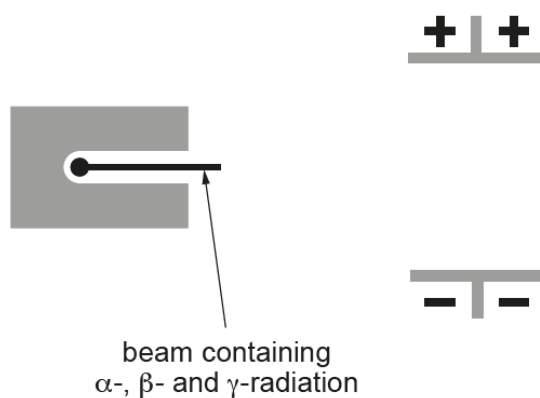# GCE AS LEVEL CHEMISTRY

S21- B410

Assessment Resource B

Structure of Matter and Simple Reactions

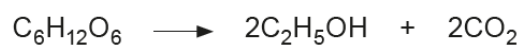**1.** Complete the diagram to show how α-, β- and γ-radiation are affected by an electric field. [2]

beam containing
α-, β- and γ-radiation

2. Complete the equation. [1]

.... CH_3COOH + ... $ZnO \longrightarrow$ .... $(CH_3COO)_2Zn$ + ...

3. Ethanol, C_2H_5OH, can be made by the fermentation of glucose, $C_6H_{12}O_6$.

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

Calculate the atom economy of this reaction. [2]

Atom economy = ... %

4. Using ideas that you have studied in your Chemistry course comment on and explain the following observations.

(a) Ice floats on water. [3]

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(b) The mass spectrum of naturally-occurring chlorine, Cl_2, contains three lines of different heights in the molecular ion region. [3]

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(c) Universal indicator is red when placed in $0.1 \, mol \, dm^{-3}$ hydrochloric acid and it is orange when placed in $0.1 \, mol \, dm^{-3}$ propanoic acid, C_2H_5COOH. [3]

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5. Limewater is a saturated solution of calcium hydroxide, $Ca(OH)_2$. A student carried out an experiment to find the concentration of calcium hydroxide in a sample of limewater. The student had access to the apparatus and chemicals usually available in a school or college laboratory.

The teacher told the student that he needed to carry out a titration using $0.050\,mol\,dm^{-3}$ hydrochloric acid.

(a) Describe how the student could prepare $0.050\,mol\,dm^{-3}$ hydrochloric acid from $2.0\,mol\,dm^{-3}$ hydrochloric acid. You should include details of any apparatus required. [3]

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(b) The student carried out the titration and used $19.60\,cm^3$ of the $0.050\,mol\,dm^{-3}$ hydrochloric acid to neutralise $25.0\,cm^3$ of the calcium hydroxide solution.

Calculate the concentration of the calcium hydroxide solution in $g\,dm^{-3}$. [4]

Concentration = ... $g\,dm^{-3}$

(c) The student left the bottle of calcium hydroxide solution overnight without its stopper in place. Explain what he observed when he returned next day. [2]

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(d) The student decided to repeat the titration using a saturated solution of barium hydroxide, $Ba(OH)_2$.

How would the volume of hydrochloric acid used in the titration be different? Explain your answer. [1]

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(e) The student did not label the solutions of calcium hydroxide and barium hydroxide. Describe a test he could use to determine which solution is which. Include the result of the test in each case. [2]
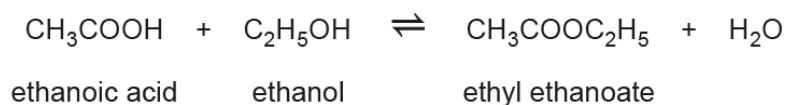
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6. Carboxylic acids react with alcohols to make esters, using sulfuric acid as a catalyst. These reactions are reversible.

$$CH_3COOH \ + \ C_2H_5OH \ \rightleftharpoons \ CH_3COOC_2H_5 \ + \ H_2O$$

    ethanoic acid   ethanol   ethyl ethanoate

(a) State what is meant by a *reversible* reaction. [1]

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(b) In an experiment to prepare ethyl ethanoate, 3.0 mol of ethanoic acid were mixed with 2.5 mol of ethanol and a small amount of concentrated sulfuric acid. Water was added to make a total volume of 1.0 dm^3.

The number of moles of ethanoic acid present was measured as the reaction proceeded until equilibrium was reached. The results were then plotted.
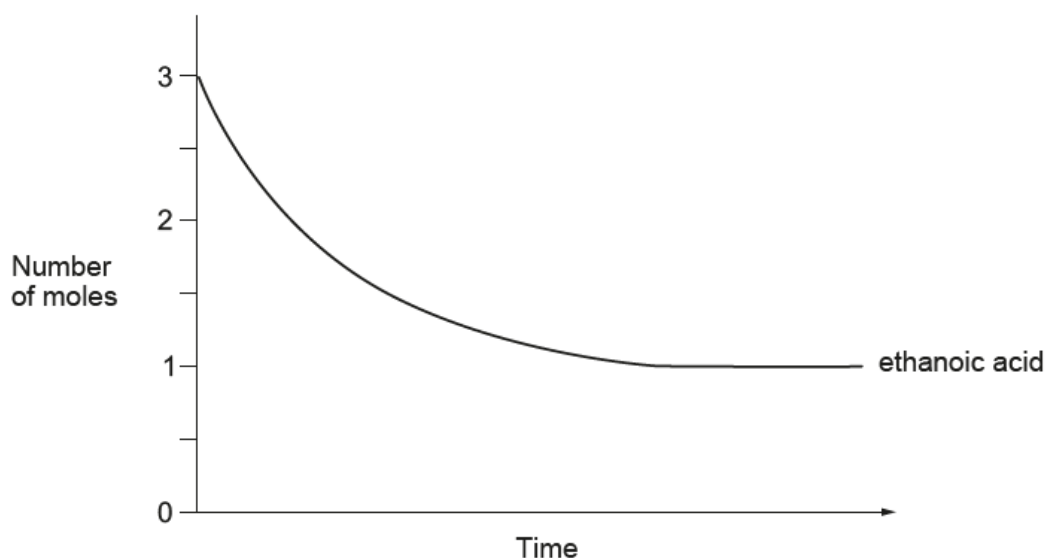
On the grid sketch:

- the line that shows the number of moles of ethanol as the reaction proceeds to equilibrium. Label this line **A**.

- the line that shows the number of moles of ethyl ethanoate as the reaction proceeds to equilibrium. Label this line **B**. [3]

(c)   (i)   Write the expression for the equilibrium constant, K_c, for the esterification reaction. Include the unit, if any.   [2]

Unit ....

(ii)   Under certain conditions the value of K_c was found to be 4. At a higher temperature, with all other factors being kept constant, this value remained almost the same. Explain what can be deduced from this information.   [2]

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(d)   Esterification is catalysed by the addition of concentrated sulfuric acid. In an esterification the final pH of the solution was 2.4. Calculate the concentration of hydrogen ions present, in $mol\,dm^{-3}$.   [2]

$[H^+]$ = ... $mol\,dm^{-3}$

(e) 2.94 g of ethanoic acid were mixed with 2.07 g of ethanol and allowed to react. 2.73 g of ethyl ethanoate were produced. Calculate the percentage yield of this reaction. [4]

Percentage yield = ... %