TOPIC 8 TEST MS

1. (a) (i) **M1 Initiation**

$Cl_2 \longrightarrow 2Cl\bullet$

Penalise absence of dot once only.

M2 First propagation

$Cl\bullet + CHF_3 \longrightarrow CF_3\bullet + HCl$

Penalise + or − charges <u>every time</u>.

M3 Second propagation

$Cl_2 + CF_3\bullet \longrightarrow CClF_3 + Cl\bullet$

Credit $CF_3\bullet$ with the radical dot above / below / to either side.

M4 Termination (must make C_2F_6)

$2\ CF_3\bullet \longrightarrow C_2F_6$ or CF_3CF_3

Mark independently.

4

(ii) ultra-violet / uv / sun light

OR (very) high temperature

OR 500 °C ≤ T ≤ 1000 °C

OR 773 K ≤ T ≤ 1273 K

1

(b) (i) $Cl\bullet$ **OR** chlorine atom / chlorine (free−) radical / Cl (atom)

Not 'chlorine' alone.

Credit 'Cl' alone on this occasion.

1

(ii) $\mathbf{2}O_3 \longrightarrow \mathbf{3}O_2$

Or multiples.

Ignore state symbols.

If the correct answer is on the line OR clearly identified below some working, then ignore any working.

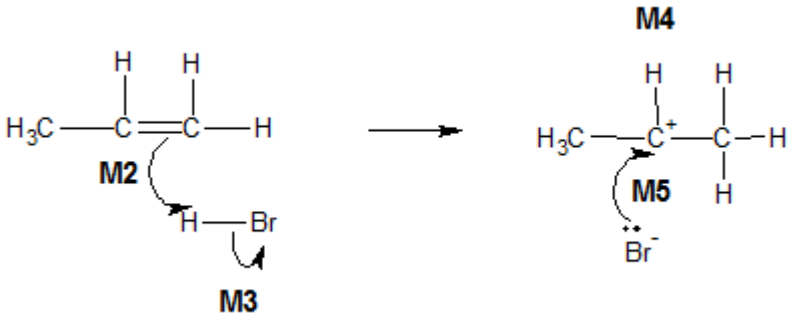
1

[7]

2. (a) **M1 <u>electrophilic addition</u>**

*For **M1**, both words required*

Accept phonetic spelling



For the mechanism

***M2** Ignore partial negative charge on the double bond*

M2 must show an arrow from the double bond towards the H atom of the H–Br molecule

***M3** Penalise partial charges on H–Br bond if wrong way and penalise formal charges*

M3 must show the breaking of the H–Br bond

Penalise once only in any part of the mechanism for a line and two dots to show a bond

M5 must show an arrow from the lone pair of electrons on the negatively charged bromide ion towards the correct (positively charged) carbon atom

***<u>Maximum any 3 of 4 marks for the mechanism</u>** for wrong (organic) reactant **OR** wrong organic product (if shown) **OR** primary carbocation*

Accept the correct use of sticks

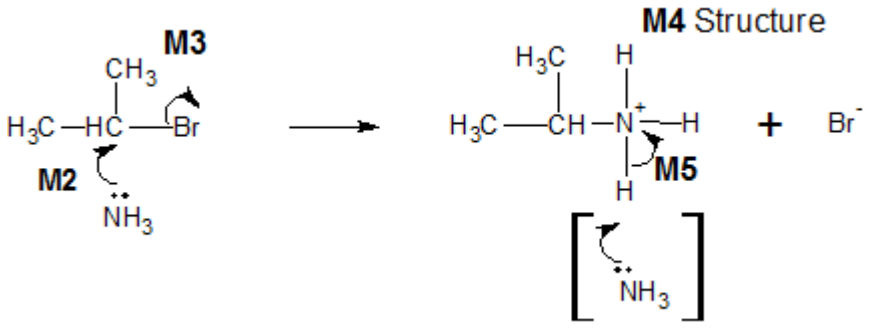
NB These are double-headed arrows

5

(b) **M1 <u>Nucleophilic substitution</u>**

*For **M1**, both words required*

Accept phonetic spelling



For the mechanism

*Penalise **M2** if NH_3 is negatively charged*

M2 must show an arrow from the lone pair of electrons **on the nitrogen atom** of an ammonia molecule to the correct C atom

*Penalise **M3** for formal charge on C of the C−Br or incorrect partial charges on C−Br*

*Penalise **M3** for an additional arrow from the Br to something else*

M3 must show the movement of a pair of electrons from the C–Br bond to the Br atom. Mark **M3** independently provided it is from <u>their original molecule</u>

*The second mole of ammonia is not essential for **M5**; therefore ignore any species here*

M4 is for the structure of the alkylammonium ion, which could be a condensed formula. A positive charge **must** be shown on / or close to, the N atom

Penalise once only for a line and two dots to show a bond

M5 is for an arrow from the N–H bond to the N atom

***<u>Maximum any 3 of 4 marks for the mechanism</u>** for wrong organic reactant **OR** wrong organic product if shown*

Award full marks for an S_N1 mechanism in which **M2** is the attack of the ammonia on the intermediate carbocation

Accept the correct use of "sticks"

NB These are double-headed arrows

5

(c) M1 (addition) polymerisation OR poly-addition

Ignore "additional"

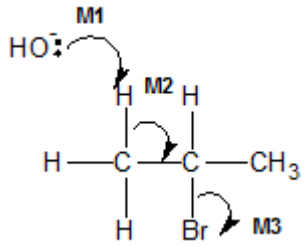
Credit polyprop-1-ene and polypropylene

M2 poly(propene) / polypropene

Penalise "condensation polymerisation"

2

(d)



*Penalise **M1** if covalent KOH*

M1 must show an arrow from the lone pair on the oxygen of a negatively charged hydroxide ion to a correct H atom

*Penalise **M3** for formal charge on C of C–Br or incorrect partial charges on C−Br.*

M2 must show an arrow from a correct C–H bond adjacent to the C–Br bond to the appropriate C–C bond. Only award if an arrow is shown attacking the H atom of a correct C−H bond in **M1**

Ignore other partial charges

Penalise once only in any part of the mechanism for a line and two dots to show a bond

M3 is independent provided it is from their original molecule, but **CE=0 if nucleophilic substitution**

***Maximum any 2 of 3 marks** for wrong organic reactant*

Award full marks for an E1 mechanism in which **M3** is on the correct carbocation.

Accept the correct use of "sticks" for the molecule except for the C–H being attacked

NB These are double-headed arrows

3

[15]

3. (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]

4. (a) Eliminate / reduce fire risk;

Allow ethanol flammable / burns / combusts.

1

(b) Orange to green;

Need full colour change to score mark.

1

[2]

5. (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

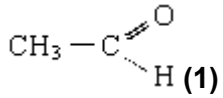
Disadvantage:
slow
low yield
significant land use
has to be distilled
labour intensive

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

3

(b) (i)

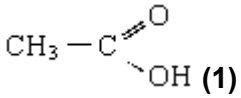
Structure of aldehyde



(1)

NOT CH_3CHO

Structure of carboxylic acid



(1)

NOT CH_3COOH

Penalise incorrect R group once

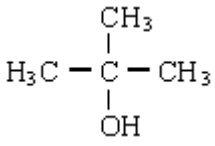
(ii) *Reagent*: sodium (/ potassium) dichromate (VI)
(VI not essential) (1) M1

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 $Cr_2O_7^{2-}$, $K_2Cr_2O_7^{2-}$ etc
M3 mark independent
Credit $KMnO_4$ for M1
Ignore T and P for M2

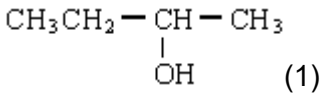
5

(c) (i)



(1)

(ii)



(1)

2

[15]

6. B **[1]**

7. C **[1]**

8. D **[1]**

9. C **[1]**

10. B **[1]**

11. D **[1]**

12. B **[1]**

13. B **[1]**