7.1 Equilibrium

Question Paper

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

Time allowed: 20

Score: /10

Percentage: /100

Question 1

Dinitrogen tetraoxide, N_2O_4, and nitrogen dioxide exist in equilibrium. This is represented by the reaction below:

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad \Delta H = -57 \text{ kJ mol}^{-1}$$

Which conditions give the greatest percentage of NO_2 at equilibrium?

A high pressure and high temperature

B low pressure and high temperature

C high pressure and low temperature

D low pressure and low temperature

[1 mark]

Question 2

Which statement below best describes a dynamic equilibrium?

A the rate of the forward reaction is equal to the backwards reaction, and the concentrations of reactants and products is constant

B the rate of the forward reaction is equal to the backwards reaction in a closed system, and the concentrations of the reactants and products are equal

C the rate of the forward reaction is equal to the backwards reaction in a closed system, and the concentrations of the reactants and products is constant

D the rate of reaction changes in either direction to counteract a change in conditions

[1 mark]

Question 3

Ethanol is manufactured by reacting steam with ethene.

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \qquad \Delta H = -45 \text{ kJ mol}^{-1}$$

What would increase the equilibrium yield of ethanol in this process?

I. adding a catalyst

II. increasing the pressure

III. decreasing the temperature

A I and II only

B I and III only

C II and III only

D I, II and III

[1 mark]

Question 4

Propyl ethanoate is formed in an esterification reaction. How can the value of the equilibrium constant K_c be increased?

Propan-1-ol + ethanoic acid $\rightleftharpoons$ propyl ethanoate + water ΔH = -10 kJ mol^{-1}

A increasing the temperature

B adding a catalyst

C increasing the pressure

D lowering the temperature

[1 mark]

Question 5

In the reaction where gaseous iodine reacts with hydrogen, an equilibrium is established at 450 °C. The reaction is exothermic

$$\underset{\text{colourless}}{H_2(g)} + \underset{\text{purple}}{I_2(g)} \rightleftharpoons \underset{\text{colourless}}{2HI(g)}$$

Which change in conditions will cause the purple colour of the equilibrium mixture to become paler?

A decrease in pressure

B decrease in temperature

C increase in pressure

D increase in temperature

[1 mark]

Question 6

Nitrosyl chloride decomposes into nitrogen monoxide and chlorine according to the following equation.

$$2NOCl\ (g) \rightleftharpoons 2NO + Cl_2(g)$$

What is the correct expression for K_c?

A $\frac{[NOCl]^2}{[NO]^2[Cl_2]}$

B $\frac{[NO]\,[Cl_2]}{[NOCl]}$

C $\frac{2[NO]\,[Cl_2]}{2[NOCl]}$

D $\frac{[NO]^2[Cl_2]}{[NOCl]^2}$

[1 mark]

Question 7

An equilibrium is established in the reaction.

$$AB(aq) + CD(aq) \rightleftharpoons AC(aq) + BD(aq) \qquad \Delta H = +180 \text{ kJ mol}^{-1}$$

Which factors would affect the value of K_c in this equilibrium?

A change in temperature in the absence of a catalyst

B change in pressure in the presence of a catalyst

C increasing the concentration of AB

D increasing the concentration of AC

[1 mark]

Question 8

What is the equilibrium constant expression for the following equation?

$$3Cl_2(g) + I_2(g) \rightleftharpoons 2ICl_3(l)$$

A $\frac{2[ICl_3]}{3[Cl_2] + [I_2]}$

B $\frac{2[ICl_3]}{3[Cl_2]\,[I_2]}$

C $\frac{[Cl_2]^3\,[I_2]}{[ICl_3]^2}$

D $\frac{[ICl_3]^2}{[Cl_2]^3\,[I_2]}$

[1 mark]

Question 9

Hydrogen iodide can be made by the direct combination of hydrogen and iodine in the following equilibrium reaction. What is the expression for the equilibrium constant?

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

A $\frac{[2HI]}{[H_2][I_2]}$

B $\frac{2[HI]^2}{[H_2]+[I_2]}$

C $\frac{[2HI]}{[H_2]+[I_2]}$

D $\frac{[HI]^2}{[H_2][I_2]}$

[1 mark]

Question 10

What is the significance of the value of $K_c \gg 1$ in a reversible reaction?

A The reaction is almost complete.

B Very little reaction occurs.

C Equilibrium is established very quickly.

D The rate of the forward reaction is larger than the rate of the backward reaction.

[1 mark]