1 1	
3 (i)	Mole fraction = $\frac{\text{no. of moles of a given gas}}{\text{total no. of moles in the mixture}}$ Mole fraction $NH_3 = \frac{26.0}{104.0} = 0.25$ Mole fraction $H_2 = \frac{13.0}{104.0} = 0.125$ Mole fraction $N_2 = \frac{65.0}{104.0} = 0.625$	1	
3 (ii)	Partial pressure = mole fraction × total pressure Partial pressure $NH_3 = 0.25 \times 12.0 = 3.00$ atm Partial pressure $H_2 = 0.125 \times 12.0 = 1.50$ atm Partial pressure $N_2 = 0.625 \times 12.0 = 7.50$ atm	1	
3 (iii)	$K_p = \frac{p^2NH_3(g)_{eqm}}{p^3H_2(g)_{eqm} \times pN_2(g)_{eqm}}$ $K_p = \frac{9.00}{3.375 \times 7.50}$ $K_p = 0.355\ atm^{-2}$	1 1 1	1 mark including unit
4	$K_p = \frac{p^2HI(g)_{eqm}}{pH_2(g)_{eqm} \times pI_2(g)_{eqm}}$ There are the same number of moles of gas on each side of the equilibrium, therefore no need to calculate the partial pressures. The units cancel. $K_p = \frac{1.40^2}{0.30 \times 0.40} = 16.33 = 16$ to 2 s.f. (no units)	1 1 1	
5	$K_p = \frac{pPCl_3(g)_{eqm} \times pCl_2(g)_{eqm}}{pPCl_5(g)_{eqm}}$ Mole fraction = $\frac{\text{no. of moles of a given gas}}{\text{total no. of moles in the mixture}}$ Mole fraction $PCl_3 = \frac{0.75}{2.05} = 0.3658$	1 1	

	Mole fraction PCl_5 = $\frac{0.40}{2.05}$ = 0.1951 Mole fraction Cl_2 = $\frac{0.90}{2.05}$ = 0.4390 Partial pressure = mole fraction × total pressure Partial pressure PCl_3 = 0.3658 × 12.0 = 4.389 atm Partial pressure PCl_5 = 0.1951 × 12.0 = 2.341 atm Partial pressure Cl_2 = 0.4390 × 12.0 = 5.268 atm K_p = $\frac{4.389 \times 5.268}{2.341}$ = 9.876 atm K_p = 9.9 atm (to 2 s.f.)	1 2	2 marks including unit
6	K_p = $\frac{p^2NH_3(g)_{eqm}}{p^2H_2(g)_{eqm} \times pN_2(g)_{eqm}}$ K_p = $\frac{0.35^2}{0.80^3 \times 0.25}$ K_p = 0.952 atm^{-2} = 0.95 atm^{-2} (to 2 s.f.)	1 1 1	