

Name of the Student: _____

Max. Marks : 28 Marks

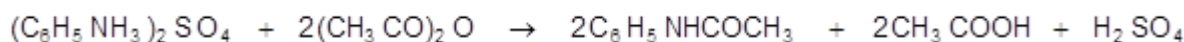
Time : 28 Minutes

Q1.

N-phenylethanamide is used as an inhibitor in hydrogen peroxide decomposition and also in the production of dyes.

N-phenylethanamide can be produced in a laboratory by the reaction between phenylammonium sulfate and an excess of ethanoic anhydride:

- (a) A student carried out this preparation using 1.15 g of phenylammonium sulfate ($M_r = 284.1$) and excess ethanoic anhydride.



- (i) Calculate the maximum theoretical yield of N-phenylethanamide that could be produced in the reaction. Record your answer to an appropriate precision.

Show your working.

(3)

- (ii) In the preparation, the student produced 0.89 g of N-phenylethanamide.

Calculate the percentage yield for the reaction.

(1)

- (b) The student purified the crude solid product, N-phenylethanamide, by recrystallisation.

- (i) Outline the method that the student should use for this recrystallisation.

(4)

- (ii) Outline how you would carry out a simple laboratory process to show that the recrystallised product is a pure sample of N-phenylethanamide.

(3)

- (iii) Assume that the reaction goes to completion.

Suggest **two** practical reasons why the percentage yield for this reaction may **not** be 100%.

1.

2.

(2)

- (c) The reaction to form N-phenylethanamide would happen much more quickly if the student used ethanoyl chloride instead of ethanoic anhydride.

Explain why the student might prefer to use ethanoic anhydride, even though it has a slower rate of reaction.

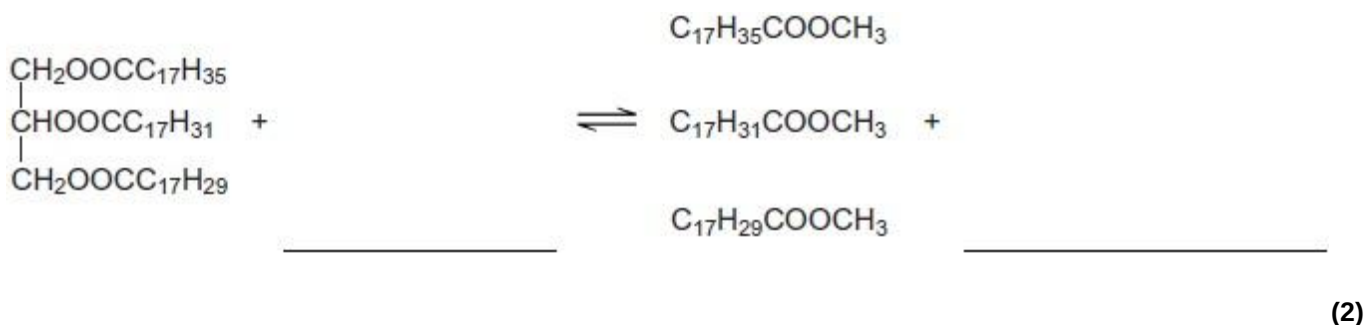
(2)
(Total 15 marks)

Q2.

Esters are produced by the reaction of alcohols with other esters and by the reaction of alcohols with carboxylic acids.

(a) The esters which make up biodiesel are produced industrially from the esters in vegetable oils.

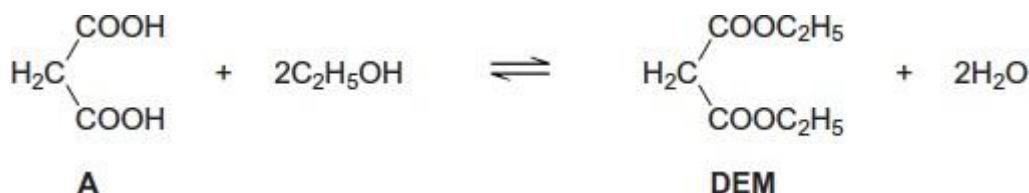
(i) Complete the equation for this formation of biodiesel.



(ii) Write an equation for the complete combustion of $\text{C}_{17}\text{H}_{35}\text{COOCH}_3$.

(2)

(b) The ester commonly known as diethyl malonate (**DEM**) occurs in strawberries and grapes. It can be prepared from acid **A** according to the following equilibrium.



(i) A mixture of 2.50 mol of **A** and 10.0 mol of ethanol was left to reach equilibrium in an inert solvent in the presence of a small amount of concentrated sulfuric acid. The equilibrium mixture formed contained 1.80 mol of **DEM** in a total volume, $V \text{ dm}^3$, of solution.

Calculate the amount (in moles) of **A**, of ethanol and of water in this equilibrium mixture.

Moles of **A** _____

Moles of ethanol _____

Moles of water _____

(3)

(ii) The total volume of the mixture in part (b)(i) was doubled by the addition of more of the inert solvent.

State and explain the effect of this addition on the equilibrium yield of **DEM**.

Effect _____

Explanation _____

(2)

(iii) Using **A** to represent the acid and **DEM** to represent the ester, write an expression for the

equilibrium constant K_c for the reaction.

(1)

- (iv) In a second experiment, the equilibrium mixture was found to contain 0.85 mol of **A**, 7.2 mol of ethanol, 2.1 mol of **DEM** and 3.4 mol of water.

Calculate a value of K_c for the reaction and deduce its units.

Calculation _____

Units _____

(3)

(Total 13 marks)