

- 1 (a) Any three from:
 same general formula;
 consecutive members differ by CH_2 ;
 similar chemical properties;
 same functional group;
 physical properties vary in a predictable way / give trend such as mp increases with n; [3]
- (b) they have the same molecular formula; [1]
 not: general formula
 different structures / structural formulae; [1]
- (ii) $\text{CH}_3\text{-CH}_2\text{-CH(OH)-CH}_3$ / $(\text{CH}_3)_3\text{C-OH}$
 allow: butan-2-ol and 2-methylpropan-2-ol
- (c) (acidified) potassium manganate(VII) [1]
 allow: oxygen / air / (acidified) potassium chromate(VI)
- (ii) carboxylic acid [1]
 allow: aldehyde / ketone
- (iii) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-COOH}$ / $\text{C}_3\text{H}_7\text{COOH}$ / $\text{C}_4\text{H}_8\text{O}_2$ [1]
 allow: $\text{C}_4\text{H}_7\text{OOH}$
 allow: ecf on (c)(ii)
- (d) (measure volume of gas; [1]
 measure time; [1]
- (ii) increase in temperature / more yeast present / yeast multiplies [1]
- (iii) glucose used up; [1]
 concentration of ethanol high enough to kill yeast; [1]

2(a)(i)	<p>Any three from: same general formula; contain the same functional group; consecutive members differ by CH₂; common methods of preparation; same or similar chemical properties; physical properties vary in a predictable manner / show trends / show a gradual change / an example of a physical variation e.g. mpt, bpt volatility viscosity;</p>		<p>3 I different physical properties / physical properties change / an unqualified or slight change R same or similar physical properties</p>
(a)(ii)	/propan-1-ol/propan-2-ol;	1	
(a)(iii)	<p>if molecular formula is given as C₁₀H₂₂O award 2 marks</p> <p>if not, look for evidence of some correct working for one mark 158 – 17 = 141 OR 12n + 2n + 1 = 141 OR n = 10</p>	2	<p>A C₁₀H₂₁OH for two marks</p> <p>A (10 × 12) + (22 × 1) + 16 = 158 for one (working) mark</p>
(b)	<p>they have the same molecular formula (C₄H₁₀O);</p> <p>different structures;</p>	2	<p>A same number of each type of atom I same number of atoms</p> <p>A different structural formula or different arrangement of atoms</p>

(c)(i)	<p>M1 butene or but-1-ene;</p> <p>M2 structural formula of but-1-ene;</p>		<p>M1 and M2 are independent A but-2-ene for M1</p> <p>2 Minimum acceptable structure is $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$ Double bond must be shown R structure of but-2-ene for M2</p>
(c)(ii)	butyl ethanoate;	1	A butanyl R ethanoate and ethanoic
(c)(iii)	butanoic acid; structural formula of butanoic acid;	2	A butyric acid Minimum acceptable structure is $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ A $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ with C–HO connectivity in acid group

Question	Answer	Marks	Guidance
3(a)(i)	living/organism or named example e.g. yeast/cells/plants/animals/part of animal or plant e.g. muscle/humans/micro-organisms; produces/releases or gain or obtain energy/exothermic/heat; from food/named foodstuff/carbohydrate/named carbohydrate/sugar/named sugar/glucose/nutrients;	3	A 'we/us' for 'humans' I products/breathing/oxygen/anaerobic/aerobic
(a)(ii)	Any 2 from 3: carbon dioxide/CO ₂ ; water/H ₂ O; adenosine triphosphate/ATP;	1	I energy
(a)(iii)	biological catalyst or protein catalyst;	1	biocatalyst/living biological catalyst
(a)(iv)	answer must include both measuring the time and measuring a relevant quantity; OR alternatively measuring the time taken for something to happen; alternatives to time are: units of time/apparatus to measure time/regular intervals/how long examples of relevant quantities are: (Increase in/decrease in) amount/mass/volume/bubbles of carbon dioxide/bubbles of gas OR (Increase in/decrease in) mass of apparatus;	1	Examples: A time taken for lime water to turn milky A time taken for bubbling to stop/gas stop being evolved A count bubbles per minute A measure temperature (change) with time R time taken for reaction to end R measure carbon dioxide/gas with time (no reference to amount)
(b) (i)	tempe increase/heat increase/warmer/high temperature/exothermic/ more yeast/yeast reproduces/yeast increases/yeast multiplies;	1	R yeast was added
(b)(ii)	more yeast/yeast reproduces/increases/multiplies;	1	yeast was added

Question	Answer	Marks	Guidance
(b)(iii)	<p><u>all</u> glucose or reactant(s) reacted OR no glucose or reactant(s) left OR glucose or reactant(s) used up / finished / runs out / reacted completely / fully reacted;</p> <p>yeast (cells) dies OR enzymes denatured OR ethanol is toxic to yeast / ethanol kills yeast;</p>	2	<p>I glucose or reactants reacted / stopped reacting</p> <p>R enzyme dies / yeast denatures R yeast used up</p>
(c)	<p>Any two from: fuel; OR petrol additive; OR solvent / tinctures; OR (making) perfumes; OR varnishes; OR preserving biological specimens / preserving food; OR essence / flavourings; OR antiseptic / kill bacteria (in medicine) / sterilizer; OR antitussive agent; OR (in) disinfectant / hand sanitizer; OR to make esters / esterification; OR to make ether(s); OR to make amines; OR to make carboxylic acid(s) / vinegar / ethanoic acid; OR thermometers; OR alcohol lamp / spirit burners; OR any other suitable use;</p>	2	<p>I medicine (unqualified) / chemical feedstock</p>

Question	Answer	Marks	Guidance
(d)	<p>cracking / crack;</p> <p>(hexane to obtain) ethene / C₂H₄ ;</p> <p>$C_6H_{14} \rightarrow C_2H_4 + C_4H_{10}$;</p> <p>hydration (of ethene)/hydrate/hydrated or add(ition of) water /add(ition of) steam / addition;</p> <p>$C_2H_4 + H_2O \rightarrow C_2H_5OH$;</p>	5	<p>I fractional distillation / distillation wherever mentioned</p> <p>I catalytic / thermal + other conditions</p> <p>Ethene / C₂H₄ can be given in either equation whether the equation is otherwise correct or not</p> <p>I state symbols</p> <p>A multiples / other equations e.g.</p> <p>$C_6H_{14} \rightarrow 3C_2H_4 + H_2$</p> <p>$C_6H_{14} \rightarrow 2C_2H_4 + C_2H_6$</p> <p>$C_6H_{14} \rightarrow C_2H_4 + C_4H_8 + H_2$</p> <p>A any correct equations in which carbon is produced e.g. $C_6H_{14} \rightarrow 2C_2H_4 + 2C + 3H_2$</p> <p>A additional</p> <p>I conditions / react with water</p> <p>I C₂H₆O / state symbols</p> <p>A multiples</p>

- 4 (a) (i) butanoic acid [1]
methanol [1]
- (ii) number of moles of ethanoic acid = 0.1 [1]
number of moles of ethanol = 0.12(0) [1]
the limiting reagent is ethanoic acid [1]
number of moles of ethyl ethanoate formed = 0.1 [1]
maximum yield of ethyl ethanoate is 8.8 g [1]
- (b) correct ester linkage [1]
two ester linkages (COND on M1) [1]
continuation (COND on M2) [1]
- (c) add bromine water/bromine [1]
turns colourless [1]
remains brown/orange/reddish brown/yellow [1]
- ALLOW:** potassium manganate(VII) (acidic or alkaline) [1]
correct colour colourless/green or brown ppt [1]
stays pink/purple [1]
- (ii) ester 1 [1]
COND alkyl group is C_nH_{2n+1} which is NOT $C_{17}H_{33}$
or $C_{17}H_{35}$ is C_nH_{2n+1} **or** less hydrogen [1]
- (iii) soap **or** (sodium) salt (of a carboxylic acid) **or** carboxylate
alcohol [1]

[Total: 17]

- 5 (a) (i) $\text{CH}_3\text{COOCH}_2\text{CH}_3$ / $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3$ / $\text{CH}_3\text{COOC}_2\text{H}_5$ / $\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5$ / $\text{C}_2\text{H}_5\text{OOCCH}_3$ / $\text{CH}_3\text{CH}_2\text{OOCCH}_3$ **not:** $-\text{OCO}-$ linkage [1]
note: formulae can be displayed or semi-displayed
note: penalise sticks (i.e. any missing atoms)
- (ii) butyl methanoate [1]
- (b) (i) fats / vegetable oils / triglycerides / lipids [1]
- (ii) two correct ester linkages, e.g. $-\text{OOC}$ / $-\text{O}_2\text{C}$ and $-\text{COO}$ / $-\text{CO}_2$ [1]
 contents of the 'boxes' being C_6H_4 and C_2H_4 or CH_2CH_2 [1]
 continuation bonds at **both** ends [1]
- (c) (i) to make colourless / invisible (spots) [1]
 visible / coloured / seen / position made clear / indicate [1]
- (ii) $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent (front)}} = R_f$ [1]
- (iii) sample 1 $R_f = 0.20$ to 0.24 tartaric (acid) [1]
 sample 2 $R_f = 0.44$ to 0.48 malic (acid) [1]