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

Question Number	Acceptable Answers	Reject	Mark
1(a)(ii)	**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 ≥ E_a at higher temperatures **OR** not (technologically) feasible to cool the gases before they enter the converter/costly to cool the gases **(1)** **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)**	Cooling the gases decreases the yield (of products) /an incorrect Le Chatelier argument	**2**

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

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	**(In NO):** +2 / 2+ **(1)** (**In NO_3^-):** +5 / 5+ **(1)** *NOTE:* **(In NO):** Just "2" **AND** (**In NO_3^-):** Just "5" scores **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
1(b)(ii)	NO_3^- + **4**H^+ + **3**e^- → NO + **2**H_2O *ACCEPT* multiples		**1**

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

Question Number	Acceptable Answers	Reject	Mark
1(b)(iv)	$3Ag + NO_3^- + 4H^+ \rightarrow 3Ag^+ + NO + 2H_2O$ **(2)** **(1)** for multiplication of the silver half-equation by three or cq multiple from (b)(ii) **(1)** for rest of equation correct *NOTE:* Equation must be completely correct for the second mark. *IGNORE* state symbols, even if incorrect	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 $\Delta S_{surroundings}$ 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**