KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015

233/1 CHEMISTRY PAPER 1 MARKING SCHEME

1. (a) A 2, 8, 2 (1mk)
B 2, 8, 7 (1mk)

(b) AB_2 (1mk)

2. (a) NO_2 (1mk)
(b) CuO (1mk)

3. (a) Moles of NaOH $= \frac{25}{1000} \times 0.1$ (½mk) = 0.0025 (½mk) (1mk)

(b) $H_2X_{(aq)} + 2NaOH_{(aq)} \rightarrow Na_2X_{(aq)} + 2H_2O_{(l)}$
Mole ratio H_2X: NaOH = 1: 2 (½mk)
Moles of $H_2X = \frac{1}{2} \times 0.0025$ (½mk) = 0.00125
Concentration in moles per litre $= \frac{0.00125 \times 1000}{20}$ (½mk)
= 0.0625 (½mk) (2mks)

4. (a) $CO_{2(g)} + C_{(S)} \rightarrow 2CO_{(g)}$ (1mk)
(b) To absorb the excess/unreacted CO_2 (1mk)
(c) A blue flame would be produced (1mk)

5. (a) Dehydrating agent (1mk)
(b) Oxidising agent (1mk)

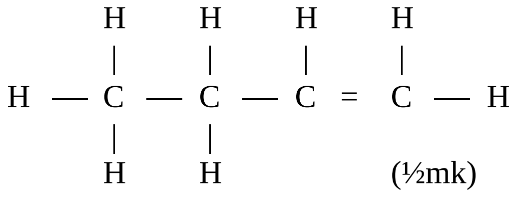
6. (a) 50 x 4.2 x (26 – 23) (½mk) = 630J (½mk)

(b) $\frac{25}{1000} \times 0.5$ mol H^+ give 630J (½mk)
0.0125 mol of H^+ give 630J
$\therefore$ 1 mole of each $\equiv \frac{1}{0.00125} \times 630$ (½mk) = 5040KJ (½mk)
$\Delta H_{sol} = -50.4KJ\ mol^{-1}$ (½mk)

7. (a) $CH_2 \rightarrow 12 + 2 = 14$
MF = $(CH_2)_n$
$n = \frac{42}{14} = 3$ (½mk)
MF = $(CH_2)_3$
$= C_3H_6$ (½mk)

(b) Alkenes (1mk)

(c)



$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{C}=\overset{H}{C}-H$

Pent -l- ene (½mk)

(½mk)

8. (a) Magnesium would react with air in the combustion tube since nitrogen gas has not yet been produced. (1mk)
(b) Nitrogen gas (1mk)
(i) $3Mg_{(S)} + N_{2(g)} \rightarrow Mg_3N_{2(S)}$ (1mk)

9. (i) Calcium chloride. (1mk)
   (ii) It is economical, (½mk) less fuel is used hence low cost of production. (½mk)
   (iii) - Sodium – potassium alloys is used as coolant in nuclear reactors. (1mk)
   - Manufacture of sodium cyanide which is used in extraction of gold.
   - Manufacture of sodium peroxide, sodium amide etc.
   - In street light to produce yellow glow.

10. (i) Equilibrium shift to the right. (1mk)
    (ii) Shift to the right. (1mk)
    (iii) Shift to the left (equivalent to increase in pressure) (1mk)

11. The rate of diffusion of a gas at constant pressure and temperature is inversely proportional to the square root of it density. (1mk)

(b) $$\frac{T_{SO_2}}{T_{O_2}} = \frac{\sqrt{M.M\ SO_2}}{\sqrt{M.M\ O_2}}$$

Time taken for 100cm³ of oxygen gas to diffuse.

$$\frac{20}{TO_2} = \frac{\sqrt{64}}{\sqrt{32}}$$ (½mk)

$$TO_2 = \frac{20\sqrt{32}}{\sqrt{64}} = \frac{20 \times 5.6568}{8}$$

$= 14.1425$ (½mk)

100cm³ of $O_2 \rightarrow$ 14.142 sec

?? $\leftarrow$ 30 sec

Volume = $\frac{100 \times 30}{14.142}$ (½mk)

= 212.134 sec (½mk)

12. $$\left(\frac{1}{4} \times 16\right) + \left(\frac{3}{4} \times 18\right)$$ (1mk) = 4 + 13.5 = 17.5 (1mk)

13. (a) B – Soapless detergent (1mk)
    (b) B (1mk); It lathers easily with hard water. (1mk)

14. (a) $Al^{3+}_{(aq)} + 3OH^{-}_{(aq)} \rightarrow Al(OH)_{3(S)}$ (1mk)
    (b) $Al(OH)_4^-$ (1mk)

15. (i) A (1mk)
    (ii) C (1mk) it is weakly alkaline hence will neutralize excess acid in the stomach. (1mk)

16. Add excess lead (II) carbonate to nitric (V) acid (½mk). Filter the excess carbonate. (½mk) Add dilute sulphuric (VI) acid to the filtrate. (½mk) Filter to obtain lead (II) sulphate as residue. (½mk) Rinse the residue with distilled water (½mk) and allow to dry. (½mk)

17. (a) $$38 \xrightarrow{t\frac{1}{2}} 192 \xrightarrow{t\frac{1}{2}} 96 \xrightarrow{t\frac{1}{2}} 48$$ (1mk)

$$3t\tfrac{1}{2} = 540\ days$$

$$t\tfrac{1}{2} = \frac{540}{3} = 180\ days$$ (1mk)

(b) Uses of radio isotopes in industries
- Quality control in metal sheets, paper
- Detection of flaws in pipes. (1mk)

18. (a) A green precipitate is formed.(1mk)
    (b) To prevent sucking back/.To increases the surface area for absorption of the gas. (1mk)

19. (a) Mass of $KClO_3$ = 14g
    Mass of water = 26g (½mk)
    14g of $KClO_3$ $\rightarrow$ 26g of water
    ? $\leftarrow$ 100g of H_2O
    $\frac{14 \times 100}{26}$ (1mk) = 53.846g/100g of H_2O (½mk)

    (b) Advantages of hard water
    - Ca^{2+} are useful for development of strong bones and teeth. (1mk)

20. (a) A green solid was formed (1mk)
    (b) (i) $2HCl_{(g)} + Fe_{(S)} \rightarrow FeCl_{2(S)} + H_{2(g)}$ (1mk)
    (ii) $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$ (1mk)

21. (a) (i) Electrolyte for facilitating flow/movement of ions from one electrode to the other. (1mk)

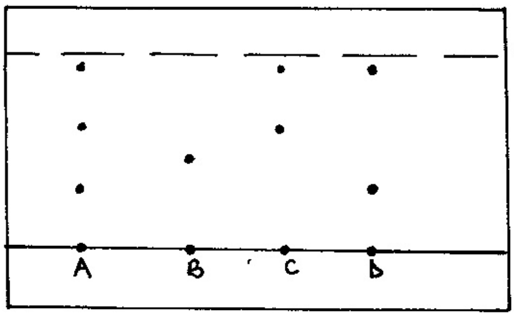
    (ii) Oxidizing hydrogen gas liberated to prevent polarization of the cell and enable contact with electrolyte for electron flow in the external circuit to be achieved. (1mk)

    (b) (0.74 + 0.76)V = 1.5V (1mk)

22. (a) $Pb^{2+}_{(S)} + SO^{2-}_{4(aq)} \rightarrow PbSO_{4(S)}$ (1mk)
    (b) Moles of Pb used $= \frac{1.26}{207}$ (½mk) = 0.006087
    Moles of Pb $(NO_3)_2$ produced = 0.006087
    R.F.M of $PbSO_4$ = 207 + 32 + 64 = 303 (½mk)
    Moles of $PbSO_4$ = 0.006087
    Moles of $PbSO_4$ = 0.006087 x 303 (½mk)
    = 1.844g (½mk)

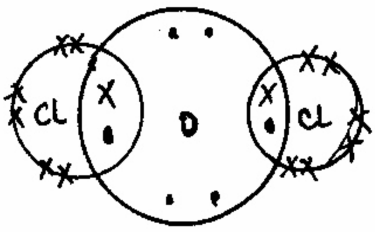
23. The middle part was not burnt because it was in the region of the unburnt gases. (1mk)
    The ends were burnt because of complete combustion of the gas at the ends which were hot. (1mk)

24. (a) C and D (1mk)
    (b) B (1mk)
    (c)



Solvent front (1mk)

25.



(1mk)

(b) Has simple molecular structure (1mk) and weak van der waal's forces between molecules (1mk) that require little heat to break.

26. $\xrightarrow[\text{decreasin g reactivity}]{J\ K\ L\ M}$ All correct (2mks) 1st and last correct only (1mk)

27. (a) To melt lead iodide for it to conduct electricity (1mk)

(b) $2I^-_{(l)} \rightarrow I_{2(g)} + 2e^-$ (1mk)

(c) Electrode A (1mk)

28.

	Na_2SO_4	H_2O
Mass	1.42	1.8 (½mk)
No of moles	$\frac{1.42}{142}$ = 0.01	$\frac{1.8}{18} = 0.1$ (1mk)
Ratio	$\frac{0.01}{0.01} = 1$	$\frac{0.1}{0.01} = 10$ (½mk)

Formular = $Na_2SO_4.10H_2O$

$\chi = 10$ (1mk)

29. (a) (i) Particles gaining kinetic energy, temperature increasing. (1mk)

(ii) Particles rearranging themselves as they change from liquid to gas and all the heat supplied used for this rearrangement and no temperature rise occurs. (1mk)

(b) Melting point of naphthalein. (1mk)

30. O.N of Cr in $Cr_2O_7^{2-} = +6$ (½mk)

O.N of Cr in $CrO_4^{2-} = +3$ (½mk)

Cr has undergone reduction form +6 to +3 (1mk)

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015

233/2 CHEMISTRY PAPER 2 MARKING SCHEME

1. (a) (i) A ½✓and G ½✓
- The ionic radius is greater than the atomic radius ✓1

(ii) The oxide of E contains strong electrostatic forces ✓1 since it is ionic while the oxide of G has weak intermolecular forces ✓1 // van der waals forces since it is molecular.

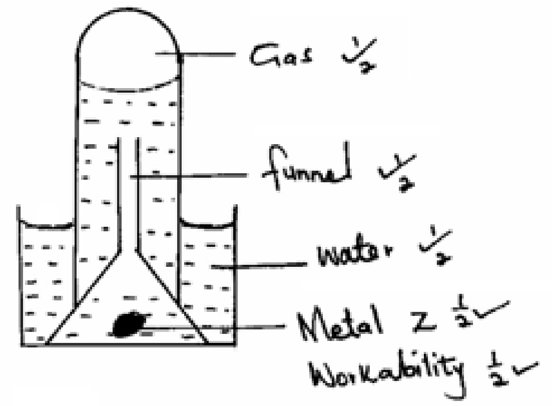
(iii) B and A. ✓1
- B is the most reactive metal while A is the most reactive non metal ✓1
// B has the largest atomic radius so loses electrons most readily while A has the smallest atomic radius so it gains electrons most readily.

(b) (i) Alkaline – earth metals ✓1

(ii) The amount of energy required to remove ✓1 an electron from an atom when in gaseous state. ✓1

(iii) 2nd ionization energy involves removal of an electron from a positively charged ion ½✓ while 1st ionization energy involves removal of an electron from a neutral atom. ½✓

(iv)



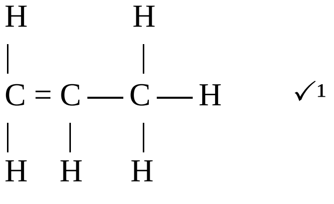
2. (a) D – Sulphur (IV) oxide // SO_2 ½✓
L – Hydrogen sulphide // H_2S ½✓
V – Hydrogen // H_2 ½✓

(b) (i) Compound B – Iron (III) chloride // $FeCl_3$ ½✓
(ii) Compound T – Iron (II) sulphide // FeS ½✓
(iii) Solid A – Iron (III) oxide // Fe_2O_3 ½✓
(iv) Solid Y – Iron (III) hydroxide // $Fe(OH)_3$ ½✓
(v) Solid X – Iron (II) hydroxide // $Fe(OH)_2$ ½✓

(c) Rusting ½✓
(d) Green ✓1
(e) Step 1 $2Fe_{(S)} + 3Cl_{2(g)} \rightarrow 2FeCl_3$ ✓1
Step 5 $FeS_{(S)} + 2HCl_{(aq)} \rightarrow 2FeCl_{2(aq)} + H_2S_{(g)}$ ✓1
(Penalise ½mk for wrong or missing state symbols)
(f) An oxidizing agent ✓1

3. (a) (i) I Q – C_3H_6 // CH_2 $CHCH_3$ ✓1
II P – C_4H_{10} // CH_3 CH2 CH_2 CH_3✓1

(ii)



$$\begin{array}{ccccc} H & & & & H \\ | & & & & | \\ C & = & C & — & C — H \\ | & & | & & | \\ H & & H & & H \end{array}$$ ✓1

(iii) Polypropene ✓^{1}

(iv) Pollutes the environment ✓^{1} (as it is non-biodegradable)

(v) Alumina // Al_2O_3 ✓^{1} or Silica // SiO_2

(b) (i)

	Carbon	Hydrogen	Oxygen
%	64.86	13.51	100 – 78.37 = 21.63 ½✓
Moles	$\frac{64.86}{12} = 5.405$	$\frac{13.51}{1} = 1351$	$\frac{21.63}{16} = 1.352$ ½✓
Moles	$\frac{5.405}{1.352} = 4$	$\frac{13.51}{1.352} = 10$	$\frac{1.352}{1.352} = 1$ ½✓

Empirical formula = $C_4H_{10}O$ ½✓

$(C_4H_{10}O)_n = 74$ ½✓

$74n = 74$

$n = 1$

Molecular formula = $C_4H_{10}O$ ½✓

(ii) Alkanols // Alcohols ✓^{1}

(iii) $2C_4H_{10}O_{(l)} + 2Na_{(S)} \rightarrow 2C_4H_9ONa_{(aq)} + H_{2(g)}$ ✓^{1}

(iv) Displacement ✓^{1}

(v) Butanoic acid ✓^{1}

4. (a) (i) Plotting – All points correctly plotted = (1mk)

9 points correctly plotted = (½mk)

$\angle 9$ = (0mk)

Axes + scale – Maximum = (1mk)

Curve – Should be smooth = (1mk)

(ii) $\frac{280-180}{40-25}$ ✓^{1} $= \frac{100}{15} = 6.67cm^3/s$

To be marked consequentially from students graph.

- Penalize ½mk for wrong or missing units.

(iii) Curve B to be on the right of curve A and levelling at 480cm^3 but later than A. ✓^{1}

(iv) $MCO_{3(S)} + 2HNO_{3(aq)} \rightarrow M(NO_3)_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$ ✓^{1}

Moles of CO_2 produced $= \frac{480}{24000}$ ½✓ = 0.02

Moles of MCO_3 = 0.02 ½✓

0.02 mol MCO_3 = 2.5g

1 mol (molar mass) $= \frac{2.5 \times 1}{0.02} = 125$ ½✓

M + 12 + 48 = 125

M = 125 – 60 = 65 ½✓

(b) The yellow colour fades ½✓ // Decolourisation of the mixture. Adding sodium hydroxide <u>lowers the concentration of H^+ ions</u>. ½✓ This makes <u>equilibrium</u> to shift to the right ½✓ i.e. forward reaction is favoured <u>lowering concentration of yellow Br_2</u> ½✓ molecules.

5. (a) (i) C // C_2 ✓1 Reject C^+
It has an E^θ of zero ✓1 // Being used as the standard electrode.
Reject – It has no e.m.f.

(ii) -290V ✓1 Reject A or A2+

(iii) E_{cell} = $E_{red} - E_{ox}$
= +0.34 - -2.38 ½✓
= +2.72V ½✓

(b) (i) B ✓1

(ii) $4OH^-_{(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)} + 4e^-$

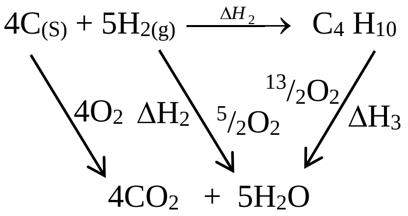
(iii) Becomes acidic ✓1 // PH lowers, reduces H^+ ions remain in solution as OH^- ions are discharged. ✓1

(iv) $Cu_{(S)} \rightarrow Cu^{2+}_{(aq)} + 2e^-$

(c) Q = It
= 0.2 x 5 x 60 x 60 ½✓
= 3600C
$Cu^{2+} + 2e^- \rightarrow Cu$ ½✓
64g → 2 x 96500C
y → 360C
y = $\dfrac{360 \times 64\ \text{½✓}}{2 \times 96500\ \text{½✓}}$ = 1.194g ½✓
The cathode increased ½✓ in mass by 1.194g.

6. (a) Energy change in converting reactants A and B to products C and D is the same regardless of ✓1 the route by which the chemical change occurs provided that the initial and final conditions are the same.

(b) (i)



Cycle – (1mk)
Direction of arrows - (½mk)
Balancing equation – (½mk)

(ii) $\Delta H_1 - \Delta H_3 = \Delta H_2$ ✓1
ΔH_1 = 4(-393) + 5(-286)
= -1572 – 1430
ΔH_2 = -3002 - -2877 = -125KJ/mol ✓1

(c) Hydration energy is the enthalpy change when gaseous ions are hydrated by water. ✓1
Lattice energy is the enthalpy change that occurs when one mole of a crystal structure is formed from its gaseous ions. ✓1

(d) (i) A – Heat of solution ½✓
B – Lattice energy ½✓
C – Hydration energy ½✓

(ii) $\Delta H_A = \Delta H_B + \Delta H_C$ ½✓
(OR any other appropriate form)

(e) Heat value of a fuel is the amount of heat energy produced when a unit mass of a fuel is completely burnt in oxygen. ✓1

(f) - Environmentally friendly.
- Easy to transport and store.
- High calorific value.
- Readily available.
- Cheap.
- Non-poisonous.
- Burns slowly. Any two @ (1mk)

7. (a) (i) Hydrogen – Natural gas – e.g. Methane ✓1
- Crude oil
- Electrolysis of acidified water or brine

(ii) Nitrogen - Fractional distillation of liquid air. ✓1

(b) (i) Compressor – Pressure of 200 – 500 atm. ✓1

(ii) Catalytic chamber – Temperature of 400 - 500°C. ✓1
- Finely divided iron.

(c) To compress the gases to high pressure which favour high yield of ammonia. ✓1

(d) $2NH_{3(g)} + H_2SO_{4(aq)} \rightarrow (NH_4)_2SO_{4(aq)}$ ✓1

(e) NH_4NO_3 ✓1

(f) $(NH_4)2SO_4 = 132$ ✓1

% of N $= \frac{28}{132} \times 100 = 21.2\%$ ✓1

(g) A pale blue precipitate on addition of a few drops ✓1 precipitate dissolves in excess of C to form a deep blue solution. ✓1

KIRINYAGA CENTRAL SUB-COUNTY

233/3 CHEMISTRY PAPER 3
(PRACTICAL) MARKING SCHEME

QUESTION 1

TABLE I (4mks)

	I	II	II
Final reading (cm³)	12.5	25.0	12.5
Initial reading (cm³)	0.0	12.5	0.0
Volume used (cm³)	12.5	12.5	12.5

Marks distributed as follows.

(a) Complete table (1mk)
3 titrations done = (1mk)
Incomplete table with 2 titrations = (½mk)
Incomplete table with one titration done = (0mk)

- Penalties
- Wrong arithmetic.
- Inverted table
- Unrealistic titre values (unless explained)

Penalize (½mk) for each to a maximum of (½mk)

(b) Decimal place (1mk)
- Accept only 1 or 2d.p used consistently, otherwise penalize fully.
- Accept inconsistency in the use of zeros as initial burette reading e.g. 0.0, 0.00 or 0.000.

NB: Decimal place tied to 1st and 2nd rows only.

(c) Accuracy (1mk)
- Compare candidates titre value with school value S.V. If one value within ± 0.1 of S.V (1mk)

No value within ± 0.1 of S.V but at least 1 value within ± 0.2 of S.V ⇒ (0mk)
No value within ± 0.2 ⇒ (0mk)

NB: If there is arithmetic error, compare S.V with correctly worked out titre value and award accordingly.

(d) Averaging (1mk)
Values averaged must be shown.
If 3 consistent titrations done and averaged = (1mk)
If 3 titrations done but only 2 are consistent and averaged = (1mk)
If only 2 titrations done, are consistent and averaged = (1mk)
Otherwise penalize fully.

CALCULATIONS

(a) $\frac{12.5+12.5+12.5}{3}$ ½✓= 12.5cm³ ½✓

(b) (i) Moles in 250cm³ $= \frac{0.5}{40}$ $0.0125\ moles$ ½✓

Moles used = $\frac{0.0125 \times 25}{250}$ ½✓ = 0.00125 moles ½✓

(ii) Moles of acid reacting = 0.00125 ½✓ (mole ratio 1:1)

12.5cm³ → 0.00125
250 → ?

$\frac{0.0125 \times 25}{250}$ ½✓= 0.025 moles ½✓

(iii) Molarity of solution A

10cm³ = 0.025 moles
1000 = ?

$\frac{1000 \times 0.025}{10}$ ½✓ = 2.5 moles ½✓

PROCEDURE II
TABLE II

Volume of Solution A (cm³)	Volume of distilled water (cm³)	Concentration of solution A (moles/l)	Time(s)	$\frac{I}{t}\left(S^{-1}\right)$
12	0	2.5	25.27	0.0363
10	2	2.08	34.25	0.0292
8	4	1.67	45.45	0.0220
6	6	1.25	69.44	0.0144
4	8	0.83	120.01	0.0083

(7 marks)

Complete table ⇒ (4mks)
Decimal places (tied to 3rd and 5th column). (1mk)
Accuracy (tied to row (i) to (iv)) (1mk)
Trend (Gradual increase in time) (1mk)

Questions

(b) (i) Read from graph (1mk)

Value of $\frac{I}{t}$ (½mk)

Correct answer (½mk)

(ii) Increase in concentration increases the rate of reaction. ✓¹

	Observation	inference
2. (a)	- Colourless liquid condenses at cooler parts of test tube ✓ - Gas evolved turns red litmus blue ✓ - A white residue remains ✓ (Any two) (1mk)	- Hydrated salt ✓ - NH_4^+ *ions* ✓ Any two correct ions award (1mk)
(b) (i)	- Solid dissolves ½✓ to form a colourless solution ½✓	Mg^{2+}, Al^{3+}, Zn^{2+} present ⇒ any one Or Cu^{2+}, Fe^{2+}, Fe^{3+} absent (½mk)
(ii)	White precipitate is formed ½✓ (½mk)	$CO_3^{2-}, SO_3^{2-}, Cl^-, CO_{34}^{2-}$ present Any two correct ions award (½mk) Penalize the (½mk) for any

		contradictory ion.
(iii)	A white precipitate forms (½mk)	SO_4^{2-} ions confirmed (½mk)
(iv)	White precipitate ½✓ dissolves in excess to form a colourless solution ½✓	Zn^{2+} ✓, Pb^{2+} ✓ or Al^{3+} ✓ Ions present Any 3 ions – (1mk) 2 ions (½mk) 0mk for any only one ion
(v)	White precipitate ½✓ Insoluble ½✓ in excess	Pb^{2+} , Al^{3+} present Both ions (1mk) One ion (½mk)
(vi)	A white precipitate ½✓ dissolves ½✓ on warming.	Pb^{2+} ions present ½✓

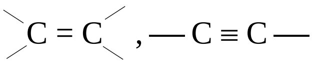
3. (a)

Observation	inference
Dissolves to form ½✓ a colouless homogenous solution ½✓	Polar substance ½✓

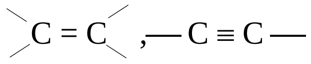
(b) (i)

Observation	inference
PH value 1 – 3 ½✓ (specify)	Strong acid present ½✓

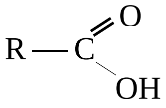
(ii)

Observation	Inference
Purple acidified Inference $KMnO_4$ decolorised ✓1	 $>C=C<$, $-C\equiv C-$ OR –OH present

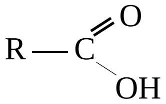
(iii)

Observation	Inference
Bromine water decolourised ✓1	 $>C=C<$, $-C\equiv C-$ Or –OH present All three (1mk) Two only (½mk)

(iv)

Observation	Inference
Effervescence ½✓	 $R-C(=O)OH$ ½✓ Present

(v)

Observation	Inference
Sweet smelling Compound formed ✓1	 $R-C(=O)OH$ ½✓ Present