

C10 Organic Reactions Homework task 1

Q1.

This question is about organic compounds.

- (a) Butane is an alkane with small molecules.

Complete the sentence.

Choose the answer from the box.

fertiliser	formulation	fuel
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Butane can be used as a _____.

(1)

- (b) Poly(propene) is a polymer.

What is the name of the monomer used to produce poly(propene)?

Tick (✓) **one** box.

Propane

Propanoic acid

Propanol

Propene

(1)

Ethene and steam react to produce ethanol.

The equation for the reversible reaction is:



- (c) The reaction produces a maximum theoretical mass of 400 kg of ethanol from 243 kg of ethene and 157 kg of steam.

A company produces 380 kg of ethanol from 243 kg of ethene and 157 kg of steam.

The percentage yield of ethanol is less than 100%

Calculate the percentage yield of ethanol.

Use the equation:

$$\text{percentage yield of ethanol} = \frac{\text{mass of ethanol actually made}}{\text{maximum theoretical mass of ethanol}} \times 100$$

Percentage yield = _____ %

(2)

- (d) What are **two** possible reasons why the percentage yield of ethanol is less than 100%?

Tick (✓) **two** boxes.

Ethanol is the only product of the reaction.

Ethanol is very unreactive.

Some ethanol changes back into ethene and steam.

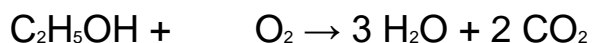
Some ethanol escapes from the apparatus.

Some ethanol reacts with steam.

(2)

- (e) Ethanol burns in oxygen.

Balance the equation for the reaction.



(1)

- (f) Two processes for producing ethanol are:
- fermentation
 - hydration (reacting ethene with steam).

The table below shows information about the processes.

Feature	Process	
	Fermentation	Hydration
Raw material	sugar	crude oil
Energy usage	low	high
Rate of reaction	slow	fast
Purity of ethanol	15%	98%

Give **two** advantages and **two** disadvantages of using fermentation to produce ethanol.

Advantage of fermentation 1 _____

Advantage of fermentation 2 _____

Disadvantage of fermentation 1 _____

Disadvantage of fermentation 2 _____

(4)

(Total 11 marks)

Q2.

Methylated spirit is a useful product made from a mixture of substances.

The table below shows the mass of the substances in a sample of methylated spirit.

Substance	Mass in grams
Ethanol	265.5
Methanol	23.3
Pyridine	3.0
Methyl violet	1.5

(a) What name is given to a useful product such as methylated spirit?

(1)

(b) Calculate the percentage by mass of methanol in methylated spirit.

Use the table above.

Percentage = _____ %

(2)

Methylated spirit contains ethanol and is available cheaply.

Methylated spirit also contains:

- pyridine which has a very unpleasant smell
- methyl violet which makes the mixture purple.

(c) Suggest why pyridine and methyl violet are added to ethanol to make methylated spirit.

(1)

(d) Suggest **one** use of methylated spirit.

(1)

(e) Describe how ethanol is produced from sugar solution.

Give the name of this process.

(3)

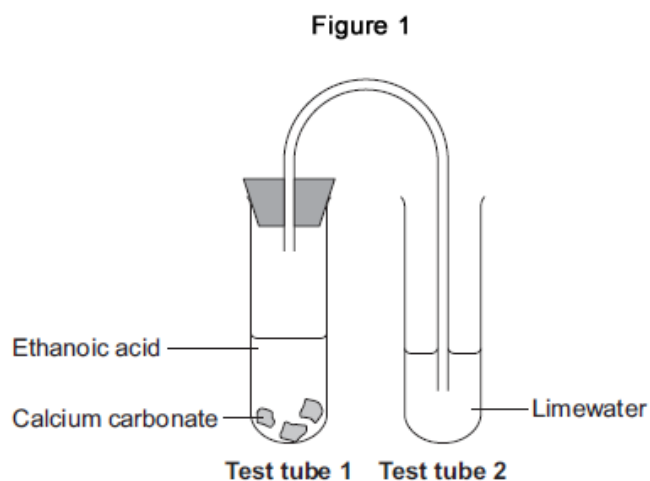
(Total 8 marks)

HIGHER TIER QUESTIONS

Q3.

This question is about reactions of ethanoic acid and the analysis of salts.

- (a) **Figure 1** shows the apparatus used to investigate the reaction of ethanoic acid with calcium carbonate.



- (i) Describe a change that would be seen in each test tube.

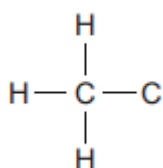
Give a reason for each change.

Test tube 1 _____

Test tube 2 _____

(4)

- (ii) Complete the displayed structure of ethanoic acid.



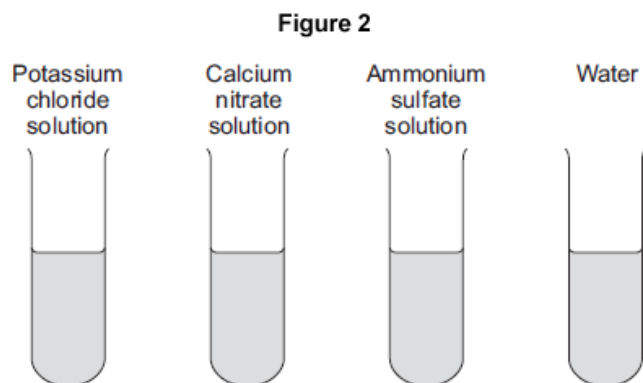
(1)

- (iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

Carboxylic acids react with alcohols in the presence of an
_____ catalyst to produce pleasant-smelling compounds
called _____ .

(2)

- (b) **Figure 2** shows four test tubes containing three different salt solutions and water.



Each solution and the water was tested with:

- silver nitrate in the presence of dilute nitric acid
- barium chloride in the presence of dilute hydrochloric acid.

Complete the table of results.

	Potassium chloride solution	Calcium nitrate solution	Ammonium sulfate solution	Water
Test with silver nitrate in the presence of dilute nitric acid			no change	no change
Test with barium chloride in the presence of dilute hydrochloric acid		no change	white precipitate	

(2)

- (c) Flame tests can be used to identify metal ions.

- (i) Complete the following sentences.

The flame colour for potassium ions is _____ .

The flame colour for calcium ions is _____ .

(2)

- (ii) Give **one** reason why a flame test would **not** show the presence of both potassium ions and calcium ions in a mixture.

(1)

(Total 12 marks)

Q4.

This question is about alkenes and alcohols.

Ethene is an alkene produced from large hydrocarbon molecules.

Large hydrocarbon molecules are obtained from crude oil by fractional distillation.

- (a) Name the process used to produce ethene from large hydrocarbon molecules.

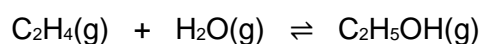
(1)

- (b) Describe the conditions used to produce ethene from large hydrocarbon molecules.

(2)

- (c) Ethanol can be produced from ethene and steam.

The equation for the reaction is:



The forward reaction is exothermic.

Explain how the conditions for this reaction should be chosen to produce ethanol as economically as possible.

(6)

(d) Ethanol can also be produced from sugar solution by adding yeast.

Name this process.

(1)

(Total 10 marks)

Mark schemes

Q1.

- (a) fuel 1
- (b) propene 1
- (c) (percentage yield =)
 $\frac{380}{400} \times 100$ 1
= 95 (%) 1
- (d) some ethanol changes back into ethene and steam 1
some ethanol escapes from the apparatus 1
- (e) $\text{C}_2\text{H}_5\text{OH} + 3 \text{O}_2 \rightarrow$
 $3 \text{H}_2\text{O} + 2 \text{CO}_2$
allow multiples 1
- (f) (advantages)
(fermentation) low energy usage 1
(fermentation) uses renewable raw materials 1
(disadvantages)
(fermentation) produces impure ethanol 1
(fermentation) slow rate of reaction 1
- [11]

Q2.

- (a) formulation 1
- (b) $\frac{23.3}{265.5 + 23.3 + 3.0 + 1.5} (\times 100)$
allow $\frac{23.3}{293.3} (\times 100)$ 1

= 7.9 (%)

allow 7.944084555 (%) rounded correctly

1

an answer of 7.9 (%) scores 2 marks

(c) to deter consumption / drinking (by people)

1

(d) any **one** from:

1

- fuel
- solvent
- antiseptic

allow specific uses e.g.

- *fuel additive*
- *cleaning products*
- *hand-sanitisers*

1

*do **not** accept as an alcoholic drink*

(e) ferment(ation)

ignore distillation

1

add yeast

1

anaerobic (conditions)

allow in the absence of oxygen

or

warm

allow a temperature value in range 5 – 45 °C

inclusive

allow room temperature

ignore hot / heat

ignore high temperature

1

1

[8]

Q3.

(a) (i) fizz / effervescence / bubbles

allow calcium carbonate decreases in size or dissolves

1

because carbon dioxide produced / released

allow because gas produced / released

1

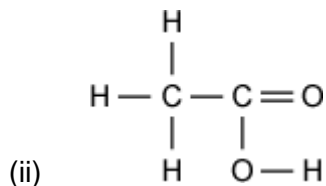
limewater turns cloudy / milky / white

1

because (a precipitate of or solid) calcium carbonate forms

allow because of carbon dioxide if not already credited

1



allow -OH
do not allow lower case 'h'

1

- (iii) acid
must be in this order
ignore any name of an acid

1

ester(s)

1

- (b) white (precipitate) no change
 no change no change

all four correct 2 marks
any two correct 1 mark

2

- (c) (i) lilac
allow purple

1

red

1

must be in this order

- (ii) colours are masked / changed by each flame colour

1

[12]

Q4.

- (a) (steam / catalytic) cracking
allow thermal decomposition

1

- (b) high temperature

1

steam / catalyst

allow a temperature in the range 300 – 900 °C

1

- (c) **Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

No relevant content

Indicative content

Rate

- higher temperature gives higher rate
- because more frequent collisions
- higher pressure gives higher rate
- because more frequent collisions
- a catalyst can be used to give a higher rate
- because the activation energy is reduced

Yield

- higher temperature gives lower yield
- because the reaction is exothermic
- higher pressure gives higher yield
- because there are more molecules on left hand side

Other factors

- higher temperatures use more energy so costs increase
- higher pressures use more energy so costs increase
- higher pressures require stronger reaction vessels so costs increase

Compromise

- chosen temperature is a compromise between rate and yield
- chosen temperature is a compromise between rate and cost (of energy used)
- chosen pressure is a compromise between rate and cost (of energy used)
- chosen pressure is a compromise between yield and cost (of energy used)

(d) fermentation

allow ferment(ing)