Question			Answer	Marks	AO element	Guidance
25	(a)		***EQUILIBRIUM CONDITIONS*** ***3 MAX*** **4 marking points → 3 max** ✓✓✓ *Mark first three **CORRECT** responses seen*	5		***FULL ANNOTATIONS MUST BE USED*** --- **ALLOW** suitable alternatives for 'towards right', e.g.: towards SO_3/products **OR** in forward direction **OR** 'favours the right'
			Temperature: (Forward) reaction is exothermic/ΔH is negative **OR** (Forward) reaction gives out heat ✓		AO3.1 ×2	**ALLOW reverse** reaction is endothermic /ΔH is positive/takes in heat
			Pressure: Right-hand side has fewer (gaseous) moles **OR** 3 (gaseous) moles form 2 (gaseous) moles ✓			For moles, **ALLOW** molecules/particles **ORA for** reverse reaction
			Equilibrium shift Correct equilibrium shift in terms of **temperature** ✓ Correct equilibrium shift in terms of **pressure** ✓		AO3.2 ×1	
			--- ***INDUSTRIAL CONDITIONS*** Low temperature gives a slow rate/slower reaction **OR** high temperatures needed to increase rate ✓		--- AO1.2 ×2	**IGNORE** responses in terms of activation energy
			(High) pressure provides a safety risk **OR** (High) pressure is expensive (to generate) /uses a lot of energy ✓			**ALLOW** high pressure is dangerous/explosive **ALLOW** 'These conditions are expensive' *Statement subsumes **pressure** as 'these' will apply to **pressure** (required for this mark) and temperature* **ALLOW ORA** e.g. Lower pressure → less danger/uses less energy **IGNORE** 'It's expensive *Link with pressure required*

Question	Answer	Marks	AO element	Guidance
(b)		4		***FULL ANNOTATIONS MUST BE USED***
	Value of K_c 1 mark K_c is small **OR** $K_c < 1$ **AND** equilibrium (position) is towards left ✓		AO3.2	**ALLOW** suitable alternatives for 'towards left, e.g.: towards SO_2/O_2 **OR** towards reactants **OR** in reverse direction **OR** 'favours the left
	Calculation: **FIRST CHECK ANSWER** **IF [SO_3] = 0.876 *OR* 0.88 (mol dm^{-3})** **award all 3 marks available for calculation** --- **K_c expression 1 mark** $\frac{[SO_3]^2}{[SO_2]^2[O_2]}$ **OR** $\frac{[SO_3]^2}{2.00^2 \times 1.20}$ ✓ **Evaluation of K_c $[SO_2]^2[O_2]$ 1 mark** $K_c\ [SO_2]^2[O_2] = 0.160 \times 2.00^2 \times 1.20$ = 0.768 ✓ **Calculation of $[SO_3]$** ***ONLY*** *available from* ***correct*** *evaluation for 2nd mark* $[SO_3] = \sqrt{(0.160 \times 2.00^2 \times 1.20)}$ = 0.876 (mol dm^{-3}) ✓		AO1.2 AO2.6 AO2.6	Square brackets required in K_c expression **ALLOW ECF** from $\frac{[SO_3]}{[SO_2]^2[O_2]}$, i.e. no $[SO_3]^2$ **ALLOW 0.77 (2 SF)** **ALLOW 0.88** (**2 SF**) up to calculator value of 0.876356092 correctly rounded **IF** K_c expression is inverted 2nd and 3rd marks are available by **ECF**: $[SO_3]^2 = \frac{2.00^2 \times 1.20}{0.160}$ **OR** 30 ✓ $[SO_3] = \sqrt{30} = 5.48$ **OR** 5.5 ✓ Any other K_c expression → **NO MARKS,** e.g. $\frac{[SO_3]^2}{[SO_2]^2 + [O_2]}$ → √0.832 → 0.912 **NO** marks
	Total	**9**		