2 The balance between enthalpy change and entropy change determines the feasibility of a reaction. The table below contains enthalpy of formation and entropy data for some elements and compounds.

	$N_2(g)$	$O_2(g)$	NO(g)	C(graphite)	C(diamond)
$\Delta H_f^{\ominus}$ / kJ mol^{-1}	0	0	+90.4	0	+1.9
$S^{\ominus}$ / J K^{-1} mol^{-1}	192.2	205.3	211.1	5.7	2.4

2 (a) Explain why the entropy value for the element nitrogen is much greater than the entropy value for the element carbon (graphite).

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(2 marks)

2 (b) Suggest the condition under which the element carbon (diamond) would have an entropy value of zero.

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(1 mark)

2 (c) Write the equation that shows the relationship between ΔG, ΔH and ΔS for a reaction.

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(1 mark)

2 (d) State the requirement for a reaction to be feasible.

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(1 mark)

2 (e) Consider the following reaction that can lead to the release of the pollutant NO into the atmosphere.

$$\tfrac{1}{2}N_2(g) + \tfrac{1}{2}O_2(g) \longrightarrow NO(g)$$

Use data from the table on page 4 to calculate the minimum temperature above which this reaction is feasible.

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(5 marks)

2 (f) At temperatures below the value calculated in part **2 (e)**, decomposition of NO into its elements should be spontaneous. However, in car exhausts this decomposition reaction does **not** take place in the absence of a catalyst.
Suggest why this spontaneous decomposition does **not** take place.

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(1 mark)

2 (g) A student had an idea to earn money by carrying out the following reaction.

$$C(\text{graphite}) \longrightarrow C(\text{diamond})$$

Use data from the table on page 4 to calculate values for $\Delta H^{\ominus}$ and $\Delta S^{\ominus}$ for this reaction. Use these values to explain why this reaction is **not** feasible under standard pressure at any temperature.

$\Delta H^{\ominus}$.....

$\Delta S^{\ominus}$.....

Explanation.....

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(3 marks)

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