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IB Chemistry: SL

7.1 Equilibrium

CHEMISTRY

SL

7.1 Equilibrium

Question Paper

Course	DP IB Chemistry
Section	7. Equilibrium
Topic	7.1 Equilibrium
Difficulty	Hard

Time allowed: 20

Score: /10

Percentage: /100

Question 1

The following K_c values were obtained for a reaction carried out at different temperatures, T_1 to T_4

Temperature	K_c value
T_1	1×10^{-2}
T_2	1×10^{1}
T_3	1
T_4	1×10^{2}

Which of the following gives the correct amount of products in the mixtures from least to most?

A. $T_1 < T_2 < T_3 < T_4$
B. $T_4 < T_3 < T_2 < T_1$
C. $T_4 < T_2 < T_3 < T_1$
D. $T_1 < T_3 < T_2 < T_4$

[1 mark]

Question 2

Which of the following conditions and reasons will increase the amount of hydrogen iodide produced?

$$H_2\,(g) + I_2\,(g) \rightleftharpoons 2HI\,(g) \qquad \Delta H^{\theta} = -126\ kJ$$

	Condition	Reason	Condition	Reason
A	increase T	exothermic reaction	increase P	two gaseous reactants but only one gaseous product
B	increase T	endothermic reaction	no change in P	equal numbers of moles of gases
C	decrease T	exothermic reaction	decrease P	two moles of gaseous product but only one mole of each gaseous reactant
D	decrease T	exothermic reaction	no change in P	equal numbers of moles of gases

[1 mark]

Question 3

Study the following equilibrium reaction and determine which of the statements must be true.

$$2X \rightleftharpoons Y \quad K_c = 1.1$$

A. [X] $\gg$ [Y]
B. [X] $>$ [Y]
C. [X] = [Y]
D. [X] $<$ [Y]

[1 mark]

Question 4

Hydrogen reacts with iodine according to the following equation

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

The value of K_c for this reaction has been measured at different temperatures

K_c = 60 at 355 °C

K_c= 47 at 450 °C

From the information given which of the following must be true?

A. The reaction is exothermic
B. The reaction is endothermic
C. The reaction barely proceeds at 355 °C
D. The reaction almost goes to completion at 450 °C

[1 mark]

Question 5

What is the relationship between K_{c1} and K_{c2} in the following reactions?

$$2NOBr\ (g) \rightleftharpoons 2NO\ (g) + Br_2\ (g) \quad K_{c1}$$

$$NO\ (g) + \frac{1}{2} Br_2\ (g) \rightleftharpoons NOBr\ (g)\ K_{c2}$$

A. $2K_{c2} = K_{c1}$

B. $(K_{c2})2 = K_{c1}$

C. $K_{c2} = \frac{1}{\sqrt{K_{c1}}}$

D. $K_{c2} = \frac{1}{2K_{c1}}$

[1 mark]

Question 6

Nitrogen dioxide can react with itself to produce a dimer molecule called dinitrogen tetroxide in the following equilibrium reaction

$$2NO_2\ (g) \rightleftharpoons N_2O_4\ (g) \quad K_c = 0.01 \text{ at } 25\ °C$$

In an experiment, 100 cm^3 of nitrogen dioxide is placed in a gas syringe and the barrel is pushed in, meaning the volume is
reduced to 50 cm^3 at constant temperature.

Which of the following are true?

1 The value of K_c increases

2 More N_2O_4 is formed

3 The ratio of $\frac{[NO_2]}{[N_2O_4]}$ decreases

A. 1 and 2 only
B. 1 and 3 only
C. 2 and 3 only
D. 1, 2 and 3

[1 mark]

Question 7

One of the characteristics of a state of equilibrium, is that equilibria are said to be dynamic. What is the meaning of dynamic in this context?

A. The position of equilibrium is constantly changing
B. The rates of forward and backward reactions change
C. The reactants and products are continually reacting
D. The concentrations of the reactants and products continue to change

[1 mark]

Question 8

The reaction shown below has a value of $K_c = 1.0 \times 10^{-4}$ at 25 °C.

$$2NOBr\ (g) \rightleftharpoons 2NO\ (g) + Br_2(l)$$

Which of the following relationships is correct about this equilibrium at 25 °C?

A. [NO] ≫ [NOBr]
B. [NOBr] ≫ [Br_2]
C. 2 x [NOBr] = [Br_2]
D. [NO] = [NOBr]

[1 mark]

Question 9

The blood-red complex iron (III) thiocynanate, $[FeSCN]^{2+}$ is formed when iron (III) ions react with thiocyanate ions in the following equilibrium reaction:

$$\underset{\text{yellow}}{Fe^{3+}(aq)} + \underset{\text{colourless}}{SCN^{-}aq)} \rightleftharpoons \underset{\text{red}}{[FeSCN]^{2+}} \qquad \Delta H^{\theta} = +12 \text{ kJr}$$

Which of the following changes would make the solution go darker?

1 raising the temperature of the solution
2 adding iron(III) chloride solution
3 adding a catalyst

A. 1 and 2 only
B. 1 and 3 only
C. 2 and 3 only
D. 1, 2 and 3

[1 mark]

Question 10

Which of the following features is not a characteristic of a state of equilibrium?

A. Equilibrium is dynamic
B. Equilibrium is achieved in a closed system
C. Concentrations of reactants and products are equal
D. Equilibrium can be reached from either direction

[1 mark]