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

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

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

A $[X] \gg [Y]$

B $[X] > [Y]$

C $[X] = [Y]$

D $[X] < [Y]$

[1 mark]

Question 2

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 3

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 4

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 5

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

$$Fe^{3+}(aq) + SCN^{-}(aq) \rightleftharpoons [FeSCN]^{2+} \qquad \Delta H^{\theta} = +12\ kJ$$

yellow colourless red

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

I. raising the temperature of the solution

II. adding iron(III)chloride solution

III. adding a catalyst

A I and II only

B I and III only

C II and III only

D I, II and III

[1 mark]

Question 6

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]

Question 7

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

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

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

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 8

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

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad K_c = 0.01 \text{ at } 25\ ^\circ C$$

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?

I. The value of K_c increases

II. More N_2O_4 is formed

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

A I and II only

B I and III only

C II and III only

D I, II and III

[1 mark]

Question 9

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 10

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]