

Question number	Answer	Marks	Guidance
1	$K_p = \frac{p^2\text{SO}_3(\text{g})_{\text{eqm}}}{p^2\text{SO}_2(\text{g})_{\text{eqm}} \times p\text{O}_2(\text{g})_{\text{eqm}}}$ $K_p = \frac{5.0^2}{0.08^2 \times 0.9}$ $K_p = 4340.2 \text{ atm}^{-1}$ $K_p = 4300 \text{ atm}^{-1} \text{ (to 2 s.f.)}$	1 1 1	1 mark for numerical answer with unit. 1 mark for correct s.f.
2	$K_p = \frac{p\text{N}_2\text{O}_4(\text{g})_{\text{eqm}}}{p^2\text{NO}_2(\text{g})_{\text{eqm}}}$ $K_p = \frac{0.25}{0.80^2}$ $K_p = 0.3906 \text{ atm}^{-1}$ $K_p = 0.391 \text{ atm}^{-1} \text{ to 3 s.f.}$	1 1 1	
3 (i)	<p>Mole fraction = $\frac{\text{no. of moles of a given gas}}{\text{total no. of moles in the mixture}}$</p> <p>Mole fraction $\text{NH}_3 = \frac{26.0}{104.0} = 0.25$</p> <p>Mole fraction $\text{H}_2 = \frac{13.0}{104.0} = 0.125$</p> <p>Mole fraction $\text{N}_2 = \frac{65.0}{104.0} = 0.625$</p>	1	
3 (ii)	<p>Partial pressure = mole fraction \times total pressure</p> <p>Partial pressure $\text{NH}_3 = 0.25 \times 12.0 = 3.00 \text{ atm}$</p> <p>Partial pressure $\text{H}_2 = 0.125 \times 12.0 = 1.50 \text{ atm}$</p> <p>Partial pressure $\text{N}_2 = 0.625 \times 12.0 = 7.50 \text{ atm}$</p>	1	
3 (iii)	$K_p = \frac{p^2\text{NH}_3(\text{g})_{\text{eqm}}}{p^2\text{H}_2(\text{g})_{\text{eqm}} \times p\text{N}_2(\text{g})_{\text{eqm}}}$ $K_p = \frac{9.00}{3.375 \times 7.50}$ $K_p = 0.355 \text{ atm}^{-1}$	1 1 1	1 mark including unit
4	$K_p = \frac{p^2\text{HI}(\text{g})_{\text{eqm}}}{p\text{H}_2(\text{g})_{\text{eqm}} \times p\text{I}_2(\text{g})_{\text{eqm}}}$ <p>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.</p> $K_p = \frac{1.40^2}{0.30 \times 0.40} = 16.33 = 16 \text{ to 2 s.f. (no units)}$	1 1 1	
5	$K_p = \frac{p\text{PCl}_3(\text{g})_{\text{eqm}} \times p\text{Cl}_2(\text{g})_{\text{eqm}}}{p\text{PCl}_5(\text{g})_{\text{eqm}}}$ <p>Mole fraction = $\frac{\text{no. of moles of a given gas}}{\text{total no. of moles in the mixture}}$</p> <p>Mole fraction $\text{PCl}_3 = \frac{0.75}{2.05} = 0.3658$</p>	1 1	

	<p>Mole fraction $\text{PCl}_5 = \frac{0.40}{2.05} = 0.1951$</p> <p>Mole fraction $\text{Cl}_2 = \frac{0.90}{2.05} = 0.4390$</p> <p>Partial pressure = mole fraction \times total pressure Partial pressure $\text{PCl}_3 = 0.3658 \times 12.0 = 4.389 \text{ atm}$ Partial pressure $\text{PCl}_5 = 0.1951 \times 12.0 = 2.341 \text{ atm}$ Partial pressure $\text{Cl}_2 = 0.4390 \times 12.0 = 5.268 \text{ atm}$</p> <p>$K_p = \frac{4.389 \times 5.268}{2.341} = 9.876 \text{ atm}$</p> <p>$K_p = 9.9 \text{ atm}$ (to 2 s.f.)</p>	1	
		2	2 marks including unit
6	<p>$K_p = \frac{p^2 \text{NH}_3(\text{g})_{\text{eqm}}}{p^2 \text{H}_2(\text{g})_{\text{eqm}} \times p \text{N}_2(\text{g})_{\text{eqm}}}$</p> <p>$K_p = \frac{0.35^2}{0.80^3 \times 0.25}$</p> <p>$K_p = 0.952 \text{ atm}^{-2} = 0.95 \text{ atm}^{-2}$ (to 2 s.f.)</p>	1	
		1	
		1	