Chemistry Form 4 Paper 1 Marking Scheme

1. A given element E has atomic number 14 and consist of isotopes as shown below:

Isotope	X	Y	Z
Isotopic mass	28	29	30
Percentage abundance	92.2	4.7	3.1

   a) What are isotopes? (1mk)
      - ***Isotopes are atoms with same atomic numbers (number of protons) but different mass numbers (or number of neutrans)***

   b) Determine the relative atomic mass of E. (2mks)

$$= \frac{(92.2 \times 28) + (4.7 \times 29) + (3.2 \times 30}{100}$$

$$= \frac{2581.6 + 136.3 + 93.0}{100}$$

$$= \frac{2810.9}{100}$$

$$= 28.109$$

2. Passing a small quantity of carbon (iv) oxide through limewater, forms a white precipitate which dissolves when excess carbon (IV) oxide is bubbled through.

   a) Name the white precipitate. (½ mk)
      - ***Calcium carbonate/$COCO_3$***

   b) Explain using a chemical equation why the white precipitate dissolves in excess carbon (IV) oxide. (1 ½ mks)
      - ***The white precipitate dissolves due to formation of calcium hydrogen carbonate.***
      - $CaCO_3(s) + CO_2(g) + H_2O(i) \quad Ca(HCO_3)_2(aq)$

   c) What will happen when solution in (b) above is boiled? (1mk)
      - ***Write precipitate reappears.***

      $Ca(HCO_3)_2 \longrightarrow CaCO_3(s) + CO_2(g) + CO_2(s) + H_2O(l)$

3. Study the set up below and answer the questions that follow.

   a) State and explain the observation made in the tube. (2mks)
      - ***A white solid/ ring was formed inside the combustion tube closer to the cotton wool in concentrated hydrochloric acid, ammonia is lighter and diffuse faster.***

   b) Indicate with a cross (x) on the diagram the likely position where the observation state in (a) above would be made. (1mk)

   c) Explain the observation made above in relation to Graham's law. (1mk)
      - ***Gases with low densities diffuses faster than those with high densities.***

4. In an experiment a small amount of charcoal was added into a test tube and $5cm^3$ of concentrated nitric (V) acid added, then warmed.

   a) State the observation that was made. (1mk)
      - ***Brown fumes of nitrogen (IV) Oxide***

   b) Explain the observation made in (a) above. (1mk)
      - ***Nitric (V) acid is a strong oxidising agent and thus oxides carbon to carbon to carbon (IV) oxide and itself reduced to nitrogen (IV) oxide.***

   c) Write an equation for the reaction that took place. (1mk)
      - $C(s) + 4HNO_3(l) \longrightarrow 4NO_2(g) + CO_2(g) + 2H_2O(l)$

5. Compare the electrical conductivity of dilute ethanoic acid and dilute sulphuric (VI) acid, explain your answer. (2mks)

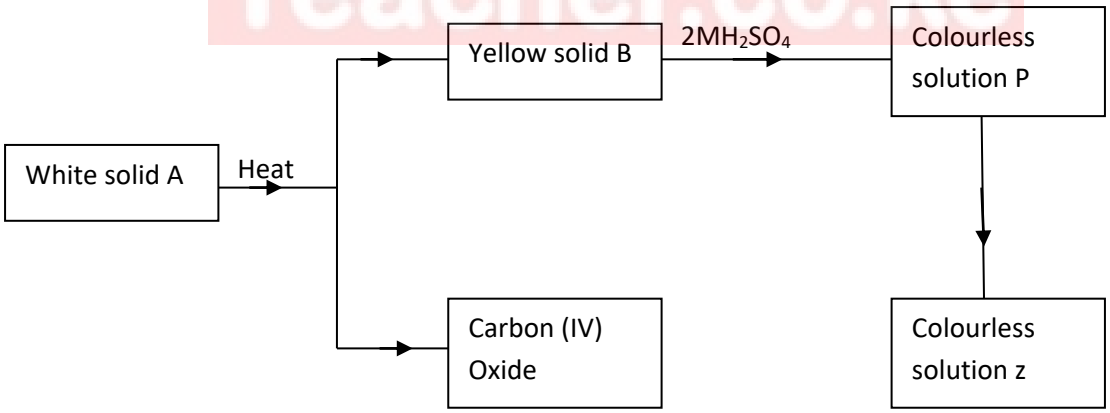
- ***Dilute sulphuric (VI) acid has a higher electrical conductivity than dilute ethanoic acid; dilute H_2SO_4 acid has more hydrogen ions in solution, being a strong acid than dilute CH_3COOH acid.***

6. a. What is meant by solubility? (1mk)
   - ***Solubility is the maximum amount of solute that will dissolve in 100g of water at a given temperature or***
   - ***Is the mass in grammes of solute required to saturate 100g of water at a given temperature.***

   b. In an experiment to determine the solubility of solid Y in water at 30°C the following results were obtained.
   Mass of evaporating dish = 26.2g
   Mass of evaporating dish + saturated solution = 42.4g
   Mass of evaporating dish + dry solid y = 30.4g
   Using the information, determine the solubility of solid y at 30°C in grammes per 100g of water. (2mks)

   - ***Mass of solid Y = (30.4 – 26.2) = 4.2g***
     Mass of water in the solution = (42.4 -30.4)
     =12g
     12g of water dissolves 4.2g
     Thus 100g of water dissolves =?
     = $\frac{100 \times 4.2}{12}$
     = 35g/100g H_2O

7. The scheme below represents some reactions starting with a white solid A.



   a) Identify solid A (1mk)
   - ***Zinc carbonate***

   b) Write an equation for the reaction between solid B and 2M sulphuric (VI) acid. (1mk)
   - ***$ZnO(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2O(l)$***

   c) Write ionic equation for the formation of colourless solution Z. (1mk)
   - ***$Zn(OH)_2(s) + 4NH_3(aq) \longrightarrow [Zn(NH_3)_4]^{2+}(aq) + 2OH(aq)$***

8. Element A and B have atomic numbers 6 and 1 respectively. Using a dot (.) and cross (x) diagram illustrate the type of bounding formed when the two elements combine. (1mk)
   A = 2.4

B=1

b. Explain why solid sodium chloride does not conduct electricity while sodium chloride solution conducts. (2mks)

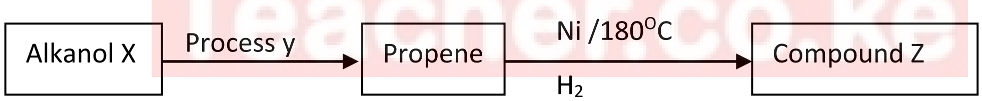
- ***Solid sodium chloride does not contain free ions while sodium chloride solution contains free ions.***

9. The diagram below shows the laboratory preparation of hydrochloric acid.
   a) State the condition necessary for the reaction to occur. (1mk)
   - ***Heating***

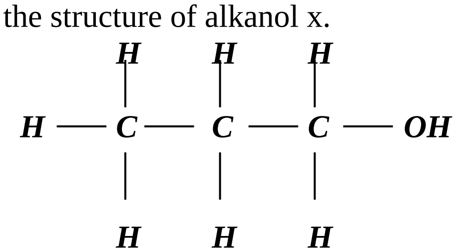
   b) Write a chemical equation for the reaction between sodium chloride and concentrated sulphuric (VI) acid. (1mk)
   - $NaCl(s) + H_2SO_4(l) \longrightarrow NaHSO_4(aq) + HCl(g)$

   c) Give one reason why an inverted funnels is used instead of delivery tube. (1mk)
   - ***Provides larger surface area over which dissolving of gas takes place.***
   - ***Prevents suck back of solution which causes breakage of the hot apparatus.***

10. Use the reaction scheme below to and the questions that follow.



   a) Draw the structure of alkanol x. (1mk)



   b) Name process Y. (1mk)
   - ***Dehydration***

   c) Write the molecular formula of the 5th member in which propene belong.
   - C_6H_{12}

11. The structural formula of compounds Q and R are as follows:

Q $CH_3CH_2CH_2COOCH_2CH_3$

R $CH_3CH_2CHCH_2CH_3$

HO-C=0

i. Give the empirical formula that represents both compounds Q and R. (1mk)
   - ***$C_6H_{12}O_2$***

ii. Which single chemical term best describes the two substances Q and R? (1mk)
   - ***Isomers***

iii. Which unique physical property of substance Q is used to identify it? (1mk)
   - ***Pleasant / sweet/ fruity smell***

12. 18.7cm^3 of a dibasic acid, H_2A required 25cm^3 0.1M sodium hydroxide for complete neutralization.

a) How many moles of sodium hydroxide are contained in 25cm^3? (1mk)
   - ***$1000cm^3$ ⟶ 0.1moles***
     $25cm^3$ = ?
     = $\frac{25 \times 0.1}{1000}$
     =0.0025 moles

b) Calculate the molarrity of the dibasic acid, H_2A. (2mks)
   $H_2A(g) + 2NaOH(aq) \longrightarrow Na_2A(aq) + H_2O(l)$
   Mole ratio = 1:2
   Moles of acid = $\frac{0.0025}{2}$
   = 0.00125 moles
   Molarity = $\frac{1000 \times 0.00125}{18.7}$
   = 0.0668M

13. Fill the empty spaces in the table below. (2mks)

Apparatus	**Use**
Pipe-clay triangle	***Used for supporting crucibles during heating***
Pair of tongs	

14. Some reaction of metals P,Q,R, and S are given below.

Metal	**Reaction with water**	**Reaction with dilute hydrochloric acid**
P	A few bubbles form slowly in water	Vigorous reaction. Gas is given off
Q	Vigorous reaction metal melts gas given off	Explosive reaction (Should not be attempt)
R	No reaction	No reaction
S	Does not react with cold water. Hot metal reacts with steam	Steady fizzing

a) Arrange the metals in order of the reactivity starting with the least reactive.(1mk)
   R, S, P, Q ⟶
   Increasing reactivity

b) Write a chemical equation for the reaction between metal Q and water. (1mk)
   $2Q(s) + 2H_2O(l) \longrightarrow 2QOH(aq) + H_2O(l)$

c) Which of the metals could be copper? Explain. (2mks)
   - ***R; copper doesn't react with both dilute acids and water since it is lower than hydrogen in reactivity series.***

15. Below is a set up used to collect hydrogen gas?

a) Identify with reason, two mistakes in the set up. (2mks)

- ***Hydrogen gas cannot be collected by downward delivery as it is lighter than air.***
- ***No gas collected as dilute nitric (V) acid would oxidize it to water.***

b) Explain the role of hydrogen in the manufacture of margarine. (1mk)

- ***Hydrogen breaks the double bonds in liquid oil making it saturated thus solidifies.***

16. Identify the acid and base in the above equation using Bronsted Lowry theory. (2mks)
    - ***Acid***
    - ***Base***
    - ***Reason; H_2O donates H^+ ions to NH_3 in the reaction.***

b. What causes permanent water hardness? (1mk)

- ***Presence of $MgSO_4$ and $CaSO_4$***

17. Study the information in the table below and answer the questions that follow

Element	Electron arrangement	1st ionization energy
Beryllium	2.2	900
Magnesium	2.8.2	740
Calcium	2.8.8.2	590

a) What chemical family does the elements belong to? (1mk)

- ***Alkaline earth metals***

b) What is meant by the term ionization energy? (1mk)

- ***The energy required to remove an electron from an atom in gaseous state.***

c) Explain the trend in the 1st ionization energy of the elements above. (2mks)

- ***Ionization energy decreases down the group due to increase in atomic radii down the group which reduces the attraction of the elecetrons in the outermost energy level towards the nucleus hence ease of loss of electrons from the outermost energy level.***

18. State the role of the following parts during fractional distillation of a mixture of water and ethanol.

a) Fractionating column (1mk)

- ***It allows water vapour to condense into liquid and flow back into the flask before the boiling point of water is reached.***

b) Glass beads in the fractionating column. (1mk)

- ***To increase the surface area for condensation process.***

19. Draw a labeled diagram of the set up of apparatus that can be used to electrolyse lead (II) bromide. (3mks)

20. The following table shows pH values of solution of compounds D, E,F and G.

Compound	D	E	F	G
pH value of solution	2	5	7	13

a) State which one of the compounds is likely to be;

i. Sodium chloride (1mk)

- ***F***

ii. Sodium hydroxide. Explain. (1mk)

- ***G; NaOH is a strong alkali with high pH***

b) Select two compounds that can be used to illustrate the amphoteric nature of an oxide. (1mk)

- ***D and G***

21. An experiment was carried out to determine the presence of substance P,Q, R and S in the mixture T. The results obtained one shown below

a) Name the method of separation illustrated above. (1mk)

- ***Paper chromatography / chromatography***

b) Select;

i. One substance which contains a component not present in T. (1mk)

- ***Q***

ii. A substance which is least soluble in the solvent used. (1mk)

- ***S***

22. During laboratory preparation of oxygen, manganese (IV) oxide is added to reagent H.
    a) Name reagent H (1mk)
    - ***Hydrogen peroxide***

    b) State the role of manganese (IV) oxide. (1mk)
    - ***It is a catalyst***

    c) Write the equation for the reaction that takes place. (1mk)
    - $H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$

23. The heat of solution and hydration energy of potassium chloride is -17.2Kj and -689Kj respectively. Calculate the lattice energy of potassium chloride. (2mks)

ΔH solution = ΔH lactice + ΔH hydration

ΔH latt = -17.2 – (- 689)

=+671.8KJ

24. Define molar heat of displacement. (1mk)
    - ***The heat revolved / the enthalpy change when one mole of a substance is displaced from its ions in solution.***

    b. The following ionic equation represents the reaction between metal Y and an aqueous solution of Zn^{2+}.

    $Y(s) + Z^{2+}(aq) \longrightarrow Y^{2+}(aq) + Z(s)$

    ΔH=-ve

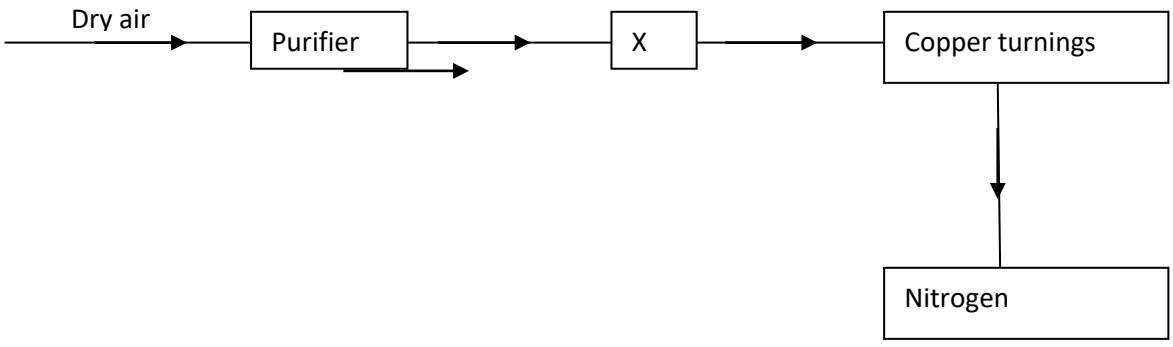
    Draw an energy level diagram to represent the reaction. (2mks)

25. a. What is meant by the term bleaching? (1mk)
    - ***removal of original colour/decolourising***

    b. Write the formula of the bleaching agent formed when chloride gas reacts with aqueous sodium hydroxide. (1mk)
    - ***BaClO or NaOCl***

    c. State the role of chlorine in water treatment. (1mk)
    - ***Kills micro organism / germs / bacteria***

26. The flow chart below shows the process of obtaining a sample of nitrogen gas. Study it and answer the questions that follow.



a) Identify X (1mk)
- ***KOH/NaOH***

b) Write an equation for the reaction with heated copper turnings. (1mk)

- ***$2Cu(s) + O_2(g)$ $2CUO(s)$***

c) Name an impurity in the sample of nitrogen gas. (1mk)

- ***Argon, neon; inert gases/noble gases***

27. A mixture contains ammonium chloride, copper (II) oxide and sodium chloride. Describe how each of the substances can be obtained from the mixture. (3mks)

- ***Put the mixture in the beaker***
- ***Place the beaker on a tripoid stand, cover it with a watch glass with cold water.***
- ***Heat the mixture to sublime the NH_4Cl, collect it as sublimate on cooler surface of watch glass.***
- ***Add water to the remaining mixture. NaCl dissolve filter to obtain copper (II) Oxide.***
- ***Evaporate the filtrate to concentrate the NaCl. Allow the hot solution to cool and turn crystal.***