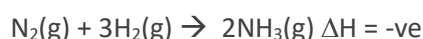
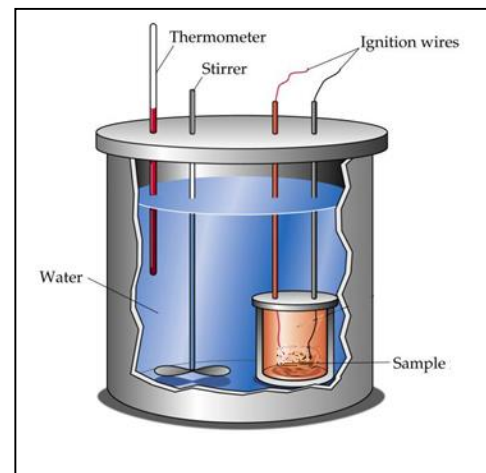


Ammonia production worksheet 3

- 1) Hydrogen and nitrogen gases were mixed in a bomb calorimeter and allowed to react according to the equation below.



The combustion chamber of the bomb calorimeter has a volume of 1.50 litres. A mixture of hydrogen and nitrogen containing 2.13 mol of H_2 gas and 3.20 mol of N_2 gas was placed in the chamber, ignited and allowed to reach equilibrium. At equilibrium it was found that 3.41 grams of ammonia was present in the chamber.

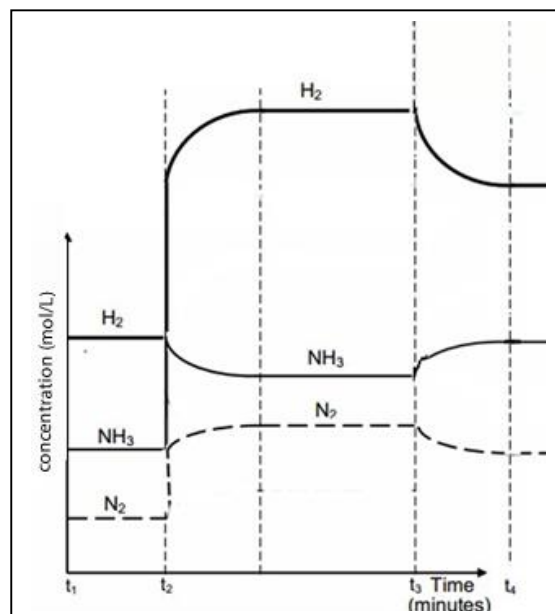


- a) Calculate the number of mol of each species at equilibrium
- b) Calculate the equilibrium constant at the temperature at which the measurements were taken.
- c) A mixture of gases was placed in the same reaction chamber at exactly the same temperature. The mixture of 0.100 mol of N_2 , 0.100 mol of H_2 and 0.100 mol of NH_3 was allowed to reach equilibrium. Which comment below is true? Explain.
- When the system reaches equilibrium the final concentration of ammonia will be lower than the initial concentration.
 - When the system reaches equilibrium the final concentration of hydrogen will be lower than the initial concentration.
 - When the system reaches equilibrium the final concentration of ammonia will be the same as that of the initial concentration
 - When the system reaches equilibrium the final concentration of nitrogen will be the same as the initial concentration
- d) In another experiment 1.00 mol of N_2 was mixed with 1.00 mol of H_2 and ignited in a 0.500 litre, sealed container. After the system had reached equilibrium it was found that 0.400 mol of NH_3 was present. Calculate the pressure, atm, exerted by the equilibrium mixture of gases at 20.0°C to the right number of significant numbers

- 2) A fertiliser company produces ammonia on a large scale at a temperature of 450° C. Adjustments were made to the conditions of an equilibrium mixture of nitrogen, hydrogen and ammonia gases in order to increase the yield of ammonia.

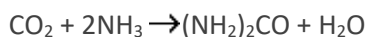
In a trial run on a small scale in the laboratory, an engineer makes adjustments to the conditions of the equilibrium mixture. The graph below represent the results obtained.

- a) What happened at t_2 ?
- b) What happened at t_3 ?
- c) The value of the equilibrium expression is represented by K_c . Compare the
- K_c at t_1 to the K_c at t_2 ? Explain.
 - K_c at t_1 to the K_c at t_4 ? Explain



- 3) Amino acids are degraded in the liver via a reaction that produces ammonia. The amine group of the amino acid is converted to. This process is called **deamination**. The non-nitrogenous portion of the molecule is converted to carbohydrates or fats. The overall equation for deamination of an amino acid in the liver is:
- $$2\text{NH}_2\text{CHR}\text{COOH} + \text{O}_2 \rightarrow 2\text{CROCOOH} + 2\text{NH}_3$$

Ammonia is highly toxic and therefore cannot be allowed to accumulate. With the help of enzymes in the liver cells carbon dioxide reacts chemically with the ammonia molecule. The less toxic nitrogenous compound urea is produced together with water according to the equation below.



Draw the structural formula of urea.



Explain why urea is soluble in water.