

**QUESTION 2:**

You are provided with substance **D** which contains **two cations** and **two anions**.

Carry out the following tests on **D** and identify the cations and anions in it.

Identify any gases evolved. Record your results in the table below.

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Heat a spatula endful of <b>D</b> in a dry test tube.	Colourless liquid, turns anhydrous copper (II)sulphate, white to Blue.  colourless gas, turns wet blue litmus paper, lime water milky.  Residue: Black(hot) Black(cold)	$\text{H}_2\text{O}_{(l)}$ , hydrated salt  $\text{CO}_{2(g)}$ ; $\text{CO}_3^{2-}$ , $\text{HCO}_3^-$ , $\text{C}_2\text{O}_4^{2-}$ , $\text{CH}_3\text{COO}^-$  $\text{CuO}$ , $\text{NiO}$ , $\text{FeO}$ : $\text{Cu}^{2+}$ , $\text{Ni}^{2+}$ , $\text{Fe}^{2+}$
(b) To one spatula of <b>D</b> , in a test-tube, add 4 drops of concentrated sulphuric acid and heat.	Dense white fumes of a gas.  Colourless gas, turns wet blue litmus red, lime water milky.	$\text{CO}_{2(g)}$ , $\text{CO}_3^{2-}$
(c) Shake three spatula end-fulls of <b>D</b> with about $5\text{cm}^3$ of water and filter. Keep both the filtrate and residue.  Divide the filtrate into seven parts.	Partially soluble  Green Residue  Colourless filtrate	$\text{Cu}^{2+}$ , $\text{Ni}^{2+}$ , $\text{Fe}^{2+}$  $\text{Zn}^{2+}$ , $\text{Al}^{3+}$ , $\text{Pb}^{2+}$ , $\text{Ca}^{2+}$ , $\text{Ba}^{2+}$
(i) To the <b>first</b> part of the filtrate, add dilute solution of <b>lead (II)nitrate</b> solution then dilute nitric acid solution.	White ppt, soluble in acid, forms colourless solution.	$\text{PO}_4^{3-}$
(ii) To the <b>second</b> part of the filtrate, <b>Barium nitrate</b> solution then <b>dilute nitric</b> acid solution.	White ppt, soluble in acid, forms colourless solution	$\text{PO}_4^{3-}$
(iii) To the <b>third</b> part add <b>silver nitrate</b> solution, then <b>ammonia solution</b> , dropwise till in excess.	yellow ppt, soluble in excess, forms yellow solution.	$\text{PO}_4^{3-}$

<p>(iv) Use the <b>fourth</b> carry-out a test of your own choice to confirm one of the anions in the filtrate.</p> <p><u>Test:</u>  Added concentrated nitric acid solution, then few drops of ammonium molybdate solution.</p>	Bright yellow ppt	$\text{PO}_4^{3-}$
<p>(c) wash the <b>residue</b> twice, using distilled water.</p> <p>Dissolve in dilute nitric acid, add dilute sodium hydroxide dropwise till in excess and filter.</p> <p>Keep both filtrate and residue.</p>	<p>Soluble in acid, green solution.</p> <p>Green ppt, insoluble in excess alkalis.</p> <p>Green residue.</p> <p>Colourless filtrate.</p> <p>Bubbles of colourless gas, turn blue litmus red, lime water milky.</p>	<p><math>\text{Ni}^{2+}, \text{Fe}^{2+}</math></p> <p><math>\text{Ni}^{2+}, \text{Fe}^{2+}</math></p> <p><math>\text{Ni}^{2+}, \text{Fe}^{2+}</math></p> <p><math>\text{Zn}^{2+}, \text{Al}^{3+}, \text{Pb}^{2+}, \text{Ca}^{2+}, \text{Ba}^{2+}</math></p> <p><math>\text{CO}_{2(g)}, \text{CO}_3^{2-}</math> confirmed</p>
<p>(d) To filtrate, add dilute nitric acid until it's <b>just acidic</b> and divide into <b>three</b> parts.</p> <p>(i) To the <b>first</b> part add dilute sodium hydroxide dropwise until in excess.</p>	<p>white ppt, soluble in excess, forms colourless solution.</p> <p>white ppt, soluble in excess, forms colourless solution.</p>	<p><math>\text{Zn}^{2+}, \text{Al}^{3+}, \text{Pb}^{2+}</math></p> <p><math>\text{Zn}^{2+}, \text{Al}^{3+}, \text{Pb}^{2+}</math></p>
<p>(ii) To the <b>second</b> part of the acidic solution, dilute ammonia solution dropwise until in excess.</p>	white ppt, soluble in excess, colourless solution	$\text{Zn}^{2+}$
<p>(iii) Use <b>third</b> part of filtrate to confirm the anion in <b>D</b></p> <p><u>Test:</u>  Added solid ammonium chloride then disodium hydrogenphosphate solution and ammonia solution, dropwise till in excess.</p>	white ppt, soluble in alkalis, colourless solution.	$\text{Zn}^{2+}$ confirmed.

(e) wash the <b>residue</b> twice, using distilled water. Dissolve in dilute nitric acid and divide the resultant solution into <b>three</b> parts.	Dissolves in acid forms green solution.	$\text{Ni}^{2+}$ , $\text{Fe}^{2+}$
(i) To the <b>first</b> part add dilute sodium hydroxide dropwise until in excess.	Green ppt, insoluble	$\text{Ni}^{2+}$
(ii) To the <b>second</b> part of the acidic solution, dilute ammonia solution dropwise until in excess.	Green ppt, soluble, forms pale blue solution.	$\text{Ni}^{2+}$
(iii) To the <b>third</b> part of the acidic solution, dilute ammonia solution dropwise until in excess then <b>Dimethylglyoxime</b> solution.	Green ppt, soluble, forms pale blue solution.  Red ppt.	$\text{Ni}^{2+}$ confirmed.

(d) (i) The cations in **D** are:  $\text{Zn}^{2+}$  and  $\text{Ni}^{2+}$

(ii) The anions in **D** are:  $\text{PO}_4^{3-}$  and  $\text{CO}_3^{2-}$

### QUESTION 3:

You are provided with substance **L** which is an organic compound. You are required to determine the nature of **L**. carry out the following tests and identify any gases liberated. Record your observations in the table below.

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Heat a spatula endful of <b>L</b> On a porcelain dish.	<i>Burns with yellow, sooty flame.</i>	<i>Aromatic compound. Aliphatic compound with carbon content.</i>
(b) Dissolve 2cm <sup>3</sup> end-fulls of <b>L</b> in about 5cm <sup>3</sup> of distilled water and warm. Test the resultant solution with litmus paper. Divide the solution into five parts.	<i>Completely miscible, forms colourless solution.</i>  <i>No effect on litmus paper.</i>	<i>Polar aliphatic compound. Low molecular mass.</i>  <i>Neutral compound: Primary, secondary, tertiary, alcohols. Aldehydes, Ketones, Esters.</i>
(i) To the <b>first</b> part, add 3 drops of neutral <b>Iron (III) chloride</b> solution.	<i>No observable change.</i>	<i>Phenol absent.</i>
(ii) To the <b>second</b> part, add 3 drops of <b>sodium carbonate</b> solution.	<i>No observable change.</i>	<i>Carboxylic acids absent.</i>
(iii) To the <b>third</b> part, add 4 drops of Brady's reagent solution.	<i>No observable change.</i>	<i>Aldehydes, Ketones absent.</i>
(iv) To about 1cm <sup>3</sup> of the <b>fourth</b> part of <b>L</b> , add about an equal volume of <b>ethanoic acid</b> followed by 5 drops of <b>concentrated sulphuric acid</b> . Heat the mixture then pour into a beaker of <b>sodium carbonate</b> solution.	<i>Sweet fruity smell.</i>	<i>Ester formed. Primary, secondary, tertiary, alcohols.</i>
(c) To about 1 cm <sup>3</sup> of <b>L</b> , add about 3cm <sup>3</sup> of concentrated sulphuric acid. Heat the mixture to about boil and pass the gas produced through acidified potassium permanganate (VII) solution.	<i>White fumes of a gas, turn the alkaline potassium permanganate from purple to colourless.</i>	<i>Dehydration occurred. Alkene gas formed. Primary, secondary, tertiary, alcohols dehydrated to alkene.</i>

(d) To 1cm <sup>3</sup> another fresh sample of L, add 1cm <sup>3</sup> of acidified potassium dichromate solution and warm.	No observable change. (Solution remains orange)	No oxidation occurred. Reducing agents absent. Primary, secondary alcohols absent.
(e) to another fresh sample of L, add Luca's reagent.	Immediate cloudiness	Tertiary alcohols present.

(e) state the nature of L:

Aliphatic tertiary alcohol