

Mark schemes

Q1.

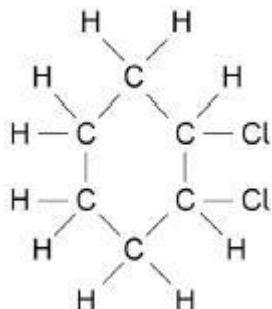
- (a) fuel 1
- (b) propene 1
- (c) (percentage yield =)
 $\frac{380}{400} \times 100$ 1
 = 95 (%) 1
- (d) some ethanol changes back into ethene and steam 1
 some ethanol escapes from the apparatus 1
- (e) $C_2H_5OH + 3 O_2 \rightarrow$
 $3 H_2O + 2 CO_2$
allow multiples 1
- (f) (advantages)
 (fermentation) 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) (test)
 (add) bromine (water) 1
- (result)
 (changes from) brown / orange to colourless
ignore clear 1

(b) C_nH_{2n-2} 1

(c)



allow 1 mark for the structure of
1, 1-dichlorocyclohexane **or**
1, 3-dichlorocyclohexane **or**
1, 4-dichlorocyclohexane

2

(d) (M_r ($C_6H_{10}Cl_2$) =) 153 1

$$(\% \text{ chlorine}) = \frac{71}{153} \times 100$$

allow correct use of an incorrectly
calculated value of M_r

1

$$= 46.4 (\%)$$

allow 46.405228758 (%) correctly
rounded to at least 2 significant figures

1

[8]

Q3.

(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.

3–4

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

1–2

No relevant content

0

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)

1

(e) warm

allow a value in the range 25 °C to 45 °C

1

anaerobic (conditions)

allow without oxygen / air

1

(f) (conversion)

200 km = 200,000 m

1

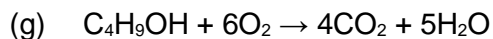
$$(\text{moles} =) \quad (\text{moles} =) \quad \frac{200000 \times 1.95 (\text{mol})}{1300}$$

allow correct use of incorrect / no conversion for distance

1

$$= 300 (\text{mol})$$

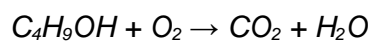
1



allow C₄H₁₀O for C₄H₉OH

allow multiples

allow 1 mark for



with incorrect / no multipliers

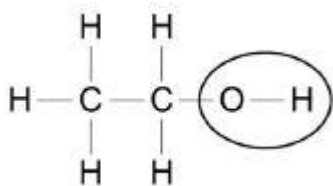
ignore state symbols

2

[17]

Q4.

(a)



1

(b)

Name of element	Symbol for element	Number of atoms in one molecule of ethanol
carbon	C	2
hydrogen	H	6
oxygen	O	1

ignore O2

1

1

1

(c) a solvent

1

(d) sugar

allow named sugar

allow saccharide

1

- (e) yeast 1
- (f) ethyl ethanoate 1
- (g) water 1
ignore H₂O
- (h) 400 cm³ = 0.40 dm³ 1

$$\frac{1.00}{0.40} \times 20$$

allow correct use of incorrectly converted or unconverted volume

1

= 50 (g)

1

alternative approach:

1.0 dm³ = 1000 cm³ (1)

$$\frac{1000}{400} \times 20 (1)$$

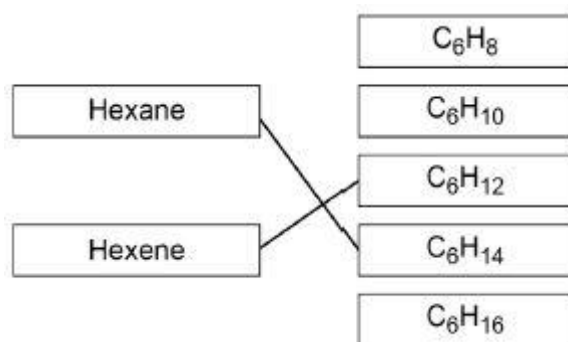
allow correct use of incorrectly converted or unconverted volume

= 50 (g) (1)

[12]

Q5.

(a)



1

additional line from a box on the left negates the mark for that box

1

- (b) (remains) orange
must be in this order

<i>allow no (colour) change</i>	1
(becomes) colourless	
<i>ignore initial colour ignore clear</i>	1
(c) Level 2: Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	4–6
Level 1: Relevant features are identified and differences noted.	1–3
No relevant content	0
Indicative content	
Structure and bonding	
<ul style="list-style-type: none"> • both are hydrocarbons • both contain two carbon atoms (per molecule) • ethane contains six hydrogen atoms (per molecule) • (but) ethene contains four hydrogen atoms (per molecule) • both have covalent bonds • ethane contains a single C—C bond • (but) ethene contains a double bond • both contain C—H bonds • both small molecules 	
Reactions	
<ul style="list-style-type: none"> • both react with oxygen in complete combustion reactions • to produce water and carbon dioxide • both react with oxygen in incomplete combustion reactions • to produce water, carbon monoxide and carbon • incomplete combustion is more likely with ethene • ethene decolourises bromine water • (but) ethane does not decolourise bromine water • ethene is more reactive (than ethane) • ethene can react with hydrogen (to produce ethane) • ethene can react with water (to produce ethanol) • ethene can react with halogens (to produce halogenoalkanes) • ethene can undergo addition reactions • ethene can polymerise (to produce poly(ethene)) 	
ignore physical properties	
ignore references to flammability	

[10]

Q6.

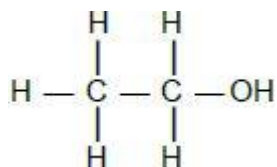
- (a) HCOOH
allow HCO₂H 1
- propanoic acid 1
- (b) incomplete / partial ionisation
allow incomplete / partial dissociation 1
- (because) reaction is reversible
allow (because) reaction is in equilibrium 1
- (c) mass (of flask and contents) decreases 1
- (because) carbon dioxide is produced 1
- (and) carbon dioxide escapes (from the flask)
allow 1 mark for the gas produced escapes (from the flask) 1
- (d) (0.01 mol/dm³) methanoic acid has a lower pH
allow converse argument for ethanoic acid
allow (0.01 mol/dm³) methanoic acid is a stronger acid 1
- (so 0.01 mol/dm³) methanoic acid has a higher concentration of hydrogen ions 1
- (therefore) more collisions per unit time 1
- (e) ethyl ethanoate 1
- (f)
- $$\begin{array}{ccccccc}
 & \text{H} & \text{O} & & \text{H} & \text{H} & \\
 & | & || & & | & | & \\
 \text{H} & - \text{C} & - \text{C} & - \text{O} & - \text{C} & - \text{C} & - \text{H} \\
 & | & & & | & | & \\
 & \text{H} & & & \text{H} & \text{H} &
 \end{array}$$
- 1
- [12]

Q7.

- (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
- (f)
- $$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$$
- allow



1

(g) hydrogen

allow H₂

1

(h) oxidising (agent).

*allow permanganate / dichromate ions**allow [O]**ignore oxygen*

1

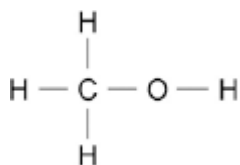
[11]**Q8.**

(a) Propanol

1

(b) Butanol has the highest boiling point

1



(c)

1

(d) ethene + water (\rightarrow ethanol)*allow answers in either order**allow steam for water*

1

(e) goes back to reactor

allow is recycled

1

(f) air contains oxygen

1

which oxidises ethanol

allow ethanol reacted with oxygen

1

to produce ethanoic acid

1

[8]**Q9.**

- (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
- (ii)
$$\begin{array}{c} \text{H} \\ | \\ \text{H} - \text{C} - \text{C} = \text{O} \\ | \quad | \\ \text{H} \quad \text{O} - \text{H} \end{array}$$

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]

Q10.

- | | |
|-----------------|---|
| (a) C_6H_{14} | 1 |
| (b) A | 1 |
| (c) B | 1 |
| (d) C | 1 |
| (e) Propanol | 1 |
- [5]