Practice Question Set For A-Level
Subject : Chemistry
Paper-1 Topic: Physical 1_Equilibrium Constant Kp For Homogeneous Systems

Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

A sealed flask containing gases **X** and **Y** in the mole ratio 1:3 was maintained at 600 K until the following equilibrium was established.

$$X(g) + 3Y(g) \rightleftharpoons 2Z(g)$$

The partial pressure of **Z** in the equilibrium mixture was 6.0 MPa when the total pressure was 22.0 MPa.

(a) (i) Write an expression for the equilibrium constant, K_p, for this reaction.

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(ii) Calculate the partial pressure of **X** and the partial pressure of **Y** in the equilibrium mixture.

*Partial pressure of **X*** _____

_____

*Partial pressure of **Y*** _____

(iii) Calculate the value of K_p for this reaction under these conditions and state its units.

Value of K_p _____

_____

_____

Units of K_p _____

(6)

(b) When this reaction is carried out at 300 K and a high pressure of 100 MPa, rather than at 600 K and 22.0 MPa, a higher equilibrium yield of gas **Z** is obtained.

Give two reasons why an industrialist is unlikely to choose these reaction conditions.

Reason 1 _____

Reason 2 _____

(2)

(Total 8 marks)

Q2.

Which change would alter the value of the equilibrium constant (K_p) for this reaction?

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

A Increasing the total pressure of the system. ⬭

B Increasing the concentration of sulfur trioxide. ⬭

C Increasing the concentration of sulfur dioxide. ⬭

D Increasing the temperature. ⬭

(Total 1 mark)

Q3.

The manufacture of methanol can be achieved in two stages.

(a) In the first stage, methane and steam react according to the following equation.

$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$ $\Delta H^o = +210 \text{ kJ mol}^{-1}$

Discuss, with reasons, the effects of increasing separately the temperature and the pressure on the yield of the products and on the rate of this reaction.

(6)

(b) In the second stage, carbon monoxide and hydrogen react according to the following equation.

$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$

A 62.8 mol sample of carbon monoxide was added to 146 mol of hydrogen. When equilibrium was reached at a given temperature, the mixture contained 26.2 mol of methanol at a total pressure of 9.50 MPa.

Write an expression for the equilibrium constant, K_p, for this reaction. Calculate a value for K_p at this temperature and give its units.

(8)

(Total 14 marks)