Practice Question Set For A-Level
Subject : Chemistry
Paper-1 Topic: Physical 1_Thermodynamics

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Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

Hydrogen can be manufactured from the reaction of steam with methane.

$$CH_4(g) + H_2O(g) \longrightarrow CO(g) + 3H_2(g)$$

(a) The table contains some enthalpy of formation and entropy data.

Substance	**$\Delta H^{\ominus}_f$ / kJ mol^{-1}**	**$S^{\ominus}$ / J K^{-1} mol^{-1}**
$CH_4(g)$	−75	186
$H_2O(g)$	−242	189
$CO(g)$	−111	198
$H_2(g)$	0	131
$CO_2(g)$	−394	214

(i) Use data from the table to calculate the enthalpy change, Δ*H*, for the reaction of steam with methane.

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(3)

(ii) Use data from the table to calculate the entropy change, Δ*S*, for the reaction of steam with methane.

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(2)

(b) Use your values of Δ*H* and Δ*S* from parts (a)(i) and (a)(ii) to calculate the temperature above which this reaction is feasible.

(4)

(c) The temperature used for this manufacture of hydrogen is usually about 1300 K.

Suggest **one** reason, other than changing the position of equilibrium, why this temperature is used rather than the value that you calculated in part (b).

(1)

(d) Hydrogen can also be obtained by reaction of carbon monoxide with steam.

$CO(g) + H_2O(g) \longrightarrow CO_2(g) + H_2(g)$ $\Delta H = -41$ kJ mol^{-1}, $\Delta S = -42$ J K^{-1} mol^{-1}

(i) Explain, using a calculation, why this reaction should **not** occur at 1300 K.

(3)

(ii) Explain how the conditions for the reaction could be changed to allow this reaction to take place.

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(2)

(Total 15 marks)

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Q2.

(a) Define the term *lattice enthalpy of dissociation*.

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(2)

(b) Lattice enthalpy can be calculated theoretically using a **perfect ionic model**.

Explain the meaning of the term *perfect ionic model*.

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(1)

(c) Suggest **two** properties of ions that influence the value of a lattice enthalpy calculated using a perfect ionic model.

Property 1 _____

_____

Property 2 _____

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(2)

(d) Use the data in the table to calculate a value for the lattice enthalpy of dissociation for silver chloride.

Enthalpy change	**Value / kJ mol^{-1}**
Enthalpy of atomisation for silver	+289
First ionisation energy for silver	+732
Enthalpy of atomisation for chlorine	+121
Electron affinity for chlorine	−364
Enthalpy of formation for silver chloride	−127

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(3)

(e) Predict whether the magnitude of the lattice enthalpy of dissociation that you have calculated in part (d) will be less than, equal to or greater than the value that is obtained from a perfect ionic model. Explain your answer.

Prediction compared with ionic model _____

Explanation _____

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(2)

(Total 10 marks)

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