

Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Q1.

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)
$\Delta H_f^\circ / \text{kJ mol}^{-1}$	0	0	+90.4	0	+1.9
$S^\circ / \text{J K}^{-1} \text{ mol}^{-1}$	192.2	205.3	211.1	5.7	2.4

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

(2)

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

(1)

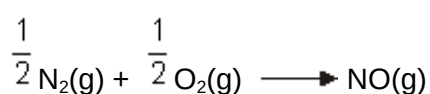
- (c) Write the equation that shows the relationship between ΔG , ΔH and ΔS for a reaction.

(1)

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

(1)

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



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

(5)

- (f) At temperatures below the value calculated in part (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.

(1)

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



Use data from the table above to calculate values for ΔH° and ΔS° for this reaction. Use these values to explain why this reaction is **not** feasible under standard pressure at any temperature.

ΔH° _____

ΔS° _____

Explanation _____

(3)

(Total 14 marks)

Q2.

Comparison of lattice enthalpies from Born-Haber cycles with lattice enthalpies from calculations based on a perfect ionic model are used to provide information about bonding in crystals.

- (a) Define the terms *enthalpy of atomisation* and *lattice dissociation enthalpy*.

Enthalpy of atomisation _____

Lattice dissociation enthalpy _____

(4)

- (b) Use the following data to calculate a value for the lattice dissociation enthalpy of sodium chloride.

	$\Delta H^\circ / \text{kJ mol}^{-1}$
$\text{Na(s)} \longrightarrow \text{Na(g)}$	+109
$\text{Na(g)} \longrightarrow \text{Na}^+(\text{g}) + \text{e}^-$	+494
$\text{Cl}_2(\text{g}) \longrightarrow 2\text{Cl(g)}$	+242
$\text{Cl(g)} + \text{e}^- \longrightarrow \text{Cl}^-(\text{g})$	-364
$\text{Na(s)} + \frac{1}{2}\text{Cl}_2(\text{g}) \longrightarrow \text{NaCl(s)}$	-411

(3)

- (c) Consider the following lattice dissociation enthalpy (ΔH_L°) data.

	NaBr	AgBr
$\Delta H_L^\circ(\text{experimental})/\text{kJ mol}^{-1}$	+733	+890
$\Delta H_L^\circ(\text{theoretical})/\text{kJ mol}^{-1}$	+732	+758

The values of ΔH_L° (experimental) have been determined from Born-Haber cycles.

The values of ΔH_L° (theoretical) have been determined by calculation using a perfect ionic model.

- (i) Explain the meaning of the term *perfect ionic model*.

(2)

- (ii) State what you can deduce about the bonding in NaBr from the data in the table.

(1)

- (iii) State what you can deduce about the bonding in AgBr from the data in the table.

(1)

(Total 11 marks)