Chemical Energetics – 2019 June

1. 0620/43/M/J/19/No.5

Carboxylic acids react with alcohols to form esters. The reaction is reversible.
The equation for the reaction between ethanoic acid and ethanol is shown.

$$CH_3COOH + CH_3CH_2OH \rightleftharpoons CH_3COOCH_2CH_3 + H_2O$$

(a) (i) What is the name of the ester formed in this reaction?

..... [1]

(ii) Draw the structure of the ester formed. Show all of the atoms and all of the bonds.

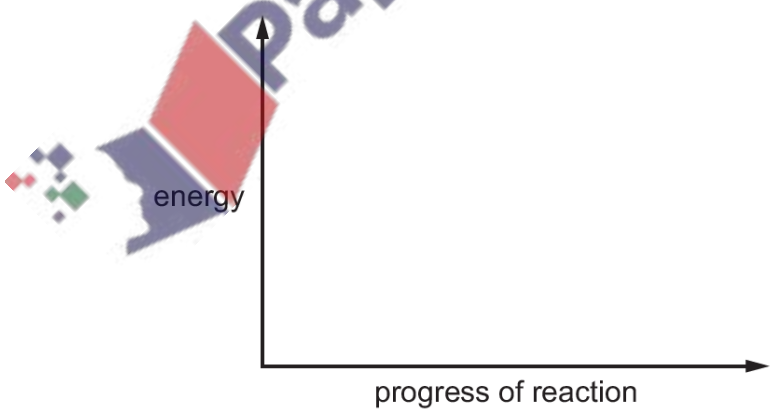
[1]

(b) The reaction between ethanoic acid and ethanol is exothermic.

Draw an energy level diagram for this reaction.

On your diagram label:

- the reactants and products
- the energy change of the reaction, ΔH.



[3]

(c) Concentrated sulfuric acid is a catalyst for this reaction.

What is meant by the term *catalyst*?

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..... [2]

(d) The rate of reaction can be increased by increasing the temperature.

Explain why increasing the temperature increases the rate of reaction.

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..... [4]

(e) The reaction between ethanoic acid and ethanol reaches equilibrium.

(i) The reaction between ethanoic acid and ethanol is exothermic.

State and explain the effect, if any, of increasing the temperature on the amount of ester at equilibrium.

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..... [2]

(ii) State and explain the effect, if any, of removing water from the mixture on the amount of ester at equilibrium.

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..... [2]

[Total: 15]