Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Chemical Equilibria, Le Chatelier's Principle And Kc

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Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Q1.

Which statement about the industrial production of ethanol from ethene at 300 °C is correct?

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \qquad \Delta H = -46 \text{ kJ mol}^{-1}$$

A An increase in pressure decreases the equilibrium yield of ethanol. ⬭

B An increase in pressure increases the value of K_c ⬭

C An increase in temperature increases the equilibrium yield of ethanol. ⬭

D An increase in temperature decreases the value of K_c ⬭

(Total 1 mark)

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Q2.

When HF is added to water at 298 K, this equilibrium is established.

$$HF(aq) \rightleftharpoons H^+(aq) + F^-(aq)$$

At equilibrium, [HF] = 7.70×10^{-3} mol dm^{-3} and [F^-] = 2.30×10^{-3} mol dm^{-3}

What is the value of the equilibrium constant, in mol dm^{-3}, at 298 K?

A 1.45×10^{3} ⬭

B 3.35 ⬭

C 2.99×10^{-1} ⬭

D 6.87×10^{-4} ⬭

(Total 1 mark)

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Q3.

Methanol is made in this equilibrium reaction, using a catalyst.

$$CO(g) + 2\ H_2(g) \rightleftharpoons CH_3OH(g) \quad \Delta H = -91\ kJ\ mol^{-1}$$

The reaction reaches equilibrium in a container of fixed volume.

Which is the expression for K_c for this equilibrium?

A $K_c = \dfrac{[CH_3OH]}{[CO] + [H_2]^2}$ ○

B $K_c = \dfrac{[CH_3OH]}{[CO]\,[H_2]^2}$ ○

C $K_c = \dfrac{[CO] + [H_2]^2}{[CH_3OH]}$ ○

D $K_c = \dfrac{[CO]\,[H_2]^2}{[CH_3OH]}$ ○

(Total 1 mark)

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Q4.

Methanol is made in this equilibrium reaction, using a catalyst.

$$CO(g) + 2\ H_2(g) \rightleftharpoons CH_3OH(g) \quad \Delta H = -91\ kJ\ mol^{-1}$$

2.0 mol of carbon monoxide is mixed with 3.0 mol of hydrogen and allowed to reach equilibrium.

The equilibrium mixture contains 0.6 mol of methanol.

What is the total amount, in mol, of gas at equilibrium?

A 3.2 ⬭

B 3.8 ⬭

C 4.4 ⬭

D 5.0 ⬭

(Total 1 mark)

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Q5.

Which statement about the addition of a catalyst to an equilibrium mixture is correct?

A The activation energy for the reverse reaction increases. ⬭

B The equilibrium constant for the forward reaction increases. ⬭

C The rate of the reverse reaction increases. ⬭

D The enthalpy change for the forward reaction decreases. ⬭

(Total 1 mark)

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Q6.

Which statement about the use of a catalyst in a reversible reaction is correct?

A The activation energy for the reverse reaction is increased. ⬭

B The equilibrium constant increases. ⬭

C The rate of the reverse reaction increases. ⬭

D The enthalpy change for the forward reaction decreases. ⬭

(Total 1 mark)

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Q7.

Methanol is made in this equilibrium reaction, using a catalyst.

$$CO(g) + 2\ H_2(g) \rightleftharpoons CH_3OH(g) \quad \Delta H = -91\ kJ\ mol^{-1}$$

Which change in condition will decrease the equilibrium yield of methanol?

A Increase the amount of CO in the equilibrium mixture. ⬭

B Increase the pressure. ⬭

C Increase the surface area of the catalyst. ⬭

D Increase the temperature. ⬭

(Total 1 mark)

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Q8.

When one mole of ammonia is heated to a given temperature, 50 % of it dissociates and the following equilibrium is established.

$$NH_3(g) \rightleftharpoons \tfrac{1}{2}N_2(g) + \tfrac{3}{2}H_2(g)$$

What is the total amount, in moles, of gas in this equilibrium mixture?

A 1.5 ⬭

B 2.0 ⬭

C 2.5 ⬭

D 3.0 ⬭

(Total 1 mark)

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Q9.

Which statement is **not** always correct for a reaction at equilibrium?

reactants ⇌ products

A The concentrations of the reactants and products are equal. ⬭

B The equilibrium can be achieved starting from the reactants. ⬭

C The equilibrium can be achieved starting from the products. ⬭

D The rate of the forward reaction is equal to the rate of the reverse reaction. ⬭

(Total 1 mark)

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Q10.

Which change leads to a higher concentration of SO_3 in this equilibrium mixture?

$$2\ SO_2\ (g) + O_2\ (g) \rightleftharpoons 2\ SO_3(g) \qquad \Delta H = -188\ kJ\ mol^{-1}$$

A higher concentration of O_2 ⬭

B higher temperature ⬭

C lower pressure ⬭

D use of a catalyst ⬭

(Total 1 mark)

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Q11.

The forward reaction in this equilibrium is endothermic

$$COCl_2\ (g) \rightleftharpoons CO(g) + Cl_2\ (g)$$

Which statement is correct?

A If the total pressure is increased at constant temperature, the proportion of $COCl_2$ in the equilibrium mixture will decrease ○

B Use of a catalyst will increase the proportion of $COCl_2$ in the equilibrium mixture at constant temperature and pressure ○

C Reducing the equilibrium concentration of CO will increase the value of the equilibrium constant ○

D Raising the temperature from 373 K to 473 K will increase the value of the equilibrium constant ○

(Total 1 mark)

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Q12.

For this reaction at equilibrium, which combination of temperature and pressure would give the greatest equilibrium yield of products?

$$W(g) + X(g) \rightleftharpoons 2Y(g) + Z(g) \qquad \Delta H = +47 \text{ kJ mol}^{-1}$$

A High pressure and high temperature ⬭

B High pressure and low temperature ⬭

C Low pressure and high temperature ⬭

D Low pressure and low temperature ⬭

(Total 1 mark)

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Q13.

Which statement is **not** correct about the industrial preparation of ethanol by the hydration of ethene at 300 °C?

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \quad \Delta H = -46 \text{ kJ mol}^{-1}$$

A The reaction is catalysed by an acid. ⬭

B The higher the pressure, the higher the equilibrium yield of ethanol. ⬭

C The higher the temperature, the higher the equilibrium yield of ethanol. ⬭

D A low equilibrium yield of ethanol is acceptable because unreacted ethene is recycled. ⬭

(Total 1 mark)

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Q14.

Hydrogen can be produced by this reaction.

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

In an experiment 4.20 mol of carbon monoxide were mixed with 2.00 mol of steam. When the reaction reached equilibrium, 1.60 mol of hydrogen had been formed.

What is the value of the equilibrium constant, K_c, for this reaction?

A 0.30 ⬭

B 0.41 ⬭

C 1.54 ⬭

D 2.46 ⬭

(Total 1 mark)

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Q15.

The following equilibrium was established in a container with volume V cm^3 at 393 K and 200 kPa.

$$M_2(g) + R(g) \rightleftharpoons RM_2(g) \qquad \Delta H = +150 \text{ kJ mol}^{-1}$$

Which change would increase the yield of RM_2?

A change the pressure to 150 kPa ⬭

B change the temperature to 293 K ⬭

C remove RM_2 as it is formed ⬭

D change the volume of the vessel to 2V cm^3 ⬭

(Total 1 mark)

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Q16.

When one mole of ammonia is heated to a given temperature, 50% of the compound dissociates and the following equilibrium is established.

$$NH_3(g) \rightleftharpoons \tfrac{1}{2}N_2(g) + \tfrac{3}{2}H_2(g)$$

What is the total number of moles of gas present in this equilibrium mixture?

A 1.5 ⬭

B 2.0 ⬭

C 2.5 ⬭

D 3.0 ⬭

(Total 1 mark)

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Q17.

Hydrogen is produced by the reaction of methane with steam. The reaction mixture reaches a state of dynamic equilibrium.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +206 \text{ kJ mol}^{-1}$$

Which of the following shows how the equilibrium yield of hydrogen and the value of the equilibrium constant are affected by the changes shown?

	Change	Effect on equilibrium yield of $H_2(g)$	Effect on value of K_c	
A	Increase pressure	decrease	decrease	⬭
B	Add a catalyst	increase	no effect	⬭
C	Increase temperature	increase	increase	⬭
D	Remove CO(g) as formed	increase	increase	⬭

(Total 1 mark)

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Q18.

A and **B** react together in this reversible reaction.

$$\mathbf{A} + \mathbf{3B} \rightleftharpoons \mathbf{C} + \mathbf{2D}$$

A mixture of 10 mol of **A** and 10 mol of **B** were left to reach equilibrium. The equilibrium mixture contained 4 mol of **B**.

What is the total amount, in moles, of substances in the equilibrium mixture?

A 14 ⬭

B 16 ⬭

C 18 ⬭

D 20 ⬭

(Total 1 mark)

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Q19.

A pale brown mixture of NO_2 and N_2O_4 is allowed to reach equilibrium in a sealed gas syringe according to the following equation.

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

When the plunger is pushed further into the syringe the pressure increases and the mixture becomes paler in colour.

When the syringe is placed in a hot oven the mixture becomes darker in colour.

Which of the following statements is correct?

A NO_2 is brown and the forward reaction is exothermic. ⬭

B NO_2 is brown and the forward reaction is endothermic. ⬭

C NO_2 is colourless and the forward reaction is exothermic. ⬭

D NO_2 is colourless and the forward reaction is endothermic. ⬭

(Total 1 mark)

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Q20.

The standard enthalpy of formation, ΔH_f for $O_3(g)$ is + 142 kJ mol^{-1}. In which one of the following would both the changes shown increase the amount of O_2 gas in an equilibrium mixture containing only $O_2(g)$ and $O_3(g)$?

A increasing the temperature and increasing the pressure

B increasing the temperature and decreasing the pressure

C decreasing the temperature and increasing the pressure

D decreasing the temperature and decreasing the pressure

(Total 1 mark)

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Q21.

Use the information about the following solutions to answer the question below.

Solution F: This is a mixture of 1 mol of propanoic acid, 1 mol of methanol and 2 mol of water.

Solution G: This was originally the same mixture as solution **F** but it has been left to reach equilibrium.

Compared to the pH of solution **F**, the pH of solution **G** will be

A considerably lower.

B slightly lower.

C slightly higher.

D exactly the same.

(Total 1 mark)

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