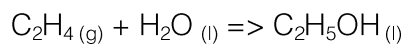
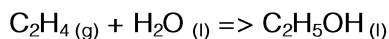


IB Chemistry: Energetics Practice Question [~30 marks]

Ethene Gas + Water => Ethanol Liquid



1. Write a balanced equation [1 mark]



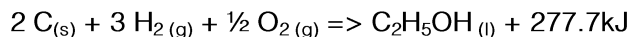
2. Explain the structure and bonding of ethane and ethanol [4 marks]

- Draw the Lewis Diagrams for both Ethene and Ethanol
- List number of each type of bond (ie. 1 C=C and 4 C-H for Ethene)
- Describe bonds in terms of Sigma and Pi bonds
- State the bonding of each charge center (ie. sp^2 trigonal planar 120° for Ethene)
- State the types of IMFA's (ie. non-polar, LDF for Ethene)

3. Explain what is meant by enthalpy of formation [2 marks]

Definition: Energy released when 1 mol of ethanol is formed from 1 mol of Ethene Gas and 1 mol of Water Liquid.

4. Write a balanced thermochemical equation for Ethanol given that $\Delta H_f = -277.7 \text{ kJ/mol}$ [2 marks]



5. Calculate the enthalpy of the reaction using the data table. [2 marks]

- Use the equation: $\Delta H_{\text{rxn}} = \Delta H_{\text{products}} - \Delta H_{\text{reactants}}$

6. Outline what you understand based on your answer from 5. [2 marks]

- Exothermic reaction
- Products more stable than reactants

7. Predict the spontaneity of the reaction [2 marks]

- Not spontaneous, entropy is decreasing since you go from (Solid + Gas) => Liquid
- Entropy of a gas is much greater than the entropy of a liquid

8. Compare and contrast between H_f° of $\text{H}_2(\text{g})$ and the entropy of $\text{H}_2(\text{g})$ [2 marks]

- H_f° is 0 since Hydrogen gas is an element (by convention it must be 0)
- ΔS of H_2 is not 0 (entropy is energy distributed in a system) therefore the entropy must have a numerical value.

9. Explain what you understand about ΔS of the reaction [3 marks]

- ΔS°
 - o Δ means change
 - o S means randomness & disorder of the system
 - o $^\circ$ means under standard conditions

10. Calculate the ΔS of the given reaction and explain what you understand based on the answer. [3 marks]

- ΔS is negative
- Use the equation $\Delta S_{\text{reactants}} = \Delta S_{\text{products}} - \Delta S_{\text{reactants}}$
- Since entropy change is negative the products are more ordered than the reactants
- This reaction is not spontaneous since entropy must always increase in a spontaneous reaction

11. Would this reaction be spontaneous at room temperature? Justify. [4 marks]

- Use the equation $\Delta G = \Delta H - T\Delta S$
- Not spontaneous at room temperature
- Reaction may occur at low temperatures since:
 - o $\Delta G < 0$ for spontaneity
 - o ΔS is negative (based on answers above)
 - o ΔH is negative (based on answers above)
 - o Therefore for ΔG to be negative, T must be very low
 - o Therefore the reaction is only spontaneous at low temperatures (most likely not room temp)

12. Calculate the temperature which this reaction is spontaneous. [3 marks]

- Use the equation $\Delta G = \Delta H - T\Delta S$
- Set $\Delta G = 0$
- ΔH and ΔS already known from previous questions
- Solve for T
- Be careful to convert units to kJ