Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a) **M1** $C_6H_{12}O_6 \longrightarrow$ **2**CH_3CH_2OH + **2**CO_2
($2C_2H_5OH$)

Mark independently

For M1 and M3 ignore state symbols and credit multiples

For M1 and M3 penalise C_2H_6O once only

M2 fermentation

M3 CH_3CH_2OH + **3**$O_2 \longrightarrow$ **2**CO_2 + **3**H_2O
(C_2H_5OH)

M4 A specified process e.g. planting / harvesting / transport / extracting sugar / distilling ethanol solution / fertiliser production etc.

M5 The specified process uses / burns (fossil) fuel that releases CO_2

For M5, "releases / increases carbon emissions" is insufficient as an alternative to releases CO_2

5

(b) **M1** sodium or potassium hydroxide / NaOH / KOH

Mark on to M2 from hydroxide ion

M2 **depends on correct M1**

Ignore OH^- if KOH/ OH^-

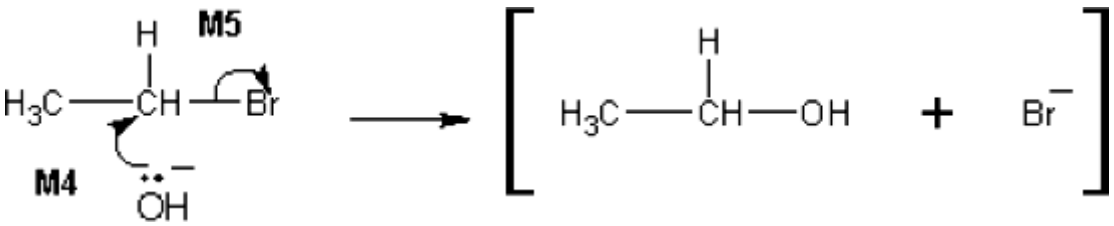
warm / heat / reflux and aqueous or (aq) or water

For M2 ignore "dilute"

For M2 penalise T > 100 °C

M3 nucleophilic substitution

Acidified KOH/NaOH or H_2SO_4 with KOH/NaOH loses M1 and M2



For M3, both words required

NB The arrows here are double-headed

M4 must show an arrow from the lone pair of electrons on the oxygen atom of the negatively charged hydroxide ion to the C atom.

Penalise M4 if covalent NaOH / KOH is used

Penalise one mark from M4 or M5 if half-headed arrows are used

M5 must show the movement of a pair of electrons from the

C— Br bond to the Br atom. Mark M5 independently provided it is from their original molecule.

Penalise M5 for formal charge on C of the C–Br or incorrect partial charges on C–Br

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

For M4 and M5, award full marks for an S_N1 mechanism

For M4 and M5, maximum 1 of 2 marks if wrong reactant is used.

Penalise M5 if an extra arrow is drawn from the Br of the C–Br bond to, for example, K^+

Do not penalise the use of "sticks"

M6 One statement from

- The yield is (very) low / not a high yield OR elimination occurs / ethene formed
- The rate of reaction slow
- Bromoethane has to be manufactured / made first
- Bromoethane is expensive

For M6 ignore references to other costs and expenses

6

(c) **M1** concentrated phosphoric acid / conc. H_3PO_4 ***OR*** concentrated sulfuric acid / conc. H_2SO_4

Answers in any order

Ignore reference to support medium in M1

M2 hydration or (electrophilic) addition

For M3 and M4 any two from

Do not apply the list principle to these three chosen criteria in M3 and M4

- Excess ethene

  OR Excess steam / water / H_2O

  OR remove the ethanol as it forms

  OR recycle the ethene

- Specified Pressure

  50 atm ≤ P ≤ 100 atm

  OR 5000 kPa ≤ P ≤ 10000 kPa

  OR 5 MPa ≤ P ≤ 10 MPa

- HighTemperature unless they give a value that is not in the ranges given here;

OR 300 °C ≤ T ≤ 600 °C

OR 570 K ≤ T ≤ 870 K

Accept a reference to "low temperature" if they specify a correct temperature range or a correct temperature in the range

4

[15]

Q2.

(a) (i) chlorotrifluoromethane

Spelling must be correct but do not penalise "flouro"

Ignore use of 1–

1

(ii) CF_3•

May be drawn out with dot on C

OR if as shown dot may be anywhere

1

(iii) An unpaired/non-bonded/unbonded/free/a single/one/lone electron

NOT "bonded electron" and NOT "paired electron"

NOT "pair of electrons"

NOT "electrons"

Ignore "(free) radical"

1

(b) **M1** $Cl• + O_3 \rightarrow ClO• + O_2$

M2 $ClO• + O_3 \rightarrow \mathbf{2}O_2 + Cl•$

Mark independently

Equations could gain credit in either position

The dot can be anywhere on either radical

Penalise the absence of a dot on the first occasion that it is seen and then mark on. Do not make the same penalty in the next equation, but penalise the absence of a dot on the other radical.

Apply the list principle for additional equations

2

(c) (i) (If any factor is changed which affects an equilibrium), the (position of) equilibrium will shift/move so as to oppose the change.

OR

(When a system/reaction in equilibrium is disturbed), the equilibrium shifts/moves in a direction which tends to reduce the disturbance

Must refer to equilibrium

Ignore reference to "system" alone

A variety of wording will be seen here and the key part is the last phrase.

An alternative to shift/move would be the idea of changing/altering the position of equilibrium

1

(ii) **M1** The (forward) reaction/to the right is endothermic or takes in heat

OR The reverse reaction/to the left is exothermic or gives out heat

M2 The equilibrium moves/shifts to oppose the increase in temperature

M2 depends on a correct statement for M1

For M2 accept

The equilibrium moves/shifts

- *to take in heat/lower the temperature*
- *to promote the endothermic reaction and take in heat/ lower the temperature*
- *to oppose the change and take in heat/lower the temperature*

(leading to the formation of more ozone)

2

(d) Any one of

- Pentane does not contain chlorine OR C–Cl (bond)
- Pentane is chlorine-free
- Pentane does not release chlorine (atoms/radicals)

Ignore reference to F OR C–F OR halogen

Ignore "Pentane is not a CFC"

Ignore "Pentane is a hydrocarbon"

Ignore "Pentane only contains C and H"

Ignore "Pentane is C_5H_{12}"

1

[9]