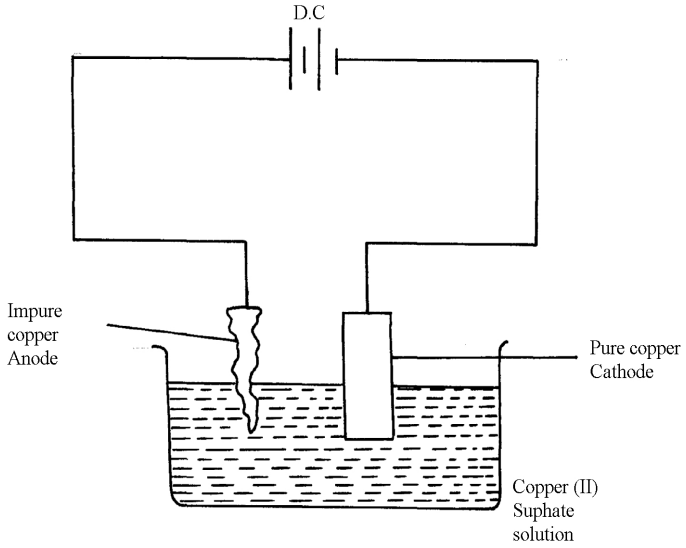
Metals

1. *a) chlorine gas would react with steel anode*
   b) Hood and steel gauze prevent chlorine sodium, from anode and cathode from mixing and reacting. Na Na
   - *Sodium metal is less dense, floats on motten brine where it is siphoned out.*
   c) -To Whom It May Concern: melt the ore, rock salt
   - For electrolysis of the molten ore
2. *a) $SO_{2(g)}$ is produced as a by- product, this mixes with rain water producing acid rain which may corrode buildings and affect plants √ ½*
   $SO_{2(g)}$ is poisonous when inhaled √ ½
   b) - H_2SO_4 manufacture – to make use of $SO_{2(g)}$
   - Manufacture of dry cells – make use of zinc
   - Production of iron sheets which are galvanized using zinc (Any one with an explanation)
   c) Low density, does not corrode easily, duchle, malleable (Any 2 each ½ mark)
3. *Aluminium is lighter/low density. (any)* ✓1
   It is a good conductor of electricity
4. *Stage 1 – oxidation; Coke is oxidized to CO* ✓ ½
   Stage 2 – Reduction: zinc is reduced to Zinc metal ✓ ½
   Stage 3;- Recycling stage; CO_2 is reduced to regenerate CO ✓ ½
5. *a) Q is sulphur (IV) oxide $SO_2(g)$.* √1
   b)



   - Impure copper is the while pure copper is cathode. During electrolysis impure copper is purified and pure copper deposited on the cathode as shown in the half electrode reaction below;

   CATHODE EQUATION:

   $Cu^{2+} + 2e \rightarrow Cu(s)$ √½

   - *The cathode is therefore removed and replaced after an interval.*

6. *(i) I-I-I-tetrachloromethane /Tetrachloromethane*
   (ii) Chloric (I) acid √1
7. *Oxide of W has simple molecular structure while that of Z has giant ionic structure*
8. *(a) Froth floatation.* √1 *(1 mk)*
   (b) $PbCO_{3(s)} \rightarrow PbO_{(s)} + CO_{2(g)}$ *(1 mk)*
   (c) Making of pipes/lead acid accumulators. √1 *(any one)* *3*

9. a) bauxite✓
b) Copper pyrites ✓

10. i)
ii) I It's uneconomic// Expensive// a lot of energy is required to produce this high temperature
II Addition of cryolite √½ mark

iii) The melting point is below 800 C √½ mark

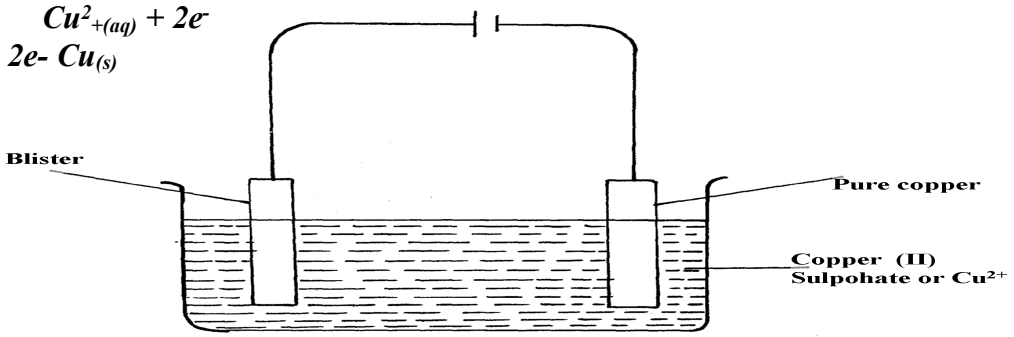
11. (a) (i) Bauxite
(ii) Iron (III) Oxide 1
Silica (any one)
(b)(i) On the diagram
(ii) It is expensive /a lot of energy will be used ✓ 1
(iii) The ore is dissolved in cryolite ($NaAlF_6$)✓ 1

12. (i) Bauxite – $Al_2O_3.H_2O$
(ii) Iron II oxide
- Silica
(iii) Being ionic, it is only an electrolyte in its molten state. Heating helps to melt it.
(iv) (a) – The two rods represent the anode.
- Cathode is the inner lining of the wall.
(b) As an impurity, lowering the melting point of aluminium oxide.
(c) Anode $2O_2\text{-}(l)\ O_{2(g)} + 4e^-$
Cathode $Al^{3+} + 3e^-\ Al_{(l)}$
d) – manufacture of household utensils
- making cables for electricity transmission
- making foils used as wrappers
- extraction of some metals e.g. manganese
- Making aeroplane parts

Describe how you would establish the presence of copper in the ore

13. (a) $CuFes_2$
(b) Froth floatation
(c) $2CuFeS_{(s)} + 4O_{2\ (g)} + Cu_2S + 2FeO_{(s)} + 3SO_{2\ (g)}$
(d) Silica is added which reacts with iron (II) Oxide to form iron (II) silicate which forms part of slag or SiO_2 is added

(e) Anode $Cu_{(s)}$ $Cu^2{}_{+(aq)} + 2e^-$
Cathode $Cu^{2+}{}_{(aq)} + 2e\text{-}\ Cu_{(s)}$



(g) – Add HNO_3 to the ore
- Filter and place small portion of the filtrate into a test tube
Add NH_4OH until in excess – deep blue solution confirms the presence of Cu^{2+}ions

14. (a) (i) Gas Q- Carbon (II) Oxide

(ii) Liquid R- dilute sulphuric acid
(iii) Residue S – excess Zinc metal

(b) Zinc blende

(c) (i) To increase percentage of Zinc in the ore
(ii) The ore is crushed, mixed with water and oil and then air is blown into the mixture.

(d) (i) $2ZnS_{(s)} + 3O_{2(g)} \quad ZnO_{(s)} + 2SO_{2(g)}$
(ii) $Zn_{(s)} + H_2SO_{4(aq)} \quad ZnSO_{4(aq)} + H_{2(g)}$

(e) (i) - Lead (II) sulphate //Pbs
- Silica //silicon (IV) oxide// SiO2
(ii) Lead (II) sulphide
$2PbS_{(s)} + 3O_{2(g)}\ 2PbO_{(s)} + 2SO_{2(g)}$

(f) (i) $\frac{45}{100} \times 250000$
$= 112{,}500g$ *of ZnS*

(ii) Rmm of ZnS = (65.4 + 32) – 97.4g
From the equation
The mole ration of Zn of ZnS: $SO_2 = 1:1$
$97.4g$ *of ZnS =* $24dm^3$ *of* SO_2 *at r.t.p*
$112{,}500g$ *of ZnS =* $\frac{112{,}500}{97.4} \times 24$
$= 27{,}720.\ 73920dm^3$ *of* SO_2

15. *a) i) Zinc Blende (Penalize for formula only)*
ii) Lead II Sulphide

b) It is concentrated by froth floatation where the ore is crushed or ground, a detergent added and the mixture agitated. Zinc sulphide floats and is collected

c) $2ZnS_{(g)} + 3\ O_{2(g)} \_\_\_\_\_ 2\ ZnO_{(g)} + 2SO_{2(g)}$

d) Zinc oxide is reduced by both carbon and carbon (ii) Oxide to zinc vapour. Lead (ii) Oxide is also reduced by both carbon and carbon (ii) Oxide to lead liquid

Accept equations

$ZnO_{(g)} + C_{(s)} \_\_\_\_\_ Zn_{(g)} + CO_{(g)}$

$ZnO_{(g)} + CO_{(g)} \_\_\_\_\_ Zn_{(g)} + CO_{2(g)}$

$PbO_{(g)} + C_{(s)} \_\_\_\_\_ Pb_{(L)} + CO_{(g)}$

$PbO_{(s)} + CO \_\_\_\_\_ Pb_{(L)} + CO_{2(g)}$

e) W = Sulphur (vi) Oxide // $SO_{3(g)}$
M= Conc. Sulphuric (Vi) acid // $H_2SO_{4(L)}$

f) $H_2S_2O_{7(L)} + H2_{O(L)} \_\_\_\_\_ 2H_2SO_{4(L)}$

g) The process is highly exothermic and heat produced boils the acid leading to acid mist which cannot be condensed easily because it is highly unstable

h) The sulphur (iv) Oxide dissolves in water to form acid rain which corrodes buildings and affects aquatic life

16. (a) Purification and concentration.

(b) (i) Bauxite

(ii) Iron (III) Oxide /Silicon (IV) Oxide

(c) On diagram

(d) Lowers the melting point of the ore from $2015^0c - 900^0c$.

17.) Q = It = 3 x 10 x 60 = 1800

3F = 3x 96500c = 27g

$$\therefore 1800c = \frac{1800 \times 27}{3 \times 96500}$$

$$= \underline{0.16788g}$$

18. a) Zinc blende

b) i)

I- carbon IV oxide

II – Dil sulphuric acid

III – unreacted zinc

ii) To reduce zinc oxide to zinc metal

iii) Silica

iv)

I $2ZnS + 30 \_\_\_\_\_ 2ZnO(s) + 250\ 2(g)$

II $2ZnO(q) + C(g) \_\_\_\_\_ 2Zn(q) + CO2(g)$

v) $Zn(g) + H2SO4(aq) \_\_\_\_\_ ZnSO4(aq) + H2(g)$

vi) 45/100 x 250 = 112.5x1000 = 112500g

= 112.5 Kg

vii) – Used to make brass

- Used to make electrodes in dry cells

- Galvanize iron sheets

19. a) i) - Effervescence, a colorless gas is produced

- Grey solid dissolves, a colorless solution is formed

ii) Nitric acid is a strong oxidizing agent. It will oxidize the hydrogen gas formed to form water instead

iii) I $Zn_{(g)} + 2HCl_{(aq)} \_\_\_\_\_ ZnCl_{2(aq)} + H_{2(g)}$

II Moles of Zn $= \frac{0.5g}{65.0} = 0.007692$

Moles of HCL = 0.007692 X 2 = 0.015384

3 moles of HCl has 1000 cm^3

0.015384 moles has $\underline{0.015384 \text{ X } 1000cm^3}$

$= 5.182cm^3$

20. (a) P – Chlorine (½)
Q – Sodium (½)

(b) Prevent reaction between sodium and chlorine

(c) $Na^+_{(l)} + e^-$ $Na_{(l)}$

21. (a)

(b) $Pb^{2+(l)} + 2e^-$ $Pb_{(s)}$ B.E ✓ ½ S.S ✓ ½

(c)

✓1

22. a) zinc blende✓½
Calcium ✓½

b) $2ZnS_{(s)} + SO_{2(g)}$ $2\ ZnO_{(s)} + 2\ SO_2\ (g)$✓1 (penalize ½ if states are missing)

$ZnCO_3\ (s)$ $ZnO_{(s)} + CO_{2(g)}$✓1 (penalize ½ if states are missing)

23. a) Iron III hydroxide

b) Concentrated sodium hydroxide is added at 4 atm pressure to the Bauxite at 160C
AL_20_3 dissolves in the sodium hydroxide leaving the iron III oxide as a solid

24. a) i) The oxygen produced at the anode reacts with hot carbon to form carbon (iv) oxide hence corrodes it therefore needs replacement

ii) Graphite is inert and a poor conductor of heat hence helps to conserve heat

b) Aluminum has more number of valency electrons which are delocalized