M1.(a) (i) Green

Ignore shades of green.

1

(ii) Excess acidified potassium dichromate(VI)

1

Reflux (for some time)

1

In the diagram credit should be given for

- a vertical condenser

  Lose M3 and M4 for a distillation apparatus.

1

- an apparatus which would clearly work

  Do not allow this mark for a flask drawn on its own.

  Penalise diagrams where the apparatus is sealed.

1

(iii) Distillation

1

Immediately (the reagents are mixed)

1

(b) Keep away from naked flames

Allow heat with water-bath or heating mantle.

If a list is given ignore eye protection, otherwise lose this mark.

1

(c) (i) Tollens' or Fehling's reagents

*Incorrect reagent(s) loses **both** marks.*

Accept mis-spellings if meaning is clear.

1

Silver mirror / red ppt. formed

Accept 'blue to red' but not 'red' alone.

1

(ii) Sodium carbonate (solution) / Group II metal

Allow indicator solutions with appropriate colours.

Accept any named carbonate or hydrogen carbonate.

1

Effervescence / evolves a gas

Accept 'fizzes'.

1

(d) Propanoic acid

If this mark is lost allow one mark if there is reference to stronger intermolecular forces in the named compound.

Lose M1 and M3.

1

Contains hydrogen bonding

1

Some comparison with other compounds explaining that the intermolecular forces are stronger in propanoic acid

1

[15]

M2.D

[1]

M3. (a) (i) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$;

(penalise C_2H_6O once only in this question)

1

(ii) Concentrated H_2SO_4 OR concentrated H_3PO_4 OR Al_2O_3;

(penalise aqueous or dilute as a contradiction)

1

$C_2H_5OH \rightarrow C_2H_4 + H_2O$ OR $C_2H_5OH \rightarrow H_2C = CH_2 + H_2O$;

(penalise CH_2CH_2 and CH_2-CH_2 and CH_2: CH_2 for ethene)

1

(b) Nickel OR Ni OR platinum OR Pt OR palladium OR Pd;

1

Hydrogen OR H_2;

1

(c) (i) $C_{18}H_{34}O_2$ Only;

1

$C_9H_{17}O$ Only;

(empirical formula is not consequential on molecular formula)

1

(ii) (An unsaturated compound) contains (at least) one double bond

OR

Contains C=C;

(must be a positive statement)

1

(iii) M1: Bromine water

OR

Br_2(aq)

OR

Bromine

OR

Br_2;

(penalise "bromide water", but mark on)

1

M1: decolourised or goes colourless

OR

from brown/red/orange/yellow to colourless;

(Must be "colourless" not "clear" for M2)
(chemical error if no reagent or wrong reagent, loses both marks) (credit $KMnO_4$ for M1, (purple) to colourless for M2 (if acidified) OR (purple) to brown/brown precipitate (if alkaline or unspecified) (No credit for hydrogen or iodine as reagents)

1

[10]

M4. (a) (i)

	The addition of $AgNO_3$	followed by concentrated	the addition of $NH_3(aq)$
Observation with NaBr(aq)	Cream or off white precipitate or solid (1)	Precipitate dissolves (1)	
Observation with NaI(aq)	Yellow precipitate or solid (1)	Precipitate insoluble or no change (1)	

(ii) Ag F is soluble;

5

(b) (i) identity: $[Ag(S_2O_3)_2]^{3-}$;

1

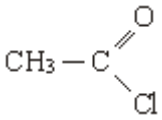
(ii) equation: $AgI + 2S_2O_3^{2-} \rightarrow [Ag(S_2O_3)_2]^{3-} + I^-$

1

(iii) use: in photography or as a fixer;

1

(c) (i) Structure

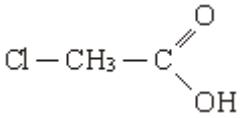


1

Observation: Vigorous or violent or exothermic reaction
or fumes or white precipitate formed immediately

1

(ii) Structure:



1

Observation: No immediate precipiate or reaction

OR

white precipitate formed very slowly;

1

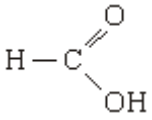
(d) (i) Silver-containing complex: $[Ag(NH_3)_2]^+$;

1

Shape: Linear;

1

(ii) Structure



1

Explanation: Methanoic acid contains an aldehyde group;

1

(iii) H_2CO_3 or CO_2 or $OC(OH)NH_2$ or $(NH_2)_2CO$ or $(NH_4)_2CO_3$

OR

$HCOONH_4$;

1

[17]

M5. (a) Functional group (isomerism)

1

(b)

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

Mark on from an incomplete/incorrect attempt at the correct reagent, penalising M1

No reagent, CE=0

Allow the following alternatives
M1 *(acidified) potassium dichromate(VI) (solution)*
M2 *(turns) green*
M3 *(stays) orange/no change*
OR
M1 *(acidified) potassium manganate(VII) (solution)*
M2 *(turns) colourless*
M3 *(stays) purple/no change*

For M3
Ignore "nothing (happens)"
Ignore "no observation"

3

(c) (Both have) C=O ***OR*** a carbonyl (group)

1

(d) (i) (Free-) radical substitution ONLY

Penalise "(free) radical mechanism"

1

(ii) **Initiation**

$Cl_2 \rightarrow 2Cl\bullet$

Penalise absence of dot once only.

First propagation

$Cl\bullet + CH_3CH_2CH_3 \rightarrow \bullet CH_2CH_2CH_3 + HCl$

OR C_3H_8

Penalise incorrect position of dot on propyl radical once only.

Penalise $C_3H_7\bullet$ once only

Second propagation

$Cl_2 + \bullet CH_2CH_2CH_3 \rightarrow CH_3CH_2CH_2Cl + Cl\bullet$

OR

C_3H_7Cl

Accept $CH_3CH_2CH_2\bullet$ with the radical dot above/below/to the side of <u>the last carbon</u>.

Termination (must make C_6H_{14})

$2 \bullet CH_2CH_2CH_3 \rightarrow C_6H_{14}$ or $CH_3CH_2CH_2CH_2CH_2CH_3$

Use of the secondary free radical might gain 3 of the four marks

4

(e) M_r = <u>44.06352</u> (for propane)

M_r = <u>43.98982</u> (for carbon dioxide)

Mark independently

M1 a correct value for <u>both</u> of these <u>M_r values</u>.

M2 a statement or idea that <u>two peaks</u> appear (in the mass spectrum)

OR

<u>two molecular ions</u> are seen (in the mass spectrum).

2

[12]