

Name of the Student: _____

Max. Marks : 17 Marks

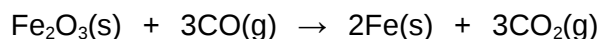
Time : 17 Minutes

Q1.

Use the data in the table below to answer the questions which follow.

Substance	Fe ₂ O ₃ (s)	Fe(s)	C(s)	CO(g)	CO ₂ (g)
$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	-824.2	0	0	-110.5	-393.5
$S^\ominus / \text{J K}^{-1} \text{mol}^{-1}$	87.4	27.3	5.7	197.6	213.6

- (a) The following equation shows one of the reactions which can occur in the extraction of iron.



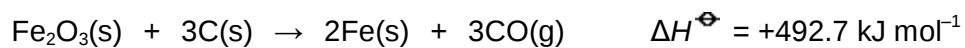
- (i) Calculate the standard enthalpy change and the standard entropy change for this reaction.

Standard enthalpy change _____

Standard entropy change _____

- (ii) Explain why this reaction is feasible at all temperatures.

- (b) The reaction shown by the following equation can also occur in the extraction of iron.



The standard entropy change, $\Delta S^\ominus$, for this reaction is $+542.6 \text{ J K}^{-1} \text{ mol}^{-1}$

Use this information to calculate the temperature at which this reaction becomes feasible.

(3)

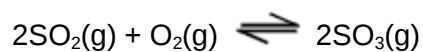
- (c) Calculate the temperature at which the standard free-energy change, $\Delta G^\ominus$ has the same value for the reactions in parts (a) and (b).

(3)

(Total 15 marks)

Q2.

This question relates to the equilibrium gas-phase synthesis of sulphur trioxide:



Thermodynamic data for the components of this equilibrium are:

Substance	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	$S^\ominus / \text{J K}^{-1} \text{mol}^{-1}$
$\text{SO}_3(\text{g})$	-396	+257
$\text{SO}_2(\text{g})$	-297	+248
$\text{O}_2(\text{g})$	0	+204

This equilibrium, at a temperature of 585 K and a total pressure of 540 kPa, occurs in a vessel of volume 1.80 dm^3 . At equilibrium, the vessel contains 0.0500 mol of $\text{SO}_2(\text{g})$, 0.0800 mol of $\text{O}_2(\text{g})$ and 0.0700 mol of $\text{SO}_3(\text{g})$.

The standard entropy change for this reaction is

- A $-222 \text{ J K}^{-1} \text{mol}^{-1}$
- B $-195 \text{ J K}^{-1} \text{mol}^{-1}$
- C $-186 \text{ J K}^{-1} \text{mol}^{-1}$
- D $+198 \text{ J K}^{-1} \text{mol}^{-1}$

(Total 1 mark)

Q3.

Which one of the following has the most covalent character?

- A MgF_2
- B MgBr_2
- C AlF_3
- D AlBr_3

(Total 1 mark)