1.
   a. – The chromatogram must have different solubility rate. (1 mk)
      - The dyes must have different adsorption on the filter paper. (1 mk)
   b. – It is the furthest distance reached by the solvent on the adsorbent material (or filter paper). (1 mk)
      - It is indicated as H on the diagram. (1 mk)
   c. Red, blue and green. (1 mk) (if only two are correct)
   d. B (1/2 mk) – It remains on the baseline (1/2 mk)
   e. Dye A and C (1/2 mk). They have only one chromatogram. (1/2 mk)
   f. – Detecting and identifying poisonous substances present in food substances. (1 mk)
      - Separation of dyes into pure colours. (1 mk)
   -

2. Period 3
   (b) Y^{3-}
   (c)   Ionic radius is large because incoming electrons repelled by energy levels.

3. a) Existence of a substance in two or more forms without a change of state *(1 mk)*
   b) (i)   Graphite*(1/2 mk)*
      (ii)   Conducts electricity, *(1 mk)* contains delocalised electrons. *(1/2 mk)* OR soft and
             slippery (1 mk) Hexagonal layer are held together by weak van der waals
             forces*(1/2 mk)(total 3 marks)*

4. Zinc oxide
   (ii) $Zn^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Zn(OH)_{2(s)}$

   (iii) $\left[Zn(NH_3)_4\right]^{2+}$
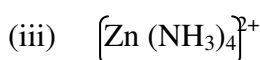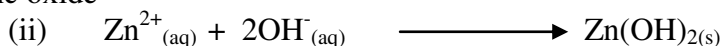
5. (a) Apart from their location, state any two differences between a proton and an electron.
                                                                                    (2 marks)

   A proton is positively charged whereas an electron is negatively charged.
   The mass of a proton is/atomic mass units whereas that of an electron is $\frac{1}{1840}$ a.m.u

   (b) Protons and neutrons are found in the nucleus of an atom. State two important roles played
       by of neutrons in the nucleus of an atom.   (2 mks)
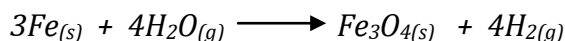   *- Prevent repulsion between the positively charged protons.*
       - Provide weight hence stability of the atom

6. Give equations to show the reactions that take place when;
   (a)   iron reacts with steam.   **(1 mark)**

          $3Fe_{(s)} + 4H_2O_{(g)} \longrightarrow Fe_3O_{4(s)} + 4H_{2(g)}$

   (b) Name and give one industrial use of the gas produced in the reactions in (i) above. **(1mk)**
       Hydrogen.
          Uses: (Any one)
          • *Industrial manufacture of hydrochloric acid*
          • *Industrial manufacture of Ammonia*
          • *Used in weather balloons*

7. $\dfrac{TQ}{TO_2} = \sqrt{\dfrac{MQ}{MO_2}}$ TQ = 12.6sec
                                       TO_2 = 22.4sec
                                       MO_2 = 2 x 16 = 32
                                       $\dfrac{12.6}{22.4} = \sqrt{\dfrac{MQ}{32}}$
                                       $M_2 = \left(\dfrac{12.6}{22.4}\right)^2 \times 32$

$$MQ = \frac{0.3164063 \times 32}{10.125002}$$

$$= 10.13$$

8.

Elements	C	H	O
% mass	26.7	2.2	71.1
No. of moles	$^{26.7}/_{12} = 2.225$	$^{22.2}/_1 = 2.1$	$^{71.1}/_{16} = 4.44375$
Ratio of moles	$^{2.225}/_{2.2} = 1$	$^{2.2}/_{2.2} = 1$	$^{4.44375}/_{2.2} = 2$
No. of atoms	1	1	2

Empirical formula CHO_2

Molecular formula $= (CHO_2) n = 90$
$$= (12+1+32) n = 90$$
$$= \frac{(45) n}{45} = \frac{90}{45}$$
$$= n=2$$
$$= C_2H_2O_4$$

9. (a) 69 -31 = 38

   (b) R.A.M of R $= \frac{(61.3 \times 69) + (38.7 \times 71)}{100}$
   $$= 69.774$$

10. (i) The volume of the solution increased. Concentrated sulphuric acid is hygroscopic absorbs water from the atmosphere.
    ii) it is hygroscopic

11. (i) Dative covalent bond
    (ii) Covalent bond

12. – When magnesium burns in air it forms magnesium nitride; when magnesium nitride is dissolved in water it produces ammonia gas which turns the moist red litmus paper blue;
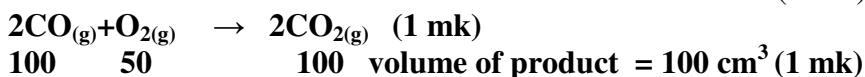
13. – Lead; Pb;
    - Cuprum;
    - Kalium;
    - Sternum

14. (a)State Gay Lussac's law.   (1mk)
When gases combine they do so in volumes that bears simple ratio to one another and to the product if it is gaseous.

b) What volume of oxygen will be required for complete combustion of 100cm^3 of carbon (II) oxide. What is the volume of the product formed (All volumes at same temperature and pressure)
                                                                 (2mks)
$2CO_{(g)}+O_{2(g)} \rightarrow 2CO_{2(g)}$ (1 mk)
100   50   100   volume of product = 100 cm^3 (1 mk)

15. Moles of acid $=\dfrac{25 \times 0.1}{1000}$ $= \quad 0.0025.$

Moles of Na_2CO_3 $= \quad 0.0025$ mol since mole ratio $= \quad 1:1$
Moles of Na_2CO_3 in $1000cm^3$ $= \quad \dfrac{1.06 \times 1000}{250} \quad = \quad 4.24g$

Molarity $= \dfrac{4.24}{106} \quad = \quad 0.04$

$\dfrac{Ma \times va}{Mb \times Vb} \quad = \quad \dfrac{mol\ of\ a}{mol\ of\ b}$

$Vb \quad = \quad \dfrac{0.1 \times 25}{0.04}$

$62.5cm^3$

18. i) the volume of a given mass of gas is directly proportional to its absolute temperature at constant pressure.

ii)
$\dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$

$V_2 = \dfrac{1 \times 308}{278} \quad = \quad$ **$1.108dm^3$**

The balloon will burst; at 35^oC since volume is more than 1 $dm^{3.;}$

19. (i) Yellow;   (ii) White;
   (iii) Red-brown;   (iv) Yellow;
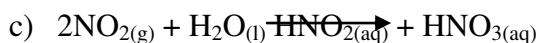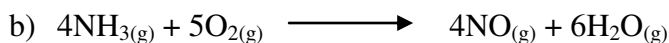
20.
    i)   Z or X
    ii)   Y
    iii)   X

21.
   a) To allow air to pass through;
   b) To regulate the amount of water entering through the air hole;
   c) To support the Bunsen burner;

22.
   a) Oxygen;

   b) $4NH_{3(g)} + 5O_{2(g)} \longrightarrow 4NO_{(g)} + 6H_2O_{(g)}$

   c) $2NO_{2(g)} + H_2O_{(l)} \longrightarrow HNO_{2(aq)} + HNO_{3(aq)}$

23.
   a) Oxygen

   b) $2HOCl_{(l)} \xrightarrow{\text{Sunlight}} 2HCl_{(aq)} + O_{2(g)}$
   c) Chloric (I) acid and hydrochloric acid

   d) hydrochloric acid

24.
   a) Ionization energy is the minimum amount of energy required to remove an electron from the last energy level of an isolated neutral atom form a positively charged ion in gaseous state.

b) The ionization energy decreases from K to T; this is because of the addition of an extra energy level from K to T which decreases the nuclear attraction hence easy to remove an electron from the outermost energy level;

c) Group I; they all have one electron in their outermost energy level;

d) Both K and T have giant metallic structures. K has smaller atomic/ionic size with strong metallic bonds that require higher amount of energy to break hence high melting and boiling point compared to T.

25.

Pass both gases through lime water; carbon (IV) oxide forms a white precipitate while carbon (II) oxide does not;

26. The following diagram shows the effect of electric current on lead (II) Chloride.
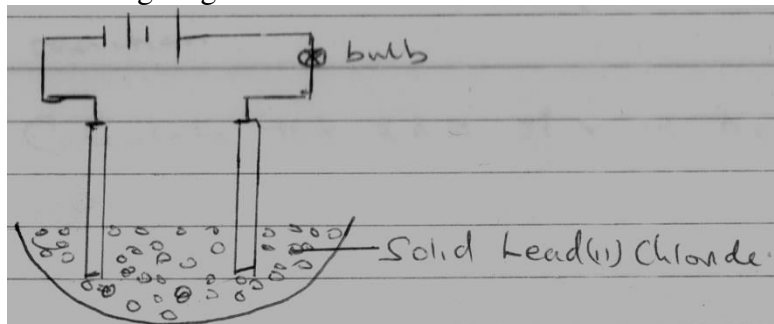
a) When the circuit was completed no current flowed. Explain why.   (1mk)
   Solid lead (ii) chloride does not conduct electricity for there are no mobile ions

b) When lead (II) Chloride was heated to about 300^0C, it melted and there was light on the bulb. State and explain the observation made.   (2mks)
   Bubbles (1 mk) of yellow green –chloride ions(1 mk) migrate to the anode and are discharged to form chlorine gas.

c) On the diagram, indicate the anode and the cathode.   (1mk)
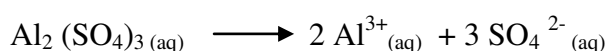
27. The set-up below shows the products formed when solid lead (ii) nitrate is heated.
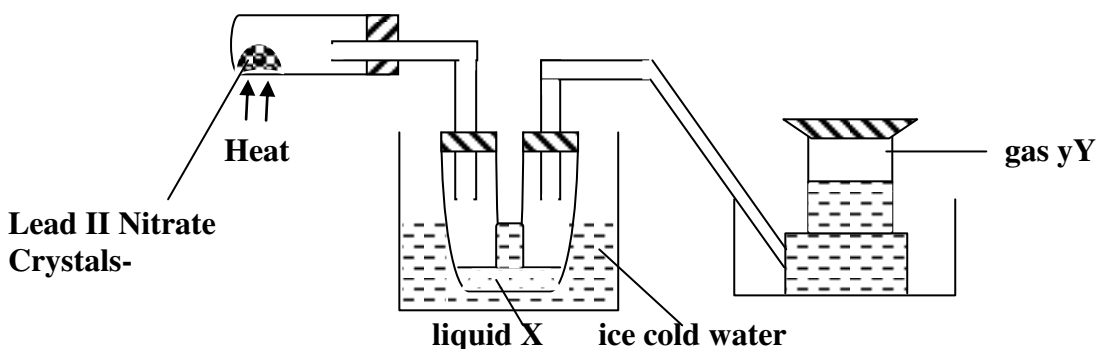
a)   Identify:
      (i)   Liquid **X** - Dinitrogen tetra – oxide   (1 mark)

      (ii)   Gas Y - Oxygen …   (1 mark)

b)   When lead (ii) Nitrate crystals are heated, they decrepitate and decompose, what is meant by the term decrepitating?   (1 mark)

      Production of cracking noise when heated

28. **Calculate the number of Al^{3+} ions released when 30cm^3 of 0.1M of Aluminium Sulphate is dissolved in water. (L = 6.024 x 10^{23}).**   **(3mks)**

$Al_2 (SO_4)_{3 (aq)} \longrightarrow 2 Al^{3+}_{(aq)} + 3 SO_4^{2-}_{(aq)}$

Moles of $Al_2(SO_4)_3$	From mole ratio
	Moles of Al^{3+} - 0.003 x 2
0.1 moles $\longrightarrow$ 1000 cm^3	= 0.006 moles ✓ ½
? = 30 cm^3	No. of ions = 0.006 x 6.024 x 10^{23}
$\dfrac{0.1 \ x \ 30}{1000}$ = 0.003 $moles$	= 3.6144 x 10^{21} ✓ions