

M1.B

[1]

M2.C

[1]

M3.D

[1]

M4. (a) (i) addition of water / steam (1)
Ignore "to the reaction"

(ii) *Advantage:* low technology
renewable feedstock / resource
allowed for use in drinks, perfumes
considered to be green (1)

any one
NOT "infinite" or "non-finite" resource

Disadvantage:

slow
low yield
significant land use
has to be distilled
labour intensive

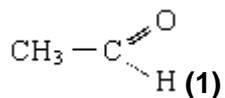
any one
Ignore yeast
NOT (unqualified) batch production
NOT impure product

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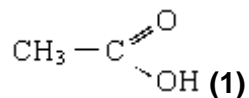
(b) (i)

Structure of aldehyde

Structure of carboxylic acid



NOT CH₃CHO



NOT CH₃COOH

Penalise incorrect R group once

- (ii) *Reagent: sodium (/ potassium) dichromate (VI)*
(VI not essential) (1) M1

Conditions: acidified or sulphuric acid (1) Can be with reagent M2
(heat under reflux) (1) M3

Or correct formula for M1 and M2

M2 depends on M1 (but M2 correct from Cr₂O₇²⁻, K₂Cr₂O₇²⁻ etc

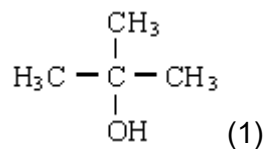
M3 mark independent

Credit KMnO₄ for M1

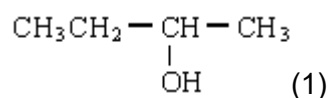
Ignore T and P for M2

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- (c) (i)



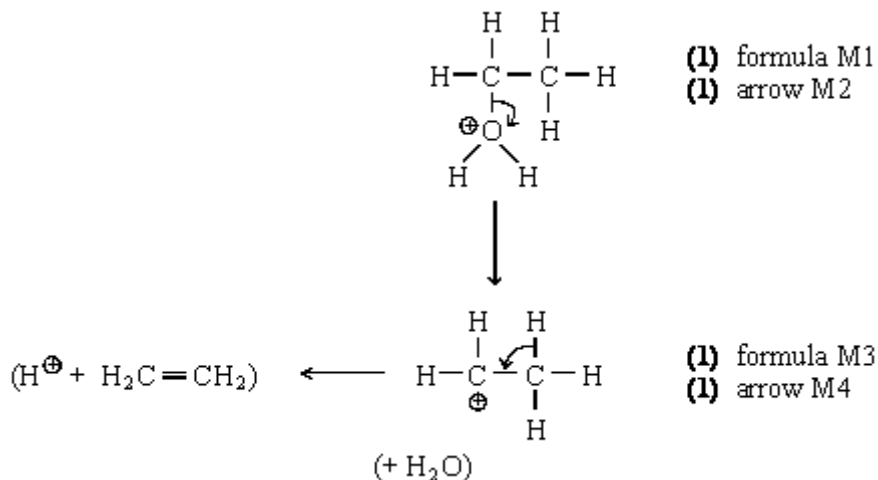
- (ii)



2

- (d) (i) **Al₂O₃ or H₂SO₄ or H₃PO₄ (1)**
Name or formula

- (ii)



For M1 the + can be on O or H if - OH₂ used
For M2 the arrow must go to the + or to oxygen
Synchronous loss without carbocation loses carbocation structure mark; can still score ¾ i.e. penalise M3

5

[15]

M5. (a) % O = 21.6 % (1)

If % O not calculated only M2 available

$\frac{64.9}{12}$	$\frac{13.5}{1}$	$\frac{21.6}{16}$ (1)
C	H	O
= 5.41	= 13.5	= 1.35

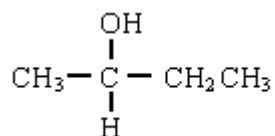
Ratio: 4 : 10 : 1 (∴ C₄H₁₀O) (1)

If arithmetic error in any result lose M3

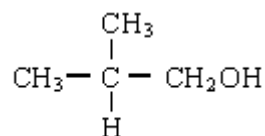
If percentage composition calculation done zero

3

(b) (i) *Type of alcohol: Tertiary (1)*
Reason: No hydrogen atom on central carbon (1)



(1)



(1)

- (ii) *Isomer 3* *Isomer 4*
 Penalise missing bonds / incorrect bonds once per paper

4

- (c) (i) Aldehyde **(1)**
Ignore named aldehydes or their structures,
penalise wrong named compound

- (ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} + [\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CHO} + \text{H}_2\text{O}$ **(1)**
 Balanced **(1)**

C₄H₁₀O is OK as a reactant

[O] can be over arrow

C₃H₇CHO not accepted for product, but C₂H₅CH₂CHO is OK

If use C₃ or C₅ compounds no marks in (ii) C.E of wrong alcohol

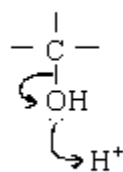
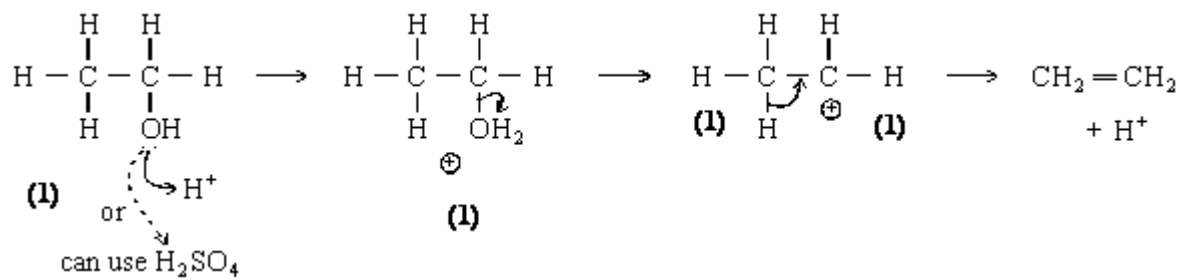
- (iii) *Name Butanoic acid* **(1)**
Structure: CH₃CH₂CH₂COOH **(1)**
mark conseq. or as stated

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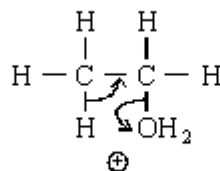
- (d) *Advantage: Fast reaction OR pure product OR continuous process*
OR cheap on manpower OR high yield, 100% alcohol **(1)**
Disadvantage: High technology OR ethene from non renewable source
OR expensive equipment not just costly **(1)**
Not answers based on fermentation

2

- (e)



scores M1 only



scores M2 & M4
but not carbocation mark, M3.

4

[18]