1. a) i) Alkaline earth metals✓   (1 mark)
   ii) A✓   (1 mark)
   iii) Covalent✓ , because the form bonds by sharing of electrons✓   (2 marks)
   iv) D_2O_3 **OR** Al_2O_3 (1 mark)

   v)

   b) i) H✓, because their boiling points are quite close✓   (1 mark)
   ii) K✓   (1 mark)
   iii) I - L✓, because its boiling point is lower than room temperature and is slightly soluble in water✓   (2 marks)
       II - J✓   (1 mark)

2. a) i) I - Distilled water/H_2O✓   (1 mark)
       II – Titanium/Platinum✓   (1 mark)
   ii) Chlorine/$Cl_{2(g)}$ ✓   (1 mark)
   iii) I - Paper Industry/Rayon manufacture/Dyes manufacture
        - Glass industry
        - Manufacture of soap
        - Manufacture of Al
        - Manufacture of bleaching agents
        - Manufacture of drugs
       II - To reduce running costs/make process economical
   - To avoid pollution✓

   b) i) I : $2Na^+_{(aq)} + 2e^- \rightarrow 2Na_{(l)}$ // $Na^+_{(aq)} + e^- \rightarrow Na_{(l)}$ **OR**
       $Na^+_{(aq)} + e^- + Hg_{(s)} \rightarrow NaHg_{(l)}$ ✓   (1 mark)

       II : $2NaHg_{(l)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + 2Hg_{(l)} + H2_{(g)}$ ✓ **OR**
       $2Na/Hg_{(l)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + Hg_{(l)} + H_{2(g)}$ ✓   (1 mark)
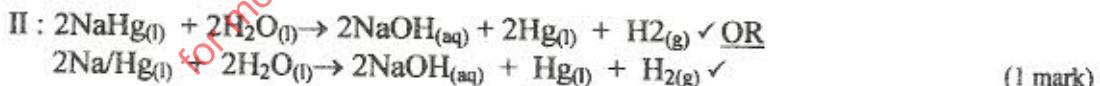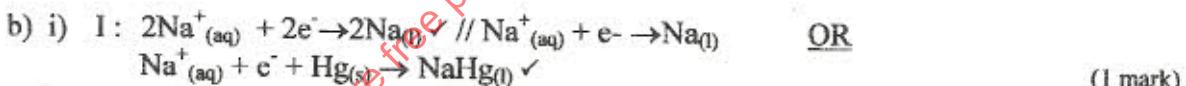
   ii) $Q = It = 100 \times 5 \times 60 \times 60 = 1800000$ 1 Faraday form 1mole of Na
     1 Mole of Na/Hg $\Rightarrow$ 1 mole of NaOH   NaOH = 23 + 16 +1 = 40

     $96500C \Rightarrow 40g$ of NaOH $180000 \Rightarrow \dfrac{40 \times 1800000}{96500} = 746g$

3. a) i) Galena✓ *(reject PbS on its own)*   (1 mark)
   ii) Some of the sulphide is converted with oxide (PbO or SO_2)   (1 mark)
   iii) Carbon monoxide (CO) ✓ **OR**   Carbon dioxide (CO_2) ✓   (1 mark)
   iv) $PbO_{(s)} + C_{(s)} \rightarrow Pb_{(s)} + CO_{(g)}$ ✓   (1 mark)
   v) To reduce unreacted PbS to Pb✓   (1 mark)
   vi) SO_2 is poisonous✓ // SO_2 causes acid rain✓ **OR** CO is poisonous✓ **OR** lead is poisonous✓
                              (any two 1 mark)

b) Hard water contains Mg^{+2}/Ca^{+2}✓, these ions from a protective layer of $CaCO_3$✓/$CaSO_4$/
$MgCO_3$ on lead. Soft water does not form these deposits✓   (3 marks)

c) Radioactive shielding✓   (1 mark)
Lead and accumulators/batteries
Making roofs
Making alloys e.g. soldering wire
Making of anti-knock additives
Manufacture of paints/bullets/fall bearings

4   a)   i)   (4 marks)

ii) $NaCl_{(s)} + H_2SO_{4(l)} \rightarrow NaHSO_{4(s)} + HCl_{(g)}$ ✓   (1mark)
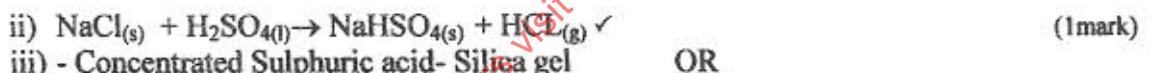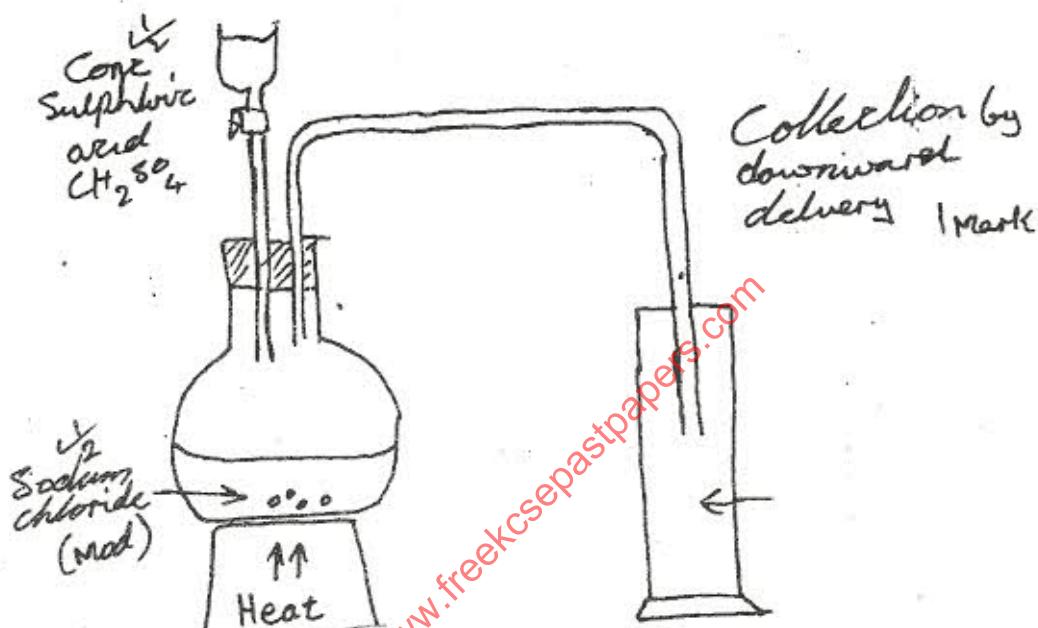
iii) - Concentrated Sulphuric acid- Silica gel   OR
    - Anhydrous $CaCl_2$ (1 mark)

iv) A white precipitate✓ is produced $HCl_{(g)}$ in water ionizes to form H^+ ions and Cl^- ions. The Cl^- ions✓ combines with Pb^{+2} to form lead (a) chloride✓. $PbCl_{2(s)}$ OR
     $HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$ ✓
     $Pb^{+2} + 2Cl^-_{(aq)} \rightarrow PbCl_2$ ✓ (white ppt)✓   (3 marks)
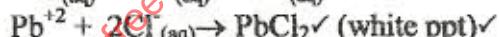
v)   HCl is not an oxidizing agent$^{(½✓)}$, it only reacts and removes the oxides hence cleaning the surface $^{(½✓)}$, HNO3 is a strong oxidizing $^{(½✓)}$ agent, it reoxidises the cleaned surface$^{(½✓)}$ (2 marks)
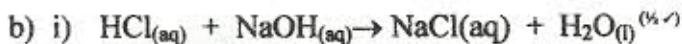
b)   i) $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl(aq) + H_2O_{(l)}$ $^{(½✓)}$
    Moles of NaOH = Moles of HCl
$$= \frac{46 \times 11}{1000} ✓ \qquad = 0.506 moles^{(½✓)}$$ (2 marks)

ii) Moles of HCl in $250cm^3 = 0.506 \times 10 = 506 moles^{(½✓)}$
    R.M.M of HCl $=1 + 35.5 = 36.5^{(½✓)}$
    Mass of HCl $= 5.06 \times 36.5^{(½✓)}$
           $= 184.69g^{(½✓)}$
           Q =14   (2 marks)

5   a)   i)   Pent-2-ene✓
     ii)   Butanoic acid✓   (2 marks)

b) i) Substitution✓ (1 mark)

ii) Addition✓ (1 mark)

c) i) $2C_4H_{10(g)} + 13O_{2(g)} \rightarrow 8CO_{2(g)} + 10H_2O_{(l)}$ ✓ (1 mark)

ii) Carbon dioxide (CO_2) is produced✓. This then dissolves in water, forming an acidic solution✓ (2 marks)

d) i) Process where monomers (small molecules) join together to form large molecules (polymers) ✓ (1 mark)

ii)

OR —CF_2—CF_2 — (1 mark)
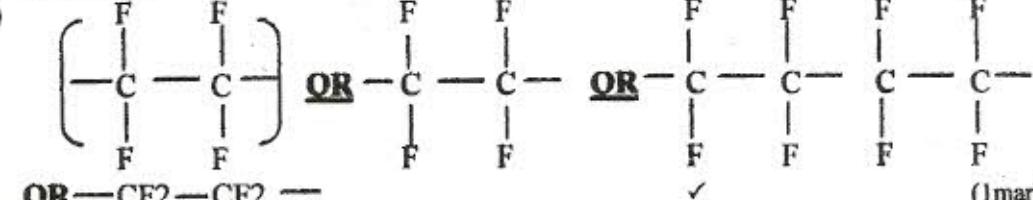
e) Cheaper, more durable/stronger, can be recycled, easily available, easily moulded/made into many shapes, lighter, can be made on demand✓ (any two 2 marks)

6. a) i) M – Graphite✓

N – Diamond✓ (2 marks)

ii) • Glass cutters/cutting glass
• Jewerelly
• Padlocks
• Tips of drills (or drilling) ✓ (1 mark)

iii) M/Graphite✓; The fourth electron of each carbon is unbonded/free/delocalised✓ (2 marks)

b) i) $C_{(s)} + CO_{2(g)} \rightarrow 2CO_{(g)}$ ✓ (1 mark)

ii) Potassium hydroxide (KOH) ✓ OR calcium hydroxide $Ca(OH)_2$ (1 mark)

iii) Pass the gases through limewater $(Ca(OH)_2)_{(aq)}$ ✓, CO_2 form a white precipitate. But CO does not give (½) a change OR CO burns (½) with a flame CO_2 does not burn. (2 marks)

iv) • Fuel in water gas and produce gas/Synthetic petrol✓ - Extraction of metals
• Manufacture of methanol (1 mark)

7. a) i) • Add drop of the liquid to anhydrous✓/white Copper (II) Sulphate ($CUSO_4$) and it will turn blue OR
• Use cobalt chlorine paper✓; which turns from blue✓ to pink.
• Use anhydrous cobalt chloride which turns from blue to pink✓ (2 marks)

ii) - Find the boiling point, water has a B.P of 100^0C at 1 atmospheric pressure✓
- Find the freezing point, water has a freezing point of 0^0C at 1 atmospheric pressure✓
- Find the density; water has a density of $1g/cm^2$ at 4^0C✓ (1 mark)

b) i) Sand/leaves/gravel/grit/stones
ii) Sedimentation ref. Precipitation
iii) I - Causes the small suspended particles to settle/precipitate
II – Kill microorganisms/microbes/germs

c) i) Permanent
ii) - Addition of $Na_2CO_{3(aq)}$ which precipitate Mg^{2+} as $MgCO_3$
- Use of distillation; residue of $MgSO_4$ is left behind
- Use of ion exchange resins which will remove Mg^{+2}

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