

- M1. (a) (i) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$;
(penalise C_2H_6O once only in this question) 1
- (ii) Concentrated H_2SO_4 OR concentrated H_3PO_4 OR Al_2O_3 ;
(penalise aqueous or dilute as a contradiction) 1
- $C_2H_5OH \rightarrow C_2H_4 + H_2O$ OR $C_2H_5OH \rightarrow H_2C = CH_2 + H_2O$;
(penalise CH_2CH_2 and CH_2-CH_2 and $CH_2 : CH_2$ for ethene) 1
- (b) Nickel OR Ni OR platinum OR Pt OR palladium OR Pd; 1
- Hydrogen OR H_2 ; 1
- (c) (i) $C_{18}H_{34}O_2$ Only; 1
- $C_9H_{17}O$ Only;
(empirical formula is not consequential on molecular formula) 1
- (ii) (An unsaturated compound) contains (at least) one double bond
OR
Contains $C=C$;
(must be a positive statement) 1
- (iii) M1: Bromine water
OR
 $Br_2(aq)$
OR
Bromine
OR

Br₂;

(penalise "bromide water", but mark on)

1

M1: decolourised or goes colourless

OR

from brown/red/orange/yellow to colourless;

(Must be "colourless" not "clear" for M2)

(chemical error if no reagent or wrong reagent, loses both marks) (credit KMnO₄ for M1, (purple) to colourless for M2 (if acidified) OR (purple) to brown/brown precipitate (if alkaline or unspecified) (No credit for hydrogen or iodine as reagents)

1

[10]

- M2.** (a) (i) *Reagent: Hydrogen of H₂ (1)*
Conditions: Ni (catalyst) (Ignore Pt) (1)
100 – 200 °C or heat (1)

Not 'high temp' or 'warm'

M1 = 0, M2 = 1 then M3 = 0 max

or M1 = M2 = 0 then M3 = 0

M3 tied to M1. Only award M3 if M1 earned

- (ii) *Difference in structure: soft margarine less hydrogenated or has more C=C bonds or is more unsaturated than hard margarine (1)*

Difference in melting point: soft has lower melting point (1)

Must be comparison

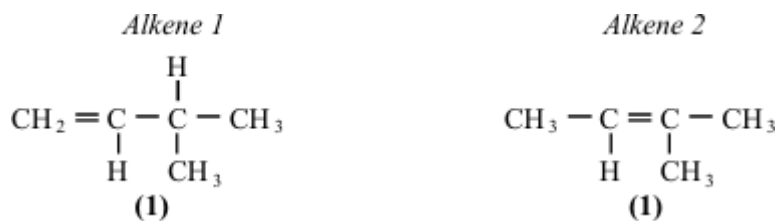
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- (b) (i) 3-methylbutan-2-ol (1)
No alternatives

- (ii) elimination or dehydration (1)

(iii) (c) H₂SO₄ or (c) H₃PO₄ – name or correct formula **(1)**

(iv)



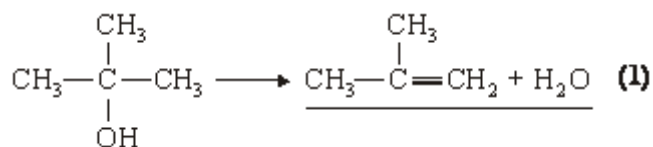
Double bond must be shown
Accept any correct unambiguous structures
if but-1-ene and but-2-ene offered, allow M2

5

[10]

M3. (a) (i) 2-methylpropan-2-ol **(1)** OR the second one

(ii) Dehydrating agent: $\text{conc H}_2\text{SO}_4$ OR $\text{conc H}_3\text{PO}_4$ OR Al_2O_3 **(1)**
ignore additional (aq)



Equation:

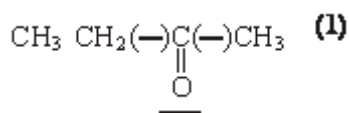
Allow C₄H₉OH in equation provided RHS is correct
if b(i) is blank, b(ii) equation must be full for credit
i.e. NOT C₄H₉OH

Mark consequential on b(i)

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- (b) (i) *Isomer: butan-2-ol OR the fourth one*
[look at name in table]
wrong isomer = CE

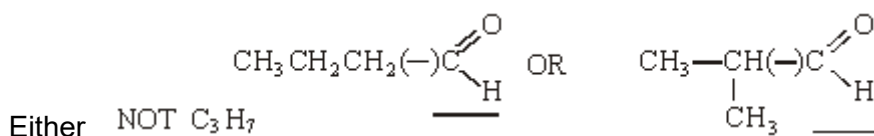
Structure of the ketone:



- (ii) *Isomer: butan-1-ol OR the first one*
OR 2-methylpropan-1-ol OR the third one
[look at name in table]

Wrong isomer = CE

Structure of the aldehyde:



(iii)

Reagent	M1	Tollen's (AgNO ₃ /NH ₃)	Fehling's
Observation with ketone	M2	Stays colourless no change	stays blue no change
Observation with aldehyde	M3	Silver mirror black ppt	<u>red solid</u> <u>orange/red</u> <u>brown/ red</u> <u>ppt/solid</u>

Other include(*)

K₂Cr₂O₇ / H₂SO₄

KMnO₄/H₂SO₄

Schiff's

Benedict's

Wrong reagent R

No reagent = CE

Penalise AgNO₃ [Ag(NH₃)₂] but allow M2 and M3 sequentially.

(*) K₂Cr₂O₇ / H₂SO₄ acidified ketone aldehyde

	orange no change	green
KMnO ₄ /H ₂ SO ₄ acidified	purple no change	colourless (v. Pale pink)

Benedict's \equiv *Fehling's* ; *Schiff's* colourless \rightarrow pink with CHO
violet

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(c) *Equation:* CH₃CH₂CH₂CH₂OH (or C₄H₉OH) + 2[O] \rightarrow CH₃CH₂CH₂COOH
(or C₃H₇COOH) + H₂O (1)

Name of product: butanoic acid (1)

Accept butaneic acid

2

[12]

M4. (a) Reaction 2: NaOH OR KOH (1) M1 alcohol (ic) OR ethanol (ic)(1) M2
ignore heat

*Condition mark linked to correct reagent but award M2 if OH
or base or alkali mentioned*

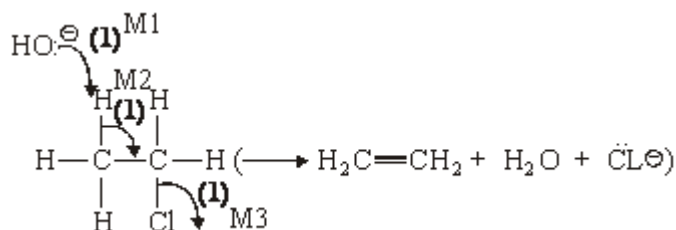
Reaction 3: concentrated H₂SO₄ OR H₃PO₄ M1 (1) heat (1) M2
OR 150°C - 200°C

*Condition mark linked to correct reagent but award M2 if
H₂SO₄ or H₃PO₄, but not concentrated*

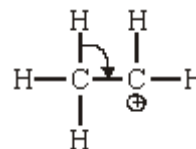
Penalise reagent and condition if dilute H₂SO₄ / H₃PO₄

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(b) Mechanism:



Award M3 (C-Cl) independently
 M1 and M2 must be to / from correct places



E1 mechanism possible in which M2

Name: of mechanism = elimination (1)

NOT dehydrohalogenation

Ignore "base" OR "nucleophilic" before elimination

Reason: Reaction 2 has (very) low yield (1)

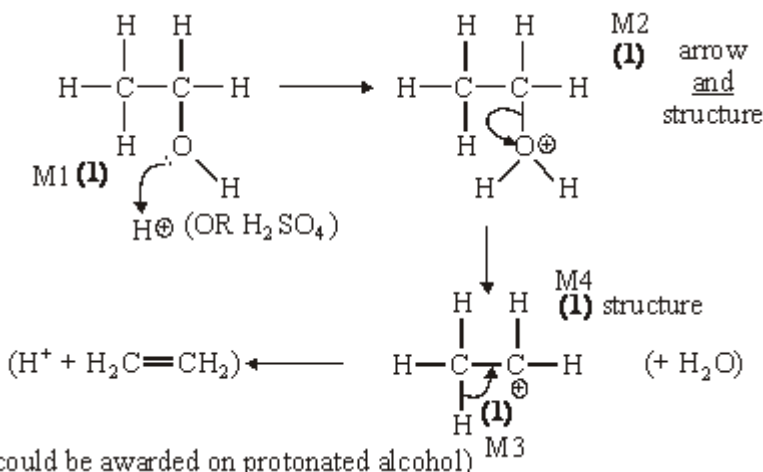
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QoL OR chloroethane has to be made (from ethane)

OR chloroethane is expensive

OR chloroethane is not readily available

(c) Mechanism:



Name of mechanism = elimination (1)

NOT dehydration alone

Reason: Ethanol could come from (fermentation of) renewable

QoL sugars / glucose / carbohydrates / sources (1)

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[15]

M5.B

[1]

- M6. (a) M1 fermentation 1
- M2 dehydration or elimination 1
- (b) (i) yeast OR zymase OR an enzyme 1
- (ii) concentrated sulphuric or phosphoric acid
(penalise aqueous or dilute as a contradiction) 1
- (c) (i) primary or 1° 1
- (ii) sugar or glucose or ethanol is renewable
OR ethanol does not contain sulphur-containing impurities
OR ethanol produces less pollution or is less smoky or less CO/C
(the objective is a positive statement about ethanol)
(penalise the idea that ethanol is an infinite source or vague statements that ethanol has less impurities) *(penalise the idea that ethanol produces no pollution)* 1
- (d) $C_2H_6 \rightarrow C_2H_4 + H_2$ 1
- (e) Addition
(ignore self or chain as a preface to "addition")
(penalise additional) 1

[8]

M7.D

[1]