

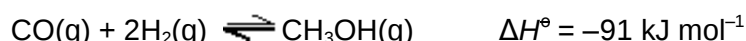
Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Q1.

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.



- (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.

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.

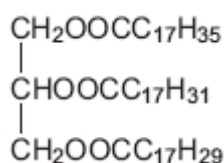


The hydrogen used in this method is obtained from the electrolysis of water.

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

(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)

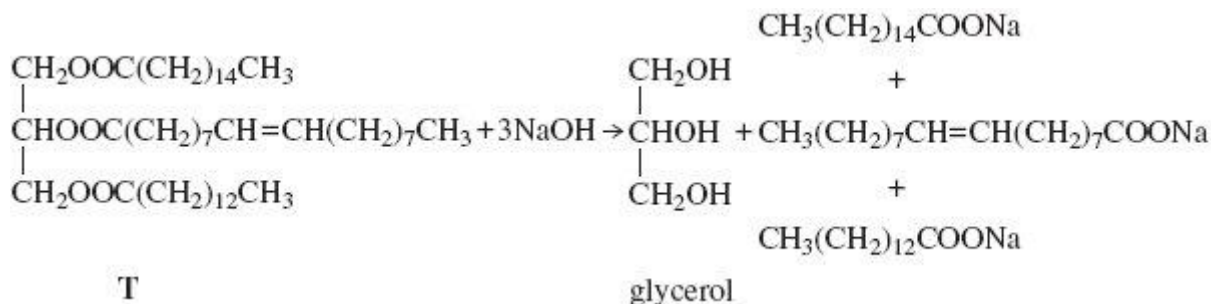
Q2.

Describe briefly how you could measure the melting point of aspirin.

(Total 2 marks)

Q3.

The triester, **T**, shown below is found in palm oil. When **T** is heated with an excess of sodium hydroxide solution, the alcohol glycerol is formed together with a mixture of three other products as shown in the following equation.



- (a) (i) Give the IUPAC name for glycerol.

(1)

- (ii) Give a use for the mixture of sodium salts formed in this reaction.

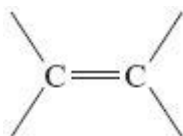
(1)

- (b) When **T** is heated with an excess of methanol, glycerol is formed together with a mixture of methyl esters.

- (i) Give a use for this mixture of methyl esters.

(1)

- (ii) One of the methyl esters in the mixture has the IUPAC name methyl (Z)-octadec-9-enoate. Draw **two** hydrogen atoms on the diagram below to illustrate the meaning of the letter Z in the name of this ester.



(1)

- (iii) One of the other methyl esters in the mixture has the formula $\text{CH}_3(\text{CH}_2)_{12}\text{COOCH}_3$. Write an equation for the complete combustion of one molecule of this ester.

(1)

(Total 5 marks)