

Q1.

Which statement is **not** correct about the industrial production of ethanol from ethene at 300 °C?



- A The reaction is catalysed by an acid.
- B The reaction has 100% atom economy.
- C An increase in temperature decreases the equilibrium yield of ethanol.
- D An increase in pressure increases the value of K_c .

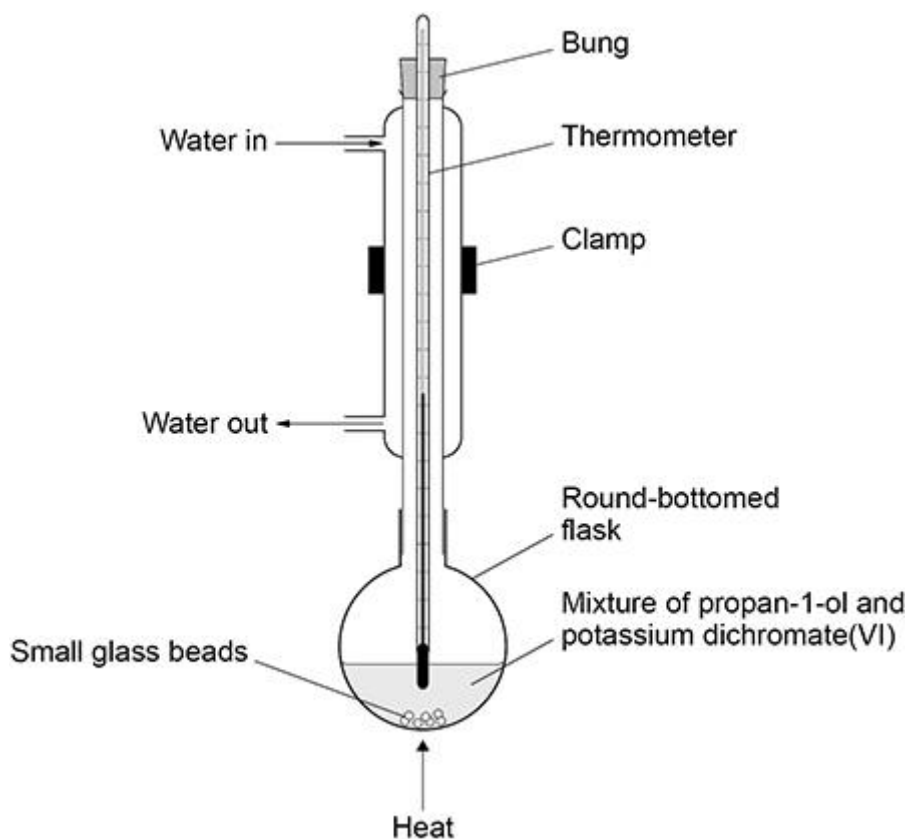
(Total 1 mark)

Q2.

A student plans an experiment to investigate the yield of propanoic acid when a sample of propan-1-ol is oxidised.

The figure below shows the apparatus that the student plans to use for the experiment.

The student's teacher says that the apparatus is not safe.



- (a) Give **two** reasons why the apparatus shown in above figure is not safe.
- 1 _____

- 2 _____

- (2)**
- (b) Give **one** additional reagent that is needed to form any propanoic acid.
- _____
- (1)**
- (c) State **two** more mistakes in the way the apparatus is set up in above figure.
- 1 _____

- 2 _____

- (2)**
- (d) State the purpose of the small glass beads in the flask in above figure.
- _____
- _____
- _____
- (1)**
- (e) After correcting the mistakes, the student heats a reaction mixture containing 6.50 g of propan-1-ol with an excess of the oxidising agent. The propanoic acid separated from the reaction mixture has a mass of 3.25 g
- State the name of the technique used to separate the propanoic acid from the reaction mixture.
- Calculate the percentage yield of propanoic acid.
- Technique _____

Percentage yield _____

(4)

- (f) State a simple chemical test that distinguishes the propanoic acid from the propan-1-ol.

Give **one** observation for the test with each substance.

Test _____

Propanoic acid _____

Propan-1-ol _____

(3)

(Total 13 marks)

Q3.

Which compound is produced when 1-phenylethanol reacts with acidified potassium dichromate(VI)?

- A $C_6H_5CH_2CH_2OH$
- B $C_6H_5CH_2CHO$
- C $C_6H_5COCH_3$
- D $C_6H_5CH(OH)CH_3$

(Total 1 mark)

Q4.

Which statement is correct about the production and use of ethanol as a biofuel?

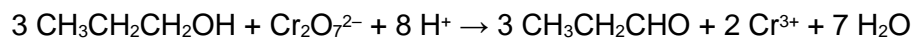
- A Biofuel ethanol is produced by the fermentation of glucose in the presence of yeast and air.
- B Biofuel ethanol is purified by fractional distillation.
- C No carbon dioxide is released when biofuel ethanol is burned.
- D Biofuel ethanol burns with a cleaner flame than ethanol made by hydration of ethene.

(Total 1 mark)

Q5.

Propanal can be prepared by the oxidation of propan-1-ol with acidified potassium dichromate(VI).

An ionic equation for this reaction is



- (a) Calculate the minimum volume, in cm^3 , of 0.40 mol dm^{-3} potassium dichromate(VI) solution needed to oxidise 6.0 cm^3 of propan-1-ol to propanal.

M_r of propan-1-ol = 60.0

Density of propan-1-ol = 0.80 g cm^{-3}

Minimum volume _____ cm^3

- (b) The reaction is done in a pear-shaped flask.

Complete the diagram to show the assembled apparatus needed to prepare propanal from propan-1-ol in this way.

Label the diagram.



(3)
(Total 6 marks)

Q6.

Which compound can be oxidised to form $(\text{CH}_3)_2\text{CHCOCH}_3$?

- A 2-methylpropan-1-ol
- B 2,2-dimethylpropanol
- C 2-methylbutan-2-ol
- D 3-methylbutan-2-ol

(Total 1 mark)

Q7.

Which compound is formed when 1-phenylethanol reacts with acidified potassium dichromate(VI)?

- A $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{OH}$
- B $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$
- C $\text{C}_6\text{H}_5\text{COCH}_3$
- D $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$

(Total 1 mark)

Q8.

In the UK industrial ethanol is now produced by the direct hydration of ethene. This process has largely replaced the fermentation method.

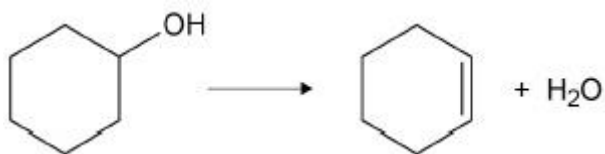
Which is a likely reason for this change of method?

- A The direct hydration route produces purer ethanol.
- B The direct hydration route employs milder conditions.
- C The direct hydration route does NOT use a catalyst.
- D The direct hydration route produces ethanol by a slower reaction.

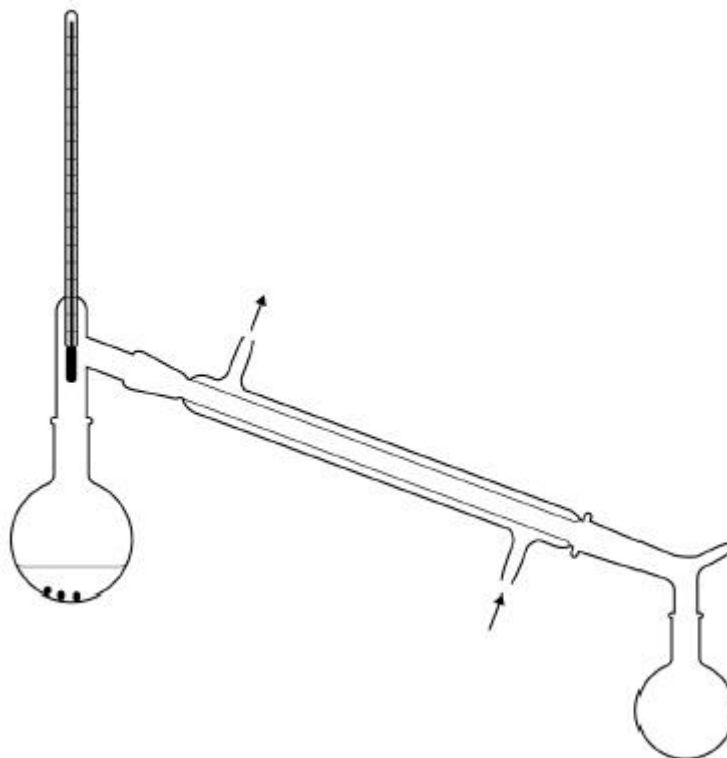
(Total 1 mark)

Q9.

Cyclohexene (boiling point = 83 °C) can be prepared by the dehydration of cyclohexanol (boiling point = 161 °C) using concentrated phosphoric acid.



A student prepared cyclohexene by placing 10 cm³ of cyclohexanol (density = 0.96 g cm⁻³) into a round-bottomed flask. 3 cm³ of concentrated phosphoric acid were then carefully added to the flask. The student added a few anti-bumping granules and set up the apparatus shown in the diagram.



- The student heated the mixture and collected the liquid that distilled at temperatures below 100 °C
- The distillate was poured into a separating funnel and washed by shaking with sodium carbonate solution.
- Periodically, the separating funnel was inverted and the tap opened.
- The aqueous layer was discarded and the final organic product was dried using anhydrous calcium chloride.
- After the product was dried, the drying agent was removed by filtration under reduced pressure.

(a) The student collected 5.97 g of cyclohexene in the experiment.

Calculate the percentage yield of cyclohexene.

Percentage yield _____ %

(3)

- (b) Describe a test-tube reaction, on the product, to show that the cyclohexanol had been dehydrated.

State what you would observe.

(2)

- (c) Suggest why sodium carbonate solution was used to wash the distillate.

(1)

- (d) Explain why it is important to open the tap of the separating funnel periodically.

(1)

- (e) Give a property of anhydrous calcium chloride, other than its ability to absorb water, that makes it suitable as a drying agent in this preparation.

(1)

- (f) Describe the apparatus used to remove the drying agent by filtration under reduced pressure. Your description of the apparatus can be either a labelled diagram or a description in words.

(2)

- (g) A sample of cyclohexene has been contaminated with cyclohexanol. The cyclohexene can be separated from the cyclohexanol by column chromatography. Silica gel is used as the stationary phase and hexane as the mobile phase.

Explain why cyclohexene has a shorter retention time than cyclohexanol.

(2)

- (h) Explain how an infrared spectrum would confirm that the cyclohexene obtained from the chromatography column did not contain any cyclohexanol.

(1)

(Total 13 marks)

Q10.

Which statement is correct about both 2-methylbutan-1-ol and 2-methylbutan-2-ol?

- A They can be formed by alkaline hydrolysis of esters.
- B They can be oxidised by reaction with acidified potassium dichromate(VI).
- C They can be formed by hydration of 2-methylbut-2-ene.
- D They have four peaks in their ^{13}C NMR spectra.

(Total 1 mark)

Q11.

Which alcohol can be oxidised by acidified potassium dichromate(VI) but cannot be dehydrated by heating with concentrated sulfuric acid?

- A 2,3-dimethylbutan-2-ol
- B 2,2-dimethylpropan-1-ol
- C 2-methylpropan-2-ol
- D pentan-3-ol

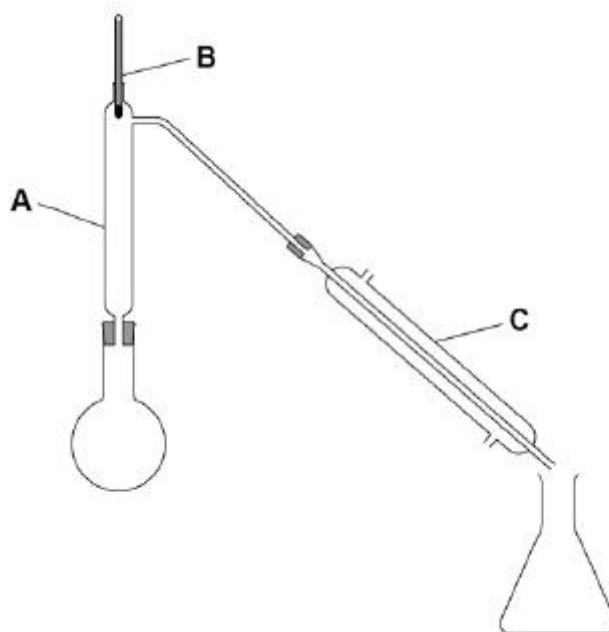
(Total 1 mark)

Q12.

A group of students wanted to produce a biofuel to power the central heating system in their school. They collected scraps of fruits and vegetables from the kitchens and fermented them with yeast, in the absence of air, in order to produce ethanol.

The aqueous mixture was filtered to remove the remaining solids.

The students then set up the apparatus shown in the diagram below and placed the aqueous mixture in the round bottomed flask.



- (a) Describe how the students would use this apparatus to collect a sample of ethanol.
Include in your answer the functions of the parts of the apparatus labelled **A**, **B** and **C**.

(6)

- (b) The students collected a 20 cm³ sample of liquid and weighed it. The mass of the sample was 16 g.

The density of ethanol is 0.79 g cm⁻³ and that of water 1.00 g cm⁻³.

Use these data to calculate the mass of ethanol in the sample collected.
You should assume that the volume of the sample is equal to the sum of the volumes of water and ethanol.

Mass of ethanol = _____ g

(2)

(Total 8 marks)