

Question Number	Acceptable Answers	Reject	Mark
1(a)(i)	<p>Mark the two points independently, subject to the constraint in Reject column</p> <p>Effect: (Equilibrium) shifts to the right (1)</p> <p><i>ALLOW:</i> "favours forward reaction" / "increase the amount of product" / "increase the yield (of product)"</p> <p>Reason: Exothermic (in forward direction) (1)</p> <p><i>NOTE: Just</i> "(equilibrium) shifts in the exothermic direction" scores (1)</p>	"Equilibrium shifts to left" will score (0) for (a)(i)	2

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	<p>First mark: Activation energy for the reaction is too high / (if cooled) molecules would not have enough energy to react / few(er) molecules have the required E_a/more molecules have energy $\geq E_a$ at higher temperatures OR not (technologically) feasible to cool the gases before they enter the converter/costly to cool the gases (1)</p> <p>Second mark: (cooling the gases would make) the rate (too) slow /rate is faster if the temperature is high (so the gases are not cooled) (1)</p>	Cooling the gases decreases the yield (of products) /an incorrect Le Chatelier argument	2

Question Number	Acceptable Answers	Reject	Mark
1(a)(iii)	<p>Mark the two points independently, subject to the constraint in Reject column</p> <p>Effect: (Equilibrium) shifts to the right</p> <p><i>ALLOW</i>: "favours forward reaction" / "increase the amount of product" / "increase the yield of product" (1)</p> <p>Reason: Shifts / moves in the direction of fewer (moles of gas) molecules</p> <p><i>ALLOW</i> "shifts in direction of fewer moles (of gas molecules)" (1)</p> <p><i>IGNORE</i> effect on the rate</p>	<p>"Equilibrium shifts to left" will score (0) for (a)(iii)</p> <p>".... fewer atoms"</p>	2

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	<p>(In NO): +2 / 2+ (1)</p> <p>(In NO₃⁻): +5 / 5+ (1)</p> <p><i>NOTE</i>:</p> <p>(In NO): Just "2" AND (In NO₃⁻): Just "5" scores (1)</p>		2

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	<p>$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightarrow \text{NO} + 2\text{H}_2\text{O}$</p> <p><i>ACCEPT</i> multiples</p>		1

Question Number	Acceptable Answers	Reject	Mark
1(b)(iii)	$\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^{(-)} / \text{Ag} - \text{e}^{(-)} \rightarrow \text{Ag}^+$ <p><i>ACCEPT</i> multiples <i>IGNORE</i> state symbols, even if incorrect</p>	"Ag + e ⁻ → Ag ⁺ "	1

Question Number	Acceptable Answers	Reject	Mark
1(b)(iv)	$3\text{Ag} + \text{NO}_3^- + 4\text{H}^+ \rightarrow 3\text{Ag}^+ + \text{NO} + 2\text{H}_2\text{O}$ <p>(2)</p> <p>(1) for multiplication of the silver half-equation by three or cq multiple from (b)(ii)</p> <p>(1) for rest of equation correct <i>NOTE:</i> Equation must be completely correct for the second mark.</p> <p><i>IGNORE</i> state symbols, even if incorrect</p>	if any e ⁻ are left in the final equation, second mark cannot be scored	2

Question Number	Acceptable Answers	Reject	Mark
2(a)	(Greater yield) as fewer moles/molecules (of gas) on RHS OR 3 moles/molecules on left but only 1 on right (1) ALLOW arguments in terms of K_p remaining constant Disadvantage: Extra cost of (building) equipment (to withstand higher pressure)/ thicker pipes/compressor/maintaining equipment (1) OR Higher cost of energy needed for compression (1) IGNORE references to explosion	Just (higher) cost	2

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	(Reaction is exothermic) so the value of $\Delta S_{\text{surroundings}}$ becomes more positive/larger (at 100 °C) (1) Therefore ΔS_{total} becomes more positive/larger/less negative (at 100 °C) (1) Second mark consequential on first		2

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	(Higher temperature gives a) faster rate of reaction /more particles have $E \geq E_a$ (ALLOW more successful collisions (per second)) IGNORE references to yield		1

Question Number	Acceptable Answers	Reject	Mark
2(c)	Remove methanol/the product (as it is formed) (1) Recycle/reuse unreacted reactants (1) IGNORE references to catalyst and increasing amounts of reactants		2