

Question		Answer	Marks	Guidance
18	(a)	$\Delta G = \Delta H - T\Delta S$ linked to $y = mx + c$ (somewhere) ✓ gradient = $-\Delta S$ ✓ P: ΔH / enthalpy change ✓ Q: (temperature) for reaction to be feasible/unfeasible OR (temperature) at which feasibility changes ✓	4	Could be: $\Delta G = -\Delta S T + \Delta H$ – sign required ALLOW $\Delta S = -\text{gradient}$ ALLOW ‘point of feasibility’ For Feasibility: ALLOW can take place/happen OR is spontaneous IGNORE ‘minimum/maximum temperature’
	(b)	(i)	1	
		(ii)	1	Allow species without state symbols and without brackets, e.g. p_{CO}^4 , $pp\text{CO}^4$, PCO^4 , $p(\text{CO}^4)$ etc. DO NOT ALLOW square brackets
		(iii)	3	IGNORE units ALLOW (+) 467 up to calculator value of 466.8762 correctly rounded ECF for any positive value determined in M1 ALLOW 962 up to calculator value of 962.0253165 correctly rounded

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(iv)	<p>FIRST, CHECK THE ANSWER ON ANSWER LINE IF answer = -110.5, Award 3 marks.</p> <p>-----</p> <p>Correct expression $-13.5 = (4 \times -393.5) - (-1118.5 + 4 \times \Delta_f H(\text{CO})) \checkmark$</p> <p>Correct subtraction using ΔH and $\Delta_f H(\text{Fe}_3\text{O}_4)$ $4 \times \Delta_f H(\text{CO}) = (4 \times -393.5) - (-1118.5) + 13.5$ $= -442(.0) \text{ (kJ mol}^{-1}\text{)} \checkmark$</p> <p>Calculation of $\Delta_f H(\text{CO})$ formation</p> $\Delta_f H(\text{CO}) = -\frac{442}{4} = -110.5 \text{ (kJ mol}^{-1}\text{)} \checkmark$	3	<p>For answer, ALLOW -111 (kJ mol⁻¹)</p> <p>-----</p> <p>NOTE: IF any values are omitted, DO NOT AWARD any marks. e.g. -393.5 OR -13.5 may be missing</p> <p>-----</p> <p>Common errors</p> <p>(+)110.5 <i>wrong/omitted sign</i> 2 marks</p> <p>(+)184.625 / 184.63 / 184.6 / 185 2 marks <i>No 4CO₂</i></p> <p>(+)738.5 / 739 <i>No 4CO₂ and no CO/4</i> 1 mark</p> <p>-117.25 / -117.3 / -117 <i>Wrong cycle</i> 2 marks</p> <p>-469 <i>Wrong cycle, no CO/4</i> 1 mark</p> <p>(+)177.875 / 177.88 / 177.9 / 178 1 mark <i>Wrong cycle, no 4CO₂</i></p> <p>-360.5 <i>Used 118.5</i> 2 marks</p> <p>Any other number: CHECK for ECF from 1st marking point for expressions using ALL values with ONE error only e.g. one transcription error:, e.g. 395.3 for 393.5</p>
	Total	12	