

Chem!stry

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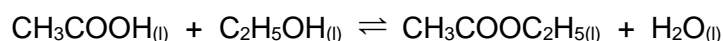
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Chemical Equilibrium

Question One:

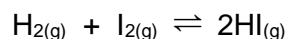
Calculate the equilibrium constant, K_c , for the esterification reaction given below:



Data: 1.00 mol of ethanoic acid was allowed to react with 4.00 mol of ethanol. At equilibrium, the amount of ethanoic acid remaining was 0.07 mol.

Question Two:

One mole of hydrogen gas and one mole of iodine vapour were mixed together and allowed to reach equilibrium at 300 K and a pressure of 1 atm:



Data: The amount of hydrogen iodide present at equilibrium was found to be 1.5 mol. Calculate the equilibrium constant, K_p , at 300 K.

Question Three:

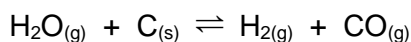
Phosphorus(V) chloride dissociates at high temperatures according to the following balanced chemical equation:



Data: The system reaches equilibrium at a certain temperature when 39% of a sample of PCl_5 has dissociated. The total equilibrium pressure is 2.00 atm. Calculate the value for the equilibrium constant, K_p :

Question Four:

Water gas is a mixture of hydrogen and carbon monoxide. It is made by passing steam over heated coke:

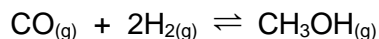


It was used for many years as a commercial fuel.

- a) This reaction was carried out at normal atmospheric pressure. Suggest, and explain, how increasing the pressure affects:
- The time taken to reach equilibrium.
 - The equilibrium yield of water gas.
- b) Write the expression for the equilibrium constant, K_p , for this reaction.
- c) During the conversion of steam into water gas, it was found that 30% of the steam had been reacted.
- Calculate the partial pressure of each gas in the equilibrium mixture if the total pressure was 100 kPa.
 - Calculate the value of K_p under these conditions. Include any units of K_p in your answer.

Question Five:

At a temperature of 107 °C the reaction:



reaches equilibrium under a pressure of 1.59 MPa with 0.122 mol of carbon monoxide and 0.298 mol of hydrogen present at equilibrium in a vessel of volume 1.04 dm³.

Use this data to answer the questions that follow:

- a) Assuming ideal gas behaviour, determine the total number of moles of gas present. Hence, calculate the number of moles of methanol in the equilibrium mixture.
Note: $R = 3.814 \text{ JK}^{-1}\text{mol}^{-1}$.
- b) Calculate the value of the equilibrium constant, K_c , for this reaction and state its units.
- c)
 - Write an expression for the equilibrium constant, K_p , for this equilibrium.
 - Calculate the mole fraction of each of the three gases present in the equilibrium mixture.
 - Calculate the partial pressures of all of the gases present in the equilibrium mixture.
 - Calculate the value of the equilibrium constant, K_p , and state its units.

- Scan the QR code below for the answers to this assignment.



http://www.chemist.sg/ammonia_equilibrium/equilibrium_calc_ans.pdf