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 : 22 Marks** **Time : 22 Minutes**

Q1.

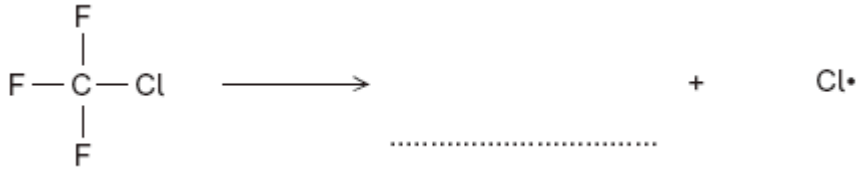
Oxygen and ozone ($O_3$) both occur as gases in the upper atmosphere.
Chlorine atoms catalyse the decomposition of ozone and contribute to the formation of a hole in the ozone layer.
These chlorine atoms are formed from chlorofluorocarbons (CFCs) such as $CF_3Cl$

(a) (i) Give the IUPAC name of $CF_3Cl$

_____

**(1)**

(ii) Complete the following equation that shows the formation of a chlorine atom from a molecule of $CF_3Cl$




**(1)**

(iii) State what the • represents in Cl•

_____

**(1)**

(b) Write two equations that show how chlorine atoms catalyse the decomposition of ozone into oxygen.

Equation 1 _____

Equation 2 _____

**(2)**

(c) An equilibrium is established between oxygen and ozone molecules as shown below.

$$3O_2(g) \rightleftharpoons 2O_3(g) \qquad \Delta H = +284 \text{ kJ mol}^{-1}$$

(i) State Le Chatelier's principle.

_____

_____

_____

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**(1)**

(ii) Use Le Chatelier's principle to explain how an increase in temperature causes an increase in the equilibrium yield of ozone.

_____

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**(2)**

(d) Chemists supported the legislation to ban the use of CFCs. Modern refrigerators use pentane rather than CFCs as refrigerants.
With reference to its formula, state why pentane is a more environmentally acceptable refrigerant.

_____

_____

**(1)**

**(Total 9 marks)**

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Q2.

Synthesis gas is a mixture of carbon monoxide and hydrogen. Methanol can be manufactured from synthesis gas in a reversible reaction as shown by the following equation.

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

(a) A sample of synthesis gas containing 0.240 mol of carbon monoxide and 0.380 mol of hydrogen was sealed together with a catalyst in a container of volume 1.50 $dm^3$.
When equilibrium was established at temperature $T_1$ the equilibrium mixture contained 0.170 mol of carbon monoxide.

Calculate the amount, in moles, of methanol and the amount, in moles, of hydrogen in the equilibrium mixture.

Methanol _____

Hydrogen _____

**(2)**

(b) A different sample of synthesis gas was allowed to reach equilibrium in a similar container of volume 1.50 $dm^3$ at temperature $T_1$

At equilibrium, the mixture contained 0.210 mol of carbon monoxide, 0.275 mol of hydrogen and 0.0820 mol of methanol.

(i) Write an expression for the equilibrium constant $K_c$ for this reaction.

_____

_____

**(1)**

(ii) Calculate a value for $K_c$ for the reaction at temperature $T_1$ and state its units.

Calculation _____

_____

_____

_____

_____

_____

Units _____

_____

**(4)**

(iii) State the effect, if any, on the value of $K_c$ of adding more hydrogen to the equilibrium mixture.

_____

**(1)**

(c) The temperature of the mixture in part (b) was changed to $T_2$ and the mixture was left to reach a new equilibrium position. At this new temperature the equilibrium concentration of methanol had increased.

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Deduce which of $T_1$ or $T_2$ is the higher temperature and explain your answer.

Higher temperature _____

Explanation _____

_____

_____

**(3)**

(d) The following reaction has been suggested as an alternative method for the production of methanol.

$$CO_2(g) + 3H_2(g) \rightleftharpoons CH_3OH(g) + H_2O(g)$$

The hydrogen used in this method is obtained from the electrolysis of water.

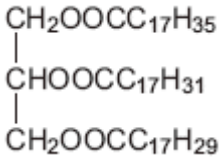
Suggest **one** possible environmental disadvantage of the production of hydrogen by electrolysis.

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_____

**(1)**

(e) One industrial use of methanol is in the production of biodiesel from vegetable oils such as



Give the formula of **one** compound in biodiesel that is formed by the reaction of methanol with the vegetable oil shown above.

_____

**(1)**

**(Total 13 marks)**

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