TOPIC 9 TEST MS

1. Add Tollens / Fehling's / Benedict's reagent / ir spectra

Accept any other chemically correct reagent and observation

1

Silver mirror / blue to red ***OR*** red precipitate (with ethanal) / peak at 1700 cm^{-1} (in ethanal)

Must have correct test to access second mark
Accept 'silver'. Do not accept 'silver solution'
Give one mark for 'silver mirror test' and 'silver mirror'
Accept correct answer based on n.m.r. spectra

1

[2]

2. (a) Structure for 3-methylbut-1-ene

$H_2C=CHCH(CH_3)_2$

Any correct structural representation.
Credit "sticks" and require the double bond.

1

(b) Structure for 2-methylpropan-2-ol

$(CH_3)_3COH$

Any correct structural representation.
Credit "sticks".

1

(c) Structure for propene

$H_2C=CHCH_3$

Any correct structural representation.
Credit "sticks" and require the double bond.

1

(d) Structure for 2-aminobutane

$CH_3CH_2CH(NH_2)CH_3$

Any correct structural representation.
Credit "sticks".

1

[4]

3. (a) Identity of **X**; 2-methylpropene **(1)**

Absorption at 1650 cm^{-1} indicates an alkene present **(1)**

OR a chemical answer e.g. Br_2 (aq) brown to colourless

2

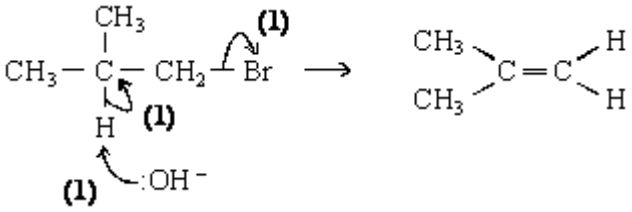
(b) Reagents

Step 1 KOH (allow NaOH) **(1)** alcoholic **(1)** warm **(1)**

Only allow solvent and warm if reagent correct

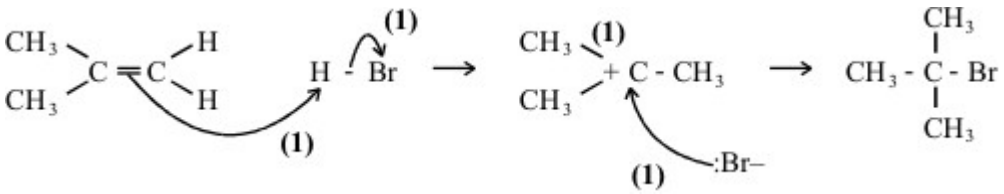
Step 2 HBr **(1)**

Mechanism: A → **X**



Or a carbocation mechanism

Mechanism **X** → B



11

[13]

4. (a) Pentan-2-one

ONLY but ignore absence of hyphens

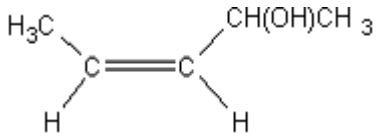
1

(b) Functional group (isomerism)

Both words needed

1

(c) (i)



Award credit provided it is obvious that the candidate is drawing the Z / <u>cis isomer</u>

The group needs to be $CHOHCH_3$ but do not penalise poor C–C bonds or absence of brackets around OH

Trigonal planar structure not essential

1

(ii) Restricted <u>rotation</u> (about the C=C)

OR

No (free) <u>rotation</u> (about the C=C)

1

(d)

M1 Tollens' (reagent) *(Credit ammoniacal silver nitrate OR a description of making Tollens')* *(Do not credit Ag^+, $AgNO_3$ or $[Ag(NH_3)_2^+]$ or "the silver mirror test" on their own, but mark M2 and M3)*	**M1** Fehling's (solution) / Benedict's *(Penalise $Cu^{2+}(aq)$ or $CuSO_4$ but mark M2 and M3)*
M2 <u>silver mirror</u> OR <u>black solid or black precipitate</u>	**M2** <u>Red solid/precipitate</u> *(Credit <u>orange</u> or <u>brown solid</u>)*
M3 (stays) colourless OR no (observed) change / no reaction	**M3** (stays) blue OR no (observed) change / no reaction

*If **M1** is blank CE = 0, for the clip*

Check the partial reagents listed and if M1 has a <u>totally incorrect</u> reagent, CE = 0 for the clip

Allow the following alternatives

***M1** (acidified) potassium dichromate(VI) (solution); mark on from incomplete formulae or incorrect oxidation state*

***M2** (turns) green*

M3 (stays) orange / no (observed) change / no reaction

OR

***M1** (acidified) potassium manganate(VII) (solution);*

mark on from incomplete formulae or incorrect oxidation state

***M2** (turns) colourless*

***M3** (stays) purple / no (observed) change / no reaction*

*In all cases for **M3***

Ignore "nothing (happens)"

Ignore "no observation"

3

(e) (i) **Spectrum is for Isomer 1**

or named or correctly identified

The explanation marks in (e)(ii) depend on correctly identifying Isomer 1.

The identification should be unambiguous but candidates should not be penalised for an imperfect or incomplete name. They may say ''the alcohol" or the ''alkene'' or the ''E isomer''

1

(ii) **If Isomer 1 is correctly identified, award <u>any two</u> from**

- (Strong / broad) absorption / peak in the range **<u>3230 to 3550</u>** cm^{-1} or specified value <u>in this range</u> or **<u>marked correctly</u>** on spectrum
  <u>and</u>
  (characteristic absorption / peak for) <u>OH</u> group /**<u>alcohol</u>** group

- No absorption / peak in range **<u>1680 to 1750</u>** cm^{-1} or absence <u>marked correctly</u> on spectrum
  <u>and</u>
  (No absorption / peak for a) **<u>C=O</u>** group / **<u>carbonyl</u>** group / **<u>carbon-oxygen double bond</u>**

- Absorption / peak in the range **<u>1620 to 1680</u>** cm^{-1} or specified value <u>in this range or marked correctly</u> on spectrum
  <u>and</u>

  (characteristic absorption / peak for) **<u>C=C</u>** group / **<u>alkene</u>** / **<u>carbon-carbon double bond</u>**

If 6(e)(i) is incorrect or blank, CE=0

Allow the words ''dip'' OR ''spike'' OR ''trough'' OR ''low transmittance" as alternatives for absorption.

Ignore reference to other absorptions e.g. C-H, C-O

2

[10]

5. (a) (i) CH_2O

Atoms in any order

Accept a clear indication that $C_6H_{12}O_6$ yields CH_2O as the answer

1

(ii) No peak / no absorption / no C=O in the **<u>range 1680 to 1750</u>** (cm^{-1}) (suggesting no evidence of C=O)

Allow the words "dip", "spike", "low transmittance" and "trough" as alternatives for absorption

Ignore references to other wavenumbers

1

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

Penalise (C_2H_6O)

*Allow multiples of the equation in **M1***

Either order
M2 (enzymes from) yeast or zymase

M3 25 °C ≤ T ≤ 42 °C OR 298 K ≤ T ≤ 315 K

*For **M2** and **M3***
Ignore "aqueous"
Ignore "anaerobic / absence of oxygen"
Ignore "controlled pH"
Ignore "warm"

3

(c) M1 Acidified potassium or sodium dichromate

*For **M1**, it must be a whole reagent and / or correct formulae*

OR H_2SO_4 / $K_2Cr_2O_7$ OR H^+ / $K_2Cr_2O_7$ etc.

Do not penalise incorrect attempt at formula if name is correct or vice versa

OR correct combination of formula and name

If oxidation state given in name, it must be correct, but mark on from an incorrect attempt at a correct reagent.

M2 (requires an attempt at M1)
orange to green

*Credit **acidified** potassium chromate(VI) / H_2SO_4 + K_2CrO_4*

Possible alternative
M1 (acidified) potassium manganate(VII) ***OR*** $KMnO_4$ / H_2SO_4
M2 purple to colourless

*Other alternatives will be accepted but **M2** is dependent on **M1** in every case*
M2** requires an attempt at a correct reagent for **M1
Ignore reference to states

2

(d) (i) Renewable / sustainable ONLY

Ignore references to global warming or greenhouse gases

1

(ii) **Any one statement <u>about this process</u> from**

Subject to weather / climate

Ignore "batch"

OR

Depletes <u>food</u> supply OR the land use <u>for</u> (specified) <u>food</u>

OR

Requires use of / uses more fossil fuels

OR

Not carbon-neutral OR CO_2 produced during a named process (eg harvest, transport etc.)

OR

Slow process / slow rate of reaction / takes a long time (to grow crops)

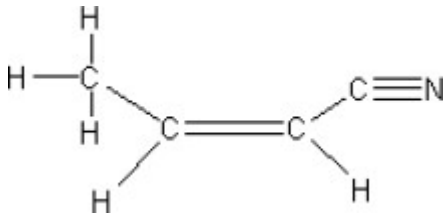
OR

This route leads to the production of a mixture of water and ethanol / impure ethanol <u>that requires separation / further processing</u>

1

[9]

6. (a) (i) Structure of (Z)-but-2-enenitrile with or without either or both of the CH_3 and the CN groups displayed



Penalise C−NC

Do <u>not</u> penalise C−H_3C

Ignore bond angles.

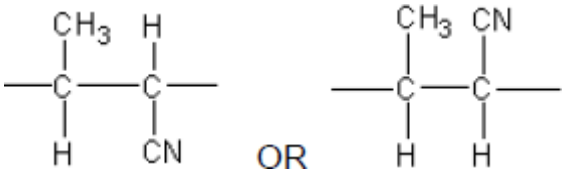
1

(ii) Restricted <u>rotation</u> / no (free) <u>rotation</u> about the double bond / about the C=C ***OR*** does not <u>rotate</u> (about the double bond)

Must use the word <u>rotate / rotation.</u>

1

(b) Repeating unit of polyalkene



All the bonds relevant to the unit must be drawn out including those on either side of the unit. There is no need to expand either the CH_3 or the CN

Penalise C−NC

Penalise "sticks".

Ignore brackets.

Penalise "n"

1

(c) **Feature 1**

Absorption / peak in the range **2220 to 2260** cm^{-1} or specified value in this range or marked correctly on spectrum

and

(characteristic absorption / peak for) **C≡N** / **CN** group / **nitrile** / **cyanide** group

*Allow the words "dip" **OR** "spike" **OR** "trough" **OR** "low transmittance" as alternatives for absorption.*

*Allow a peak at 2200 cm^{-1} to 2220 cm^{-1} **in this case**.*

Feature 2

Absorption / peak in the range **1620 to 1680** cm^{-1} or specified value in this range or marked correctly on spectrum

and

(characteristic absorption / peak for) **C=C** group / **alkene** / **carbon-carbon double bond**

Ignore reference to other absorptions eg C-H

Either order.

2

[5]

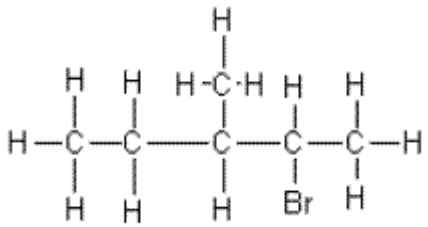
6. (a) (i) Electrophilic addition (reaction)

Both words needed

Accept phonetic spelling

1

(ii) **M1** Displayed formula of 2-bromo-3-methylpentane



All the bonds must be drawn out but ignore bond angles

M2 Position(al) (isomerism)

Do not forget to award this mark

2

(b) (i) **M1** R is represented by **Spectrum 2**

M2 Spectrum 2 shows an infrared absorption/spike/dip/ trough/peak with any value(s)/range within the range 1620 to 1680 (cm^{-1}) OR this range quoted/identified and this is due to C=C
OR this information could be a correctly labelled absorption on the spectrum

OR Spectrum 1 does not have an infrared absorption in range 1620 to 1680 (cm^{-1}) and does not contain C=C.

Award M1 if it is obvious that they are referring to the second spectrum (or the bottom one)

M2 depends on a correct M1

Ignore other correctly labelled peaks

Ignore reference to "double bond" or "alkene"

2

(ii) Functional group (isomerism)

1

(iii) Cyclohexane

OR

Methylcyclopentane etc.

Named correctly

Ignore structures and ignore numbers on the methyl group of methylcyclopentane

1

[7]