F325 Module 2: HW4

1.

(a) The expression for an equilibrium constant, K_c, for a homogeneous equilibrium reaction is given below.

$$K_c = \frac{[A]^2[B]}{[C][D]^3}$$

(i) Write an equation for the forward reaction.

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(ii) Deduce the units of K_c

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(iii) State what can be deduced from the fact that the value of K_c is larger when the equilibrium is established at a lower temperature.

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(3 marks)

(b) A 36.8 g sample of N_2O_4 was heated in a closed flask of volume 16.0 dm^3. An equilibrium was established at a constant temperature according to the following equation.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The equilibrium mixture was found to contain 0.180 mol of N_2O_4

(i) Calculate the number of moles of N_2O_4 in the 36.8 g sample.

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(ii) Calculate the number of moles of NO_2 in the equilibrium mixture.

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(iii) Write an expression for K_c and calculate its value under these conditions.

Expression for K_c .....

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Calculation .....

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(iv) Another 36.8 g sample of N_2O_4 was heated to the same temperature as in the original experiment, but in a larger flask. State the effect, if any, of this change on the position of equilibrium and on the value of K_c compared with the original experiment.

Effect on the position of equilibrium .....

Effect on the value of K_c .....

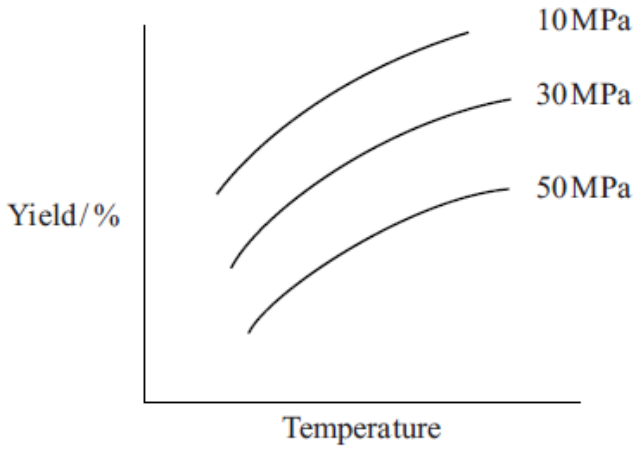
(9 marks)

12

AQA Jan 2006 CHM4

2.

(a) The diagram below shows the effect of temperature and pressure on the equilibrium yield of the product in a gaseous equilibrium.



(i) Use the diagram to deduce whether the forward reaction involves an increase or a decrease in the number of moles of gas. Explain your answer.

Change in number of moles .....

Explanation .....

(ii) Use the diagram to deduce whether the forward reaction is exothermic or endothermic. Explain your answer.

The forward reaction is .....

Explanation .....

.....

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(6 marks)

(b) When a 0.218 mol sample of hydrogen iodide was heated in a flask of volume V dm^3, the following equilibrium was established at 700 K.

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

The equilibrium mixture was found to contain 0.023 mol of hydrogen.

(i) Calculate the number of moles of iodine and the number of moles of hydrogen iodide in the equilibrium mixture.

Number of moles of iodine .....

Number of moles of hydrogen iodide .....

.....

(ii) Write an expression for K_c for the equilibrium.

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(iii) State why the volume of the flask need not be known when calculating a value for K_c.

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(iv) Calculate the value of K_c at 700 K.

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(v) Calculate the value of K_c at 700 K for the equilibrium

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

.....

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(7 marks)

13