

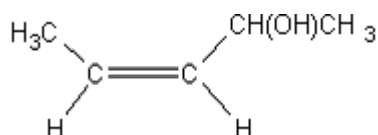
M1. (a) Pentan-2-one
ONLY but ignore absence of hyphens

1

(b) Functional group (isomerism)
Both words needed

1

(c) (i)



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

The group needs to be CHOHCH₃ but do not penalise poor C–C bonds or absence of brackets around OH

Trigonal planar structure not essential

1

(ii) Restricted rotation (about the C=C)

OR

No (free) rotation (about the C=C)

1

(d)

<p>M1 Tollens' (reagent)</p> <p><i>(Credit ammoniacal silver nitrate OR a description of making Tollens')</i></p> <p><i>(Do not credit Ag⁺, AgNO₃ or [Ag(NH₃)₂]⁺ or "the silver mirror test" on their own, but mark M2 and M3)</i></p>	<p>M1 Fehling's (solution) / Benedict's</p> <p><i>(Penalise Cu²⁺(aq) or CuSO₄ but mark M2 and M3)</i></p>
<p>M2 <u>silver mirror</u></p> <p>OR <u>black solid or black precipitate</u></p>	<p>M2 <u>Red solid/precipitate</u></p> <p><i>(Credit <u>orange</u> or <u>brown solid</u>)</i></p>

M3 (stays) colourless	M3 (stays) blue
OR	OR
no (observed) change / no reaction	no (observed) change / no reaction

If M1 is blank CE = 0, for the clip

Check the partial reagents listed and if M1 has a totally incorrect 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 any two from**

- (Strong / broad) absorption / peak in the range **3230 to 3550** cm⁻¹ or specified value in this range or **marked correctly** on spectrum
and
(characteristic absorption / peak for) OH group / **alcohol** group
- No absorption / peak in range **1680 to 1750** cm⁻¹ or absence **marked correctly** on spectrum

and

(No absorption / peak for a **C=O** group / **carbonyl** group / **carbon-oxygen double bond**)

- 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**

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]

M2. 1(-)bromobutane

1

correct structure for 1-bromo-2-methylpropane

(C–C bonds must be clear where drawn)

1

[2]

M3.A

[1]

M4.B

[1]

- M5.** (a) • (Same) General formula/allow a named homologous series with its general formula
- Chemically similar/same (chemical) reactions
 - Same functional group
 - Trend in physical properties/eg inc bp as M_r increases
 - (Molecules) increase by $\text{CH}_2/M_r = 14$
Any two points 2
- (b) Fractional distillation/fractionation/chromatography
Allow GLC 1
- (c) (Molecules/compounds/substances) with the same molecular formula/same number and type of atoms
Allow alkanes with same molecular formula
Allow same chemical formula in M1 = 0 but can allow M2 1
- but different structural formula/different displayed formula/different arrangement of atoms/different structures
Not different positions in space 1
- 2,4-dimethylhexane
M2 dependent on M1 1
- C_4H_9
Ignore the absence of dash and/or commas 1
- (d) less surface contact/less surface area/less polarisable molecule 1
- so fewer/weaker/less Van der Waals'/vdw forces
Allow more spherical or fewer points of contact
Not smaller molecule/not more compact molecule/not shorter chain
Allow converse arguments
Must be comparative answer ie not just few VDW forces

QoL

Assume 'it' refers to the branched isomer

1

[9]

- M6.** (a) (i) M1 pentan-3-one only 1
- M2 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCH}_3$
(insist on $\text{C}=\text{O}$ being drawn out)
(penalise use of C_5H_{10}) 1
- (ii) aldehyde $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$ 1
- ketone $(\text{CH}_3)_2\text{CHCOCH}_3$ 1
- (insist on a clear structure for the $\text{C}=\text{O}$ of the functional groups, but do not be too harsh on the vertical bonds between carbon atom on this occasion)
(If both structures correct, but wrong way around, award one mark)
(ignore names)
- (b) (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO} + [\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$ 1
(accept $\text{C}_4\text{H}_9\text{CHO}$ going to $\text{C}_4\text{H}_9\text{COOH}$)
(insist on a balanced equation – for example do not credit $[\text{O}]$ over the arrow alone)
- (ii) pentanoic acid 1
(credit pentan-1-oic acid)
- (c) (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ OR pentan-1-ol 1
(If both a structure and a formula are given, credit either correct one of these provided the other is a good, if imperfect, attempt)

- (ii) Primary
(credit 1° or 1)

1

[8]

- M7.** (a) (i) Prevents release of toxic CO
More energy efficient (releases more energy on combustion)

1

- (ii) $C_6H_{14} + 6.5O_2 \rightarrow 6CO + 7H_2O$

1

Suitable product eg CO or C

1

Balanced equation

1

- (iii) Detect CO gas or C (soot or particles) in exhaust gases

1

- (b) $CH_3CH_2CH_2CH(CH_3)_2$

1

2-methylpentane

1

$CH_3CH_2CH(CH_3)CH_2CH_3$ etc

1

- (c) (i) $CH_3CH_2CH_2CH=CH_2$

1

- (ii) Alumino silicate etc

1

(iii) Can be made into polymers (or alcohols etc) 1

(d) (i) % atom economy = mass CH_2Cl_2 /total mass reactants = $85 \times 100/158$ 1

= 53.8% 1

(ii) Because expensive chlorine is not incorporated into desired product Raise money by selling HCl 1

[14]

M8. (a) General formula;

Chemically similar;

Same functional group;

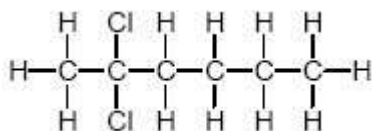
Trend in physical properties eg inc bp as M_r increases;

Contains an additional CH_2 group;

Any two points.

2 max

(b) (i)



All bonds and atoms must be shown.

1

$\text{C}_2\text{H}_4\text{Cl}_2$;

Allow any order of elements.

Do not allow EF consequential on their wrong displayed formula.

1

- (ii) Same Molecular formula/ both $C_6H_{12}O_2$ / same number and type of atoms;

1

Different structural formula/ different structure/ different displayed formula;

*Not atoms or elements with same MF
CE=0.*

Allow different C skeleton.

If same chemical formula can allow M2 only.

M2 insufficient to say atoms arranged differently.

M2 consequential on M1.

1

- (c) $M_r = 228$ for total reactants;

1

$$\frac{155 \times 100}{228} = 67.98\%;$$

Allow 67.98 or 68.0 or 68%.

1

- (d) (i) Bp increases with increasing (molecular) size/ increasing M_r / increasing no of electrons/increasing chain length;

Atoms CE = 0.

1

Increased VDW forces (between molecules) (when larger molecule)/ bigger IMFs;

QWC

Not dipole-dipole or hydrogen bonds.

If VDW between atoms in M2 CE = 0.

1

- (ii) Fractional distillation/ fractionation/ GLC/chromatography;

1

[11]

