Mark scheme – Equilibria (H)

Question			Answer/Indicative content	Marks	Guidance
1			**B ✓**	1 (AO1.1)	
			Total	**1**	
2			**B ✓**	1(AO 1.1)	**Examiner's Comments**  **Misconception** A and C were both common misconceptions in this question.
			Total	**1**	
3	a	i	Increases / AW ✓	1(AO 1.1)	**Examiner's Comments** Candidates usually appreciated that the rate of a reaction increases when the temperature is increased.
		ii	(No) (because) higher temperature favours endothermic reaction / backward reaction / ORA ✓ (so) equilibrium shifts to left hand side / yield of ammonia is reduced / ORA ✓	2(AO 2.1)	**Marks are for explanation** **ALLOW** idea that the yield does not increase, in correct context References to reduced yield must not be in the context of rate **Examiner's Comments** This question required candidates to apply their knowledge of Le Chatelier's principle and assessed AO2. Good responses described that an increase in temperature will favour the endothermic (or backward) reaction and so the yield of ammonia will be reduced. Lower ability candidates tended to gain just one mark for the idea that the equilibrium will shift to the left-hand side and / or the yield of ammonia is reduced, without being able to explain the shift in terms of a

					higher temperature favouring the endothermic reaction. **Misconception** A common misconception was to treat this as a kinetics question and to give an answer in terms of increased rate making ammonia quicker and therefore increasing the yield. **Exemplar 2** The company is incorrect as when the temperature increases the equilibrium position will shift to the endothermic side so the backward reaction will be forward and the yield will decrease. [2] This response shows clear understanding of Le Chatelier's principle and describes that an increase in temperature would favour the endothermic / backward reaction and so the yield of ammonia will be reduced.
	b		**Any two from:** Idea that rate of reaction will be slower ✓ As there will be less frequent collisions / less collisions per second / particles collide less often ✓ Idea that yield of ammonia will be less ✓ (Lower pressure) favours backward reaction / equilibrium shifts to left hand side / ORA ✓ As there are fewer (gaseous) molecules on right hand side / ORA ✓	2(AO 2.1)	**ALLOW** idea that reaction will take longer time **IGNORE** idea that the reaction will not be at equilibrium **Examiner's Comments** Two marks were usually gained in this question for reduced yield and lower rate of reaction.
			Total	**5**	
4	a		Rate of forward reaction equals the rate of the backward reaction (1) Concentration of reactants and products do not change (1)	2	**ALLOW** concentration of reactant and product do not change **DO NOT ALLOW** concentration of reactant and products are the same
	b		**Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)**	6	**AO1.1: Knowledge of temperature and pressure on percentage yield**

			Describes and explains the effect of changing the temperature and pressure on the position of equilibrium in both theoretical terms and from the table and explains that one prediction is supported and the other prediction is not *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** **Describes and explains the effect of changing the temperature and pressure on the position of equilibrium in both theoretical terms and from the table** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** **Describes the effect of changing the temperature and pressure on the position of equilibrium in theoretical terms or describes the effect of changing the temperature and pressure on the position of equilibrium from the table** *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** *No response or no response worthy of credit.*		• As temperature increases the position of equilibrium shifts to the left in an exothermic reaction. • As pressure increases the position of equilibrium shifts to the side with the least number of moles of gas. • Decreasing the temperature of a system in dynamic equilibrium favours the exothermic reaction. **AO3.1a: Analyse information in the table to interpret equilibrium position** • As temperature increases the percentage yield decreases. • As temperature increases position of equilibrium moves to the left. • As the pressure increases the percentage yield increases. • As the pressure increases position of equilibrium moves to the right. **AO3.2a: Analyse information in the table / equation to make judgements / predictions** • The prediction is not supported since reaction must be exothermic rather than endothermic because position of equilibrium moves to the left as temperature increases. • The prediction is supported in terms of the moles of gas as pressure increases the position of equilibrium moves to the right. • The prediction is supported because as the pressure increases the percentage yield increases.
			Total	**8**	