

A level Chemistry A

H432/01 Periodic table, elements and physical chemistry

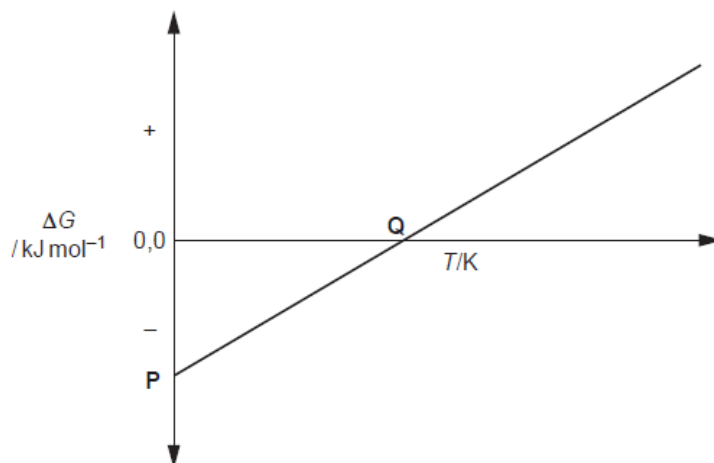
Question Set 3

- 1 (a) (i) This question is about free energy changes, ΔG , enthalpy changes, ΔH , and temperature, T .

The Gibbs' equation is shown below.

$$\Delta G = \Delta H - T\Delta S$$

A chemist investigates a reaction to determine how ΔG varies with T . The results are shown in **Fig. 1.1**.

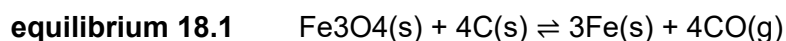


What is significant about the gradient of the line and the values **P** and **Q** shown in **Fig. 1.1**?

Explain your reasoning.

[4]

- (b) (i) Iron can be extracted from its ore Fe_3O_4 using carbon. Several equilibria are involved including **equilibrium 18.1**, shown below.



$$\begin{aligned}\Delta H &= +676.4 \text{ kJ mol}^{-1} \\ \Delta S &= +703.1 \text{ J K}^{-1} \text{ mol}^{-1}\end{aligned}$$

Why is **equilibrium 18.1** a *heterogeneous* equilibrium?

[1]

- (ii) Write the expression for K_p for **equilibrium 18.1**.

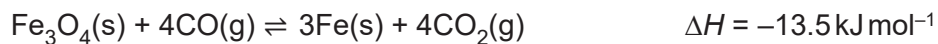
[1]

(iii) The forward reaction in **equilibrium 18.1** is only feasible at high temperatures.

- Show that the forward reaction is **not** feasible at 25°C.
- Calculate the minimum temperature, in K, for the forward reaction to be feasible.

[3]

(iv) Another equilibrium involved in the extraction of iron from Fe₃O₄ is shown below.



Enthalpy changes of formation, $\Delta_f H$, for Fe₃O₄(s) and CO₂(g) are shown in the table

Compound	$\Delta_f H / \text{kJ mol}^{-1}$
Fe ₃ O ₄ (s)	-1118.5
CO ₂ (g)	-393.5

Calculate the enthalpy change of formation, $\Delta_f H$, for CO(g).

$\Delta_f H$, for CO(g) = kJ mol⁻¹

[3]

Total Marks for Question Set 3: 12

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