FORM 2

STRUCTURE OF THE ATOM AND THE PERIODIC TABLE

1. The electron arrangement ions X^{3-} and Y^{2-} are 2, 8, and 2, 8, 8 respectively.
   (a) Write the electronic arrangement of the elements X and Y. (2 marks)
   (b) Write the formula of the compound that would be formed between X and Y. (2 marks)

2. With reference to atomic number of one, explain why hydrogen can be placed in either group I and VII of the periodic table. (2 marks)

3. Complete the table below.

Species	Number of neutrons	Electrons
$^{3}_{2}He^{2+}$		

(2 marks)

4. An ion of phosphorous can be represented as $^{31}_{15}P^{3-}$. Draw a diagram to show the distribution of the electrons and the composition of the nucleus of the ion of phosphorous. (2 marks)

5. The electronic structures for elements represented by letters **A, B, C** and **D** are
   A 2 .8.6 **B** 2.8.2 **C** 2. 8. 1 **D** 2. 8. 8.
   a) Select the element which forms:
      (i) a double charged cation. (1 mark)
      (ii) a soluble carbonate. (1 mark)
   b) Which element has the shortest atomic radius? (1 mark)

6. a) Write the electronic configuration of calcium (atomic number 20) and beryllium (Atomic number 4). (1 mark)
   b) Why is calcium more reactive than beryllium? (2 marks)

7. Use the information in the table below to answer the questions that follow. (The letters do not represent the actual symbols of the elements)

Element	**B**	**C**	**D**	**E**	**F**
Atomic number	**18**	**5**	**3**	**5**	**20**
Mass number	**40**	**10**	**7**	**11**	**40**

   a) Which two letters represent the same element? Give a reason. (2marks)
   b) Give the number of neutrons in an atom of element **D**. (1 mark)

8. The table below shows the relative atomic masses and the percentage abundance of the isotopes L_1 and L_2 of element **L**.

	Relative atomic mass	**% abundance**
L_1	**62.93**	**69.09**
L_2	**64.93**	**30.91**

   Calculate the relative atomic mass of element **L.** (3marks)

9. The table below shows the number of valence electrons of the element P, Q and **R**.

Element	**P**	**Q**	**R**
Number of valence electrons	**3**	**5**	**2**

   a) Explain why **P** and **R** would not be expected to form a compound. (1mark)
   b) Write an equation to show the effect of heat on the carbonate of **R** (1mark)
   c) Write the formula for the most stable ion or **Q**. (1mark)

10. a) What are isotopes? (1mark)

b) Determine the number of neutrons in $^{18}_{8}O$ (1mark)

11. a) What is meant by the terms:

(i) Element

(ii) Atomic number (2marks)

b) The formula for a chloride of titanium is $TiCl_3$. What is the formula of its sulphate?

(1mark)

12. The atomic numbers of phosphorus, sulphur and potassium are 15, 16 and 19 respectively. The formulae of their ions are P^{3-}, S^{2-} and K^{+}. These ions have the same number of electrons.

a) Write the electron arrangement for the ions. (1 mark)

b) Arrange the ions in the order of increasing ionic radius starting with the smallest. Give a reason for the order. (2 marks)

The table below gives the number of electrons, protons and neutrons in substances X, Y and Z. Study it and answer the questions that follow. Substance	Electrons	Protons	Neurons
X	10	10	10
Y	10	8	10
Z	8	8	8

a) Which letter represents an ion? (1mark)

b) Which of the substances are isotopes? Give a reason. (2marks)

13. What name is given to elements which appear in group (II) of the periodic table (1 mark)

14. Distinguish between ionisation energy and electron affinity of an element. (2 marks)

15. A sample of hydrogen gas was found to be a mixture of two isotopes, and $^{1}_{1}H$ $^{2}_{1}H$

Determine the relative molecular masses of the molecules formed, when each of these isotopes is burnt in oxygen. (O=16.0) (2 marks)

16. Use the part of the periodic table given below to answer the questions that follow. (Letters are not the actual symbols of the elements).

				N		P	
Q	M						R

a) Identify the element that forms giant covalent structures. (1 mark)

b) Identify **one** element that does not form compounds. (1 mark)

c) Write the formula for the nitride of M. (1 mark)

17. a) What is meant by the term radical? (1 mark)

The table below contains atoms that form common radicals. Complete the table show radicals formed from various atoms. (2 marks)

Element	N	S
H	NH_4^+	
O		

7. CHEMICAL FAMILIES

1. The table below gives information on four elements by letters K, L, M and N. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Electron arrangement	Atomic radius (nm)	Ionic radius(nm)
K	2, 8, 2	0.136	0.065
L	2, 8, 7	0.099	0.181
M	2, 8, 8, 1	0.203	0.133
N	2, 8, 8, 2	0.174	0.099

a) Which two elements have two similar properties? Explain (2 marks)
b) What is most likely formula of oxide of L? (1 mark)
c) Which element is a non-metal? Explain (1 mark)
d) Which one of elements is the strongest reducing agent? Explain (2 marks)
e) Explain why ionic radius of N is less than that of M (2 marks)
f) Explain why the ionic radius of L is bigger than its atomic radius (2 marks)

2. The table below gives the atomic numbers of elements **W, X, Y,** and **Z.** The letters do not represent the actual symbols of the elements.

Element	**W**	**X**	**Y**	**Z**
Atomic Number	**9**	**10**	**11**	**12**

a) Which one of the elements is least reactive? Explain (1 mark)
b) (i) Which two elements would react most vigorously with each other? (1 mark)
(ii) Give the formula of the compound formed when the elements in b (i) react

3. Study the table below and answer the questions that follow:

Element	Atomic number	Relative atomic mass	Melting point (°C)
Aluminium	13	27.0	
Calcium	20	40.0	850
Carbon		12.0	3730
Hydrogen		1.0	-259
Magnesium	12	24.3	650
Neon	10		-249
Phosphorous	15	31.0	44.2 (white)
Sodium		23	590 (red)

a) Complete the table by filling in this missing atomic numbers and atomic mass (2 marks)
b) Write the electron arrangement for the following ions
(i) Ca^+
(ii) (ii) P^{3-} (2 marks)
c) What is the melting point of hydrogen in degrees Kelvin? (1 mark)

d) Which of the allotropes of phosphorous ha a higher density? Explain (2 marks)

e) The mass numbers of three isotopes of magnesium are 24, 25 and 26.
What is the mass number of the most abundant isotope of magnesium? Explain (2 marks)

f) Give the formula of the compound formed between aluminium and carbon (1 marks)

g) Explain the difference in the melting points of magnesium and sodium. (2 marks)

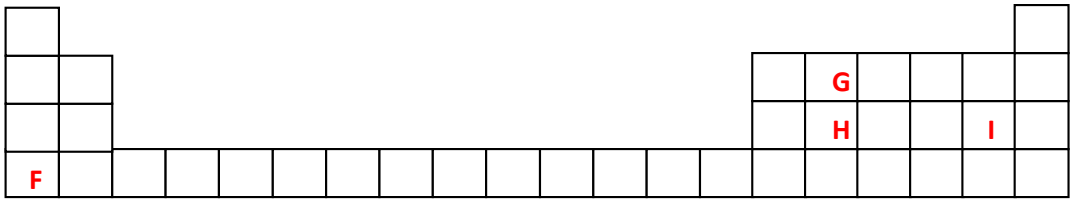
4. An element **Y** has the electronic configuration 2.8.5

a) Which period of the periodic table does the element belong? (1 mark)

b) Write a formula of the most stable anion formed when element **Y** ionises (1 mark)

c) Explain the difference between the atomic radium of element **Y** an its ionic radius. (1 mark)

5. The grid below shows part of a periodic table. The letters do not represent the actual symbols of the elements.



(a) Select the:

(i) element which has the largest atomic radius (1 mark)

(ii) Most reactive non-metal (1 mark)

(b) Show on the grid the position of the element **J** which forms J^{2+} ions with electronic configuration 2, 8, 8. (1 mark)

6. The table below gives the energy required to remove the outermost electron for some group I elements.

Element	I	II	III	IV
Energy $kJmol^{-1}$	494	418	519	376

Arrange the elements in order of their reactivity starting with the most reactive. (2 marks)

7. Write the formula of sulphide of an element **C**, whose atomic number is 5. **C** is not the actual symbol of the element. (1 mark)

8. The information below relates to elements **S, T, U** and **X**. (The letters do not represents the actual symbols of the elements.

(i) **T** displaces **X** from an aqueous solution containing ions of **X**

(ii) Hydrogen gas reduces heated oxide of S but does not reduce the heated oxide of **X**

(iii) **U** liberates hydrogen gas from cold water but **T** does not.

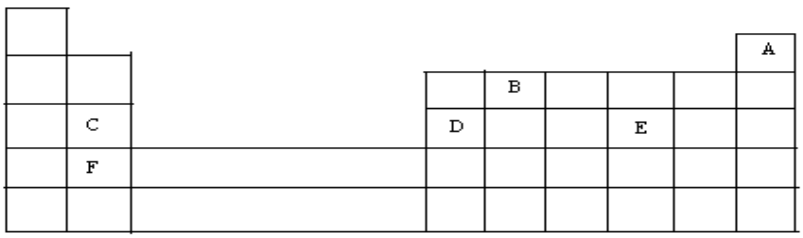
a) Write an equation for the reaction between T and the ions of **X**.
(Both T and **X** are in group II of the periodic Table) (1 mark)

b) Arrange the elements in order of their increasing reactivity. (2 marks)

9. Give two reasons why helium is used in weather balloons (2 marks)

10. (a) The grid given below represents part of the periodic table. Study it and answer the questions that follow.

(The letters do not represents the actual symbol of the elements)



(i) What name is given to the group of elements to which **C** and **F** belong? (1 mark)
(ii) Which letter represents the element that is the least reactive? (1 mark)
(iii) What type of bond is formed when **B** and E react? Explain (2 marks)
(iv) Write the formula of the compound formed when element **D** and oxygen gas react. (1mark)
(v) On the grid, indicate with a tick the position of element **G** which is in the third
grid, indicate with a tick the position of element **G** which is in the third period of the periodic table and forms G^{3-} ions (1 mark)

(c) Study the information in the table below and answer the questions that follow (the letters do not represent the actual symbol of the substances)

Substance	Melting Point (^{0}C)	Boiling Point (^{0}C)	Solubility in Water	Density at room temperature g/cm^3
H	-117	78.5	Very soluble	0.8
J	-78	-33	Very soluble	0.77×10^{-3}
K	-23	77	Insoluble	1.6
L	-219	-183	Slightly soluble	1.33×10^{-3}

(i) Which substance would dissolve in water and could be separated from the solution by fractional distillation? Give a reason.
(2 marks)
(ii) Which substances is a liquid at room temperature and when mixed with water two layers would be formed? (1 mark)
(iii) Which letter represents a substance that is gas at room temperature and which can be collected:
I. Over water? Explain. (2 marks)
II. By downward displacement of air? (Density of air is 1.29×10^{-3}g/cm^3 at room temperature. (1 mark)

11. The information in the table below relates to elements in the same group of the periodic table. Study it and answer the question that follows:

Element	Atomic size
G1	0.19
G2	0.23
G3	0.15

Which element has the highest ionization energy? Give reason. (3 marks)

12. Explain why hydrogen forms compounds in which its oxidation state is either + 1 or -1 (Atomic number of hydrogen is 1). (3 marks)

13. Name **one** property of neon that makes it possible to be used in electric lamps. (1 mark)

14. Use the reactions given below to answer the questions that follow. The letters do not represent the actual symbols of the elements

$D(s) + E^{2+}(aq) \rightarrow D^{2+}(aq) + E(s)$
$D(s) + 2F^{+}(aq) \rightarrow D^{2+}(aq) + 2F(s)$
$E(s) + 2F^{+}(aq) \rightarrow E^{2+}(aq) + 2F(s)$
$G(s) + \rightarrow E^{2+}(aq) \rightarrow G^{2+}(aq) + E(s)$
$G(s) + D^{2+}(aq) \rightarrow$ no reaction

a) What name is given to the type of reaction given above? (1 mark)
b) Arrange the elements D, E, F and G in the order of their reactivity starting with the most reactive. (1 mark)
c) Complete the equation below (1 mark)

$G(s) + 2F^+(aq) \rightarrow$ ……

15. Study the information in the table and answer the questions that follow

Ion	Electronic arrangement	Ionic radius
Na^+	2.8	0.095
K^+	2.8.8	0.133
Mg^{2+}	2.8	0.065

Explain why: (i) the ionic radius of K^+ is greater than that of Na^+. (1mark)

(ii) Mg^{2+} is smaller than that of Na^+ (1 mark)

16. An atom of hydrogen can form two ions. Write two equations to show how a neutral atom of hydrogen can form two ions. In each case show the sign of the energy change involved. (2 marks)

17. An oxide of element F has the formula F_2O_5

(a) Determine the oxidation state of F. (1 mark)

(b) In which group of the periodic- table is element F. (1 mark)

18. Explain why the reactivity of group (vii) elements decreases down the group. (2 marks)

19. The table below the first ionization energies of elements **B** and **C**.

Element	Ionisation energy KJ mol^{-1}
B	494
C	736

What do these values suggest about the reactivity of **B** compared to that of **C**? Explain (2marks)

20. Four metal F, G, H and J were each separately added to cold water, and steam.
The table below is a summary of the observations made and the formulae of the hydroxides formed.

Metal	Cold water	Hot water	Steam	Formula of Hydroxide
F	Reacts slowly	Reacts fast	Reacts very fast	F(OH)2
G	No reaction	No reaction	No reaction	-
H	Fast	Reacts very fast	Reacts explosively	HOH
J	No reaction	Reacts slowly	Reacts fast	J(OH)2

a) Which two elements are likely to be in the same group of the periodic table? (1 mark)

21. Arrange the metals in the order of their reactivity starting with the most reactive

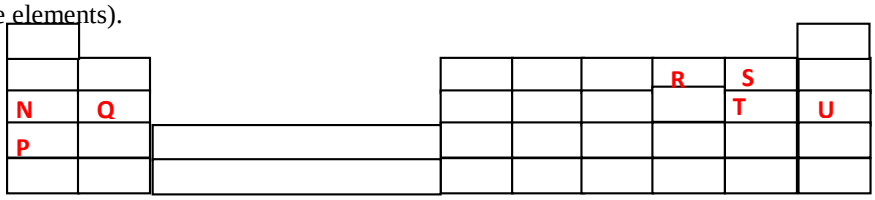
22. The table below gives some information about elements **I, II, III** and **IV** which are in the same group of the periodic table. Use the information to answer the questions that follows.

Element	First Ionisation energy ($kjmol^{-1}$)	Atomic Radius (nm)
I	520	0.15

II	500	0.19
III	420	0.23
IV	400	0.25

State and explain the relationship between the variations in the first ionisation energies and the atomic radii. (3 marks)

23. The grid below is part of the periodic table. Use it to answer the questions that follow. (the letters are not the actual symbols of the elements).



a) Indicate on the grid the position of an element represented by letter, **V** whose atomic number (1 mark)
b) Select a letter which represent a monoatomic gas. (1 mark)
c) Write an equation for reaction between **Q** and **T**. (1 mark)

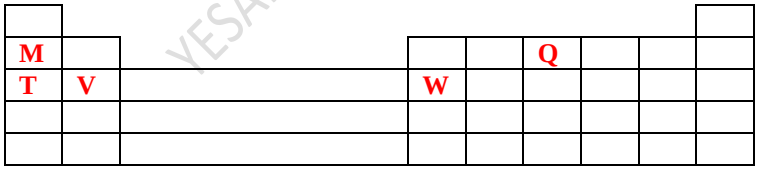
24. The ionisation energies for three elements A, B and C are shown in the table below:

Element	A	B	C
Ionisation energy (kJ/mole)	519	418	494

a) What is meant by ionization energy? (1 mark)
b) Which element is the strongest reducing agent? Give a reason. (2 marks)

24. Give the name of the product formed when magnesium reacts with phosphorus. (1mark)

25. The diagram below represents part of the periodic table. Use it to answer the questions that follow.



(a) Write the electronic arrangement for the stable ion formed by **W**. (1 mark)
(b) Write an equation for the reaction between **V** and **Q**. (1 mark)
(c) How do the ionisation energies of the elements **M** and **T** compare? Explain. (1 mark)

26. The table below gives some properties three elements in group (VII) of the periodic table.Study it and answer the questions that follow:

Element	Atomic No.	Melting Point (^{0}C)	Boiling Point (^{0}C)
Chlorine	17	101	-34.7
Bromine	35	-7	58.8
Iodine	53	114	184

(a) Which element is in liquid form at room temperature? Give a reason. (1 mark)

(b) Explain why the boiling point of iodine is much higher than that of chlorine(2 marks)

The table below shows properties of some elements **A, B, C** and **D** which belong to the same period of the periodic table. The letters are not the actual symbols of the elements.

Element	A	B	C	D
Mp (°C)	1410	98	-101	660
Atomic radii (nm)	0.117	0.186	0.099	0.143
Electrical conductivity	Poor	Good	Non conductors	Good

(a) Arrange the elements in the order they would appear in the period. Give a reason.
(2 marks)

(b) Select the metallic element which is the better conductor of electricity. Give a reason.
(1 mark)

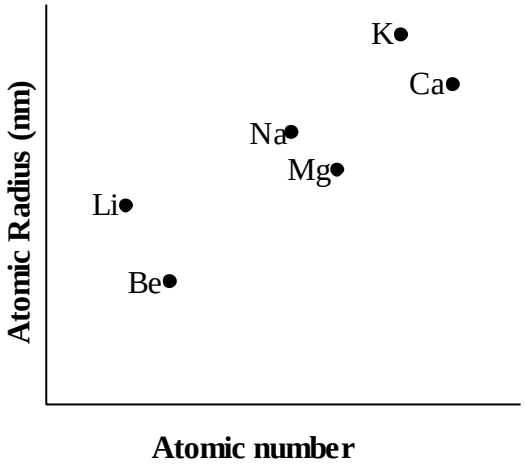
28. (a) The electronic arrangement of the ion of element Q is 2.8.8. If the formula of the ion is Q^{3-}, state the group and period to which Q belongs. (1 mark)

(b) Helium, neon and argon belong to group 8 of the periodic table. Give:

(i) The general name of these elements; (1 mark)

(ii) One use of these elements. (1 mark)

29. The plots below were obtained when the atomic radii of some elements in groups I and II were plotted against atomic numbers.



Explain:

(a) The trend shown by Li, Na and K. (1 mark)

(b) Why the atomic radii of elements Be, Mg and Ca are lower than those of Li, Na and K.
(2 marks)

30. (a) The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters are not the actual symbols of the elements.

A					B		C	
	D			E		F	G	
H								

(i) Select the most reactive metal. Explain. (2 marks)
(ii) Select an element that can form an ion with a charge of 3^-. (1 mark)
(iii) Select an alkaline earth metal. (1 mark)
(iv) Which group 1 element has the highest first ionization energy? Explain. (2 marks)
(v) Element A combines with chlorine to form a chloride of A. State the most likely pH value of solution of a chloride of A. Explain. (2 marks)

(b) (i) Explain why molten calcium chloride and magnesium chloride conduct electricity while carbon tetrachloride and silicon tetrachloride do not. (2 marks)
(ii) Under the same conditions, gaseous neon was found to diffuse faster than gaseous fluorine. Explain this observation. (F = 19.0; Ne = 20.0) (2 marks)

8. STRUCTURE AND BONDING

1. The table below shows some properties of substances **E, F, G** and **H**

Substance	Action with water	Melting point	Thermal conductivity
E	Unreactive	High	Poor
F	Reactive	High	Poor
G	Unreactive	High	Good
H	Unreactive	Low	Good

Select the substance that would be most suitable
(a) for making a cooking pot (1 mark)
(b) as a thermal insulator (1 mark)

2. Using dots (**.**) and crosses (x) to represent outermost electrons, draw diagrams to show the bonding in CO_2 and H_3O^+ (Atomic numbers; H = 1, C=6, O = 8). (2 marks)

3. Study the information below and answer the questions that follow: The letters do not the actual symbols of the elements.

Element	Atomic Number	Melting Point Element	Formula of Chloride	Melting Point Chloride
G	11	98	GCI	801
H	12	650	HCI_2	715
J	14	1410	JCI_4	-70
K	16	113	K_2CI_2	-80
L	20	851	LCI_2	780

(i) Which elements are metals? Give a reason. (2 marks)
(ii) Write the formula of the compound formed when element **H** reacts with elements **K** (1 mark)
(iii) Explain why the melting point of **J** is higher than that of **K**. (2 mark)
(iv) What is the oxidation state of **J** in its chloride. (1 mark)
(v) How does the:
I. Melting point of fluoride of **G** compare with that of its chloride? (2 marks)
II. Reactivity of **H** and **L** with water compare? Give an explanation. (2 marks)

4. The table below shows some properties of substances C, D and E. Study it and answer the questions that follow.

Substance	M.P (^{0}C)	Solubility in water	Electrical solid state	Conductivity molten stated.
C	-39	insoluble	good	good
D	1610	insoluble	poor	poor
E	801	Soluble	poor	good

Select substance

a) With a giant molecular structure. (1 mark)

b) That is not likely to be an element. (1 mark)

5. Diamond and graphite are allotropes of carbon. In terms of structure and bonding explain the following.

(a) Diamond is used in drilling through hard rocks. (1 mark)

(b) Graphite is used as a lubricant. (1 mark)

6. Study the information given in the table below and answer the questions that follow. The letters do not represents the actual symbols of the elements

Element	Atomic number	Boiling point
S	3	1603
T	13	2743
U	16	718
V	18	87
W	19	1047

(a) Select the elements which belong to the same:

(i) Group (1 mark)

(ii) Period (1 mark)

(b) Which element:

(i) is in gaseous state at room temperature? Explain. (Take room temperature to be 298K) (1 mark)

(ii) does not form an oxide? (1 mark)

(c) Write the

(i) formula of the nitrate of element **T**. (1 mark)

(ii) equation for the reaction between elements **S** and U. (1 mark)

(d) What type of bond would exists in the compound formed when **U** and **T** react?
Give a reason for your answer (2 marks)

(e) The aqueous sulphate of element **W** was electrolyzed using inert electrodes.
Name the products formed at the:

(i) Cathode (1 mark)

(ii) Anode (1 mark)

7. What type of bond is formed when lithium and Fluorine react? Explain.
(Atomic numbers: Li = 3 and F = 9) (2 marks)

8. Use the information in the table below to answer the questions that follows

Element	Fluorine	Chlorine	Bromine	Iodine
Heat of vaporization Kjmol	3.16	10.2	15.0	22.0

Explain the trend in the molar heats of vaporization (2 marks)

9. Study the information in the table below and answer the questions that follow. The letters **do not** represent the symbols of the elements.

Element(C)	Atomic number	Melting point
L	11	97.8
M	13	660
N	14	1410
Q	17	-101
R	19	63.7

(a) Write the electrons arrangement for the atom formed by elements and **M** and **Q** (2 marks)

(b) Select an element which is

(i) the most reactive non – metal (1 mark)

(ii) a poor conductor of electricity (1 mark)

(c) In which period of the periodic table does elements **R** belong? (1 mark)

(d) Element **R** loses its outermost electron more readily than **L**. Explain. (2 marks)

(e) Using dots (**.**) and crosses (x) to represent outermost electrons show bonding in the compound formed between elements **N** and **Q**. (1 mark)

(f) Explain why the melting point element **M** is higher than that of element **L**. (2 marks)

(g) Write an equation for the reaction that would occur between **L** and water. (1 mark)

(h) Describe how a solid mixture of sulphate of **R** and lead sulphate can be separated into solid samples. (3 marks)

10. Compound **Q** is a solid with a giant ionic structure. In what form would the compound conduct an electric current? (1 mark)

11. The table below shows the properties of substances **K, L, M** and **N**.

Substances	Reaction with oxygen at 25°C	Melting point	Conductivity in Solid	Conductivity in Molten
K	Unreactive	High	Poor	Good
L	Reactive	Low	Poor	Good
M	Uncreative	High	Good	Good
N	Uncreative	Low	Good	Good

Select the substances which are likely to be:

(a) Copper metal (1 mark)

(b) Magnesium chloride (1 mark)

12. The melting point of phosphorous dichloride is – 91°C. While that of magnesium chloride is 715°C.In terms of structure and bonding, explain the difference in their melting points. (3 marks)

13. Oxygen and sulphur belong to group (VI) of the periodic table. Explain why there is a big difference their (melting points of oxygen is – 216^0C while that of sulphur is 44^0C.) (2 marks)

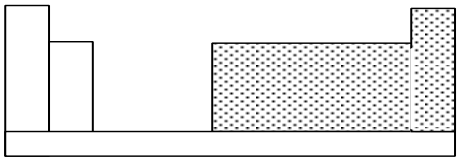
14. With reference to iodine, distinguish between covalent bonds and Van Der Waals forces. (3 marks)

15. The table below gives some information about the electrical conductivity and the likely bonding in substances **N, P** and **Q**. Complete the table by inserting the missing information the spaces numbered I, II and III

Substance	Likely type of bonding present	Electrical Conductivity	
		Solid	Molten
N	Metallic	I……	Conducts
P	II……	Does not conduct	Conducts
Q	III ……	Does not conduct	Does not conduct

(3 marks)

16. The chart below is an outline of part of the periodic table.



(a) (i)With the help of vertical and horizontal lines, indicate the direction of increasing metallic nature of the elements. (2 marks)

(ii)Which types of elements are represented in the shaded area? (1 mark)

(b) (i) Element A is the same group of the periodic table as chlorine. Write the formula of the compound formed when A reacts with potassium metal. (1 mark)

(ii) What type of bonding exists in the compound formed in (b) (l) above? Give a reason for your answers. (3 marks)

(c) Starting with aqueous magnesium sulphate, describe how you would obtain a sample of magnesium oxide. (3 marks)

(d) Write two ionic equations to show that aluminium hydroxide is amphoteric. (2 marks)

17. Using dots (.) and crosses (x) to represent electrons, show bonding in the compounds formed when the following elements react: (Si = 14, Na = 11 and Cl = 17)

(a) Sodium and chlorine (1 mark)

(b) Silicon and chlorine (1 mark)

18. (a) An atom Q can be represented as $^{52}_{24}Q$ What does the number 52 represent? (1 mark)

(b) Study the information in the table below and answer the equations that follow (Letters are not the actual symbols of the elements).

Element	Electronic Arrangement of stable ion	Atomic Radius (nm)	Ionic Radius (nm)
N	2.8.8	0.197	0.099
P	2.8.8	0.099	0.181
R	2.8	0.160	0.065
S	2.8	0.186	0.095
T	2	0.152	0.068
U	2.8	0.072	0.136

(i) Write the formula of the compound formed when N reacts with P. (atomic numbers are N = 20; P = 17) (1 mark)

(ii) Identify the elements which belong to the third period of the periodic table. Explain (2 marks)

(iii) Which of the element identified in b (ii) above comes first in the third period? Explain (2 marks)

(iv) Select two elements which are non- metals (1 mark)

(c)The table below gives some properties of substances I, II, III, and IV. Study it and answer the questions that

follow.

Substance	Electrical conductivity		M.P (^{0}C)	B.P (^{0}C)
	Solid	Molten		
I	Does not conduct	Conducts	801	1420
II	Conducts	Conducts	650	1107
III	Does not conduct	Does not conduct	1700	2200
IV	Does not conduct	Does not conduct	113	440

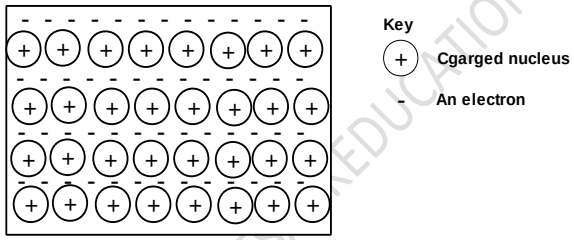
(i) What type of bonding exists in substances I and II (2 marks)
(ii) Which substances is likely to be sulphur? Explain (2 marks)

19. The atomic numbers of elements C and D are 19 and 9 respectively. State and explain the electrical conductivity of the compound CD in:
(a) Solid state (1 ½ marks)
(b) aqueous state. (1 ½ marks)

20. (a) Distinguish between a covalent bond and a co-ordinate bond (2 marks)
(b) Draw a diagram to show bonding in an ammonium ion. (1 mark)

21. Both chlorine and iodine are halogens.
(a) What are halogens? (1 mark)
(b)In terms of structure and bonding, explain why the boiling point of chlorine is lower than that of iodine. (2 marks)

22. The diagram below is a section of a model of the structure of element T.



(a) State the type of bonding that exists in T. (1 mark)
(b) In which group of the period table does element T belong? Give a reason. (2 marks)

23. The table below gives atomic numbers of elements represented by the letters **A**, **B, C** and **D**.

Element	A	B	C	D
Atomic number	15	16	17	20

Use the information to answer the questions that follow.
(a) Name the type of bonding that exists in the compound formed when A and D react. (1 mark)
(b) Select the letter which represents the best oxidizing agent. Give a reason for your answer. (2 marks)

24. The atomic number of sulphur is 16. Write the electron arrangement of sulphur in the following:
(a) H_2S
(b) SO_3^{2-} (2 marks)

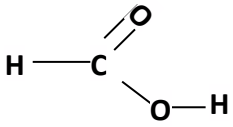
25. In terms of structure and bonding, explain why the melting point of oxygen is much lower than that of sodium. (3 marks)

26. An isotope of element E has 34 neutrons and its mass number is 64. E forms a cation with 28 electrons. Write the formula of the cation indicating the mass and atomic numbers. (1 mark)

27. Using dots (.) and crosses (x), show bonding in:
(a) the compound formed when nitrogen reacts with fluorine

(Atomic numbers F=9, N=7); (1 mark)

(b) Sodium oxide. (Atomic numbers Na= 11, 0 = 8) (1 mark)

28. The structure of methanoic acid is 

What is the total number of electrons used for bonding in a molecule of methanoic acid? Give reasons. (2 marks)

29. The boiling points of some compounds of hydrogen with some elements in groups 4 and 6 of the periodic table are given below.

Compound	Boiling point (^{0}C)	Compound	Boiling point(^{0}C)
CH_4	-1640	H_2O	100.0
SIH_4	-112.0	H_2S	-61.0

(a) Which of the compounds CH_4 and SIH_4 has stronger intermolecular forces? (1 mark)

(b) Explain why the boiling points of H_2O and H_2S show different trends from that of CH_4 and SiH_4 (2 marks)

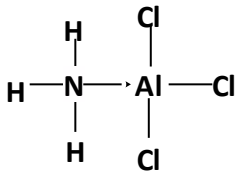
30. (a) Using electrons in the outermost energy level, draw the dot (**.**) and cross (x) diagrams for the molecules H_2O and C_2H_4. (H = 1, C = 6, O = 8) (2 marks)

(i) H_2O

(ii) (ii) C_2H_4

(c) The formula of a complex ion is $Zn(NH_3)_4^{2+}$. Name the type of bond that is likely to exist between zinc and ammonia in the complex ion. (1 mark)

31. The diagram below shows the bonding between aluminium chloride and ammonia.



(a) Name the types of bonds that exist in the molecule. (1 mark)

(b) How many electrons are used for bonding in the molecule? (1 mark)

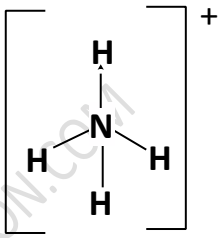
32. (a) Other than their location in the atom, name two other differences between an electron and a proton.

(b) The table below gives the number of electrons, protons and neutrons in particle **A, B, C , D, E, F**and **G**

Particle	Protons	electrons	neutrons
A	6	6	6
B	10	10	12
C	12	10	12
D	6	6	8
E	13	10	14
F	17	17	18
G	8	10	8

(i) Which particle is likely to be a halogen? (1 mark)
(ii) What is the mass number of E
(iii) Write the formula of the compound formed when E combines with G (1 mark)
(iv) Name the type of bond formed in (iii) above.
(v) How does the radii of C and E compare? Give reason. (2 marks)
(vi) Draw a dot (.) and cross(x) diagram for the compound formed between (1 mark)
(vii) Why would particle B not react with particle D? (1mark)

33. Ammonium ion has the following structure:



Label on the structure:
(a) covalent bond; (1 mark)
(b) coordinate (dative) bond. (1 mark)

34. Use the following information on substances S, T, V and hydrogen to answer the questions that follow:
(i) T displaces V from a solution containing V ions.
(ii) Hydrogen reacts with the heated oxide of S but has no effect on heated oxide of V.
(a) Arrange substances S, T, V and hydrogen in the order of increasing reactivity. (2 marks)
(b) If T and V are divalent metals, write an ionic equation for the reaction in (i) above. (1 mark)

35. The grid below is part of the periodic table. Use it to answer the questions that follow. (The letters are not the actual symbols of the elements).

				A		B	C	
D			E	F			G	
							H	

(a) Which is the most reactive non-metallic element shown in the table? Explain. (2marks)
(b) (i) Write the formula of the compound formed when element **A** reacts with element. (1mark)
(ii) Name the bond type in the compound formed in b (i) above. (1mark)
(c) ((i) What is the name given to the group of elements where C, G and H belong. (1mark)
(ii)Write an equation for the reaction that occurs when **C** in gaseous form passed through a solution containing ions of element **H**. (2marks)
(d) The melting points of elements F and G are 1410°C and -101°C respectively. In terms of structure and bonding, explain why there is a large difference in the melting points of F and G. (2marks)
(e) **D** forms two oxides. Write the formula of each of the two oxides. (1mark)
(f) **J** is an element that belongs to the 3rd period of the periodic table and a member of the alkaline earth elements. Show the position of J in the grid. (1mark)

36. In terms of structure and bonding, explain the following observations:
(a) The melting point of aluminiun is higher than that of sodium: (1 ½ marks)

(b) Melting point of chlorine is lower than that of sulphur. (1 ½ marks)

37. Given that the atomic number of Y is 13 and that of Z is 9:

(a) Write the electronic arrangement of Y and Z; (1 mark)

(b) Draw the dot (.) and cross (x) diagram for the compound formed by Y and Z. (1 mark)

9. PROPERTIES AND TRENDS ACROSS A PERIOD

1. Explain why anhydrous aluminium chloride is fairly soluble in organic solvents while anhydrous magnesium chloride is insoluble. (2marks)

2. Give a reason why phosphorus is stored under water. (1 mark)

3. Yellow phosphorous reacts with chlorine gas to form a yellow liquid. The liquid fumes when exposed to air. Explain these observations (2 marks)

4. Explain why there is general increase in the first ionization energies of the elements in period 3 of the periodic table from left to right. (2 marks)

5. Iron (III) oxide was found to be contaminated with copper (II) sulphate. Describe how a pure sample of iron (III) oxide can be obtained. (3 marks)

10. SALTS

1. Describe how the following reagents can be used to prepare lead sulphate solid potassium sulphate, solid lead carbonate, dilute nitric acid and distilled water. (2 marks)

2. (a) Using dots (.) and crosses (x) to represent electrons draw diagram to represent the bonding in:

(i) NH_3 (ii) NH_4^+ (1 mark)

b) State why an ammonia molecule (NH_3) can combine with H+ to form $NH4^+$

(Atomic numbers: N=7 and H=1) (1 mark)

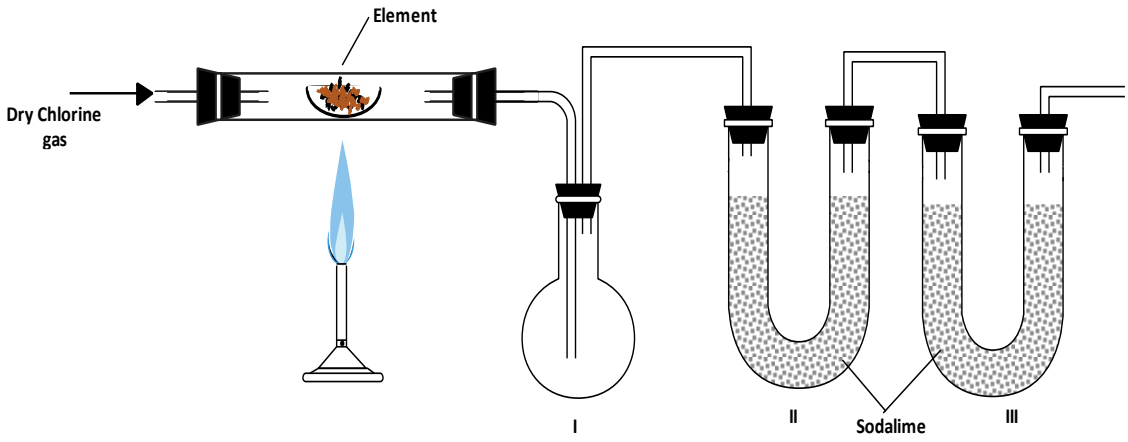
3. On strong heating of sodium nitrate liberates oxygen gas. In the spaces provided below, draw a labeled diagram of a set-up that could be used for heating sodium nitrate and collecting the oxygen gas liberated (3marks)

4. Explain how you would obtain solid carbonate from a mixture of lead carbonate and sodium carbonate powders. (3 marks)

5. When dilute nitric (V) acid was added to a sample of solid **C**, a colourless gas that formed a white a white precipitate with limewater was produced. When another sample of solid **C** was heated strongly in a dry test – tube, there was no observable change. Write the formula of the ions present in **C.** (2 marks)

6. Describe how a solid sample of lead (II) Chloride can be prepared using the following reagents; dilute nitric acid, dilute hydrochloric acid and lead carbonate. (2 marks)

7. The set – up below was used to prepare anhydrous chlorides of a number of elements in a laboratory where no fine cupboard was available. The chlorides were to be collected in flask 1.



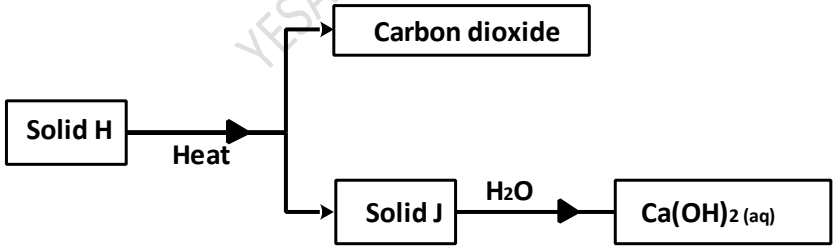
The following table shows the melting and boiling points of the chlorides that were prepared.

Chloride	Nacl	$AlCl_3$	$SiCl_4$	PCl_3
Melting point (^{0}C)	801	Sublime (178)	-70	-91
Boiling point (^{0}C)	1413	-	58	76

(a) Explain why it is necessary to pass dry chlorine through the apparatus before heating each element. (2 marks)
(b) Give **two** reasons why tubes II and III were filled with Soda lime (solid mixture of sodium hydrogen and calcium hydrogen) (2 marks)
(c) Explain why it would **not** be possible to collect any sodium chloride in flask 1 (2 marks)
(d) Name **one** other substance that can be used in tubes II and III. (1 mark)
(e) Write an equation for the reaction that forms phosphorous (III) chloride (1 mark)
(f) Describe how you would separate a mixture of sodium chloride and aluminium chloride (2 marks)

8. Starting with copper metal, describe how a solid samples of copper (II) carbonate can be prepared. (2 marks)

9. Use the scheme below to answer the questions that follow.



(a) Identify the solids **H** and **J** (2 marks)
(b) State one commercial use of solid **J** (1 mark)

10. How would you obtain a sample of pure iodine from a mixture of iodine and lead sulphate? (3 marks)

11. When potassium nitrate is heated, it produces potassium nitrate and gas C_1
(a) Identify gas C_1 (1 mark)
(b) Name the type of reaction undergone by the potassium nitrate (1 mark)

12. Describe how a solid sample of Zinc (II) carbonate can be prepared starting with zinc oxide (3 marks)

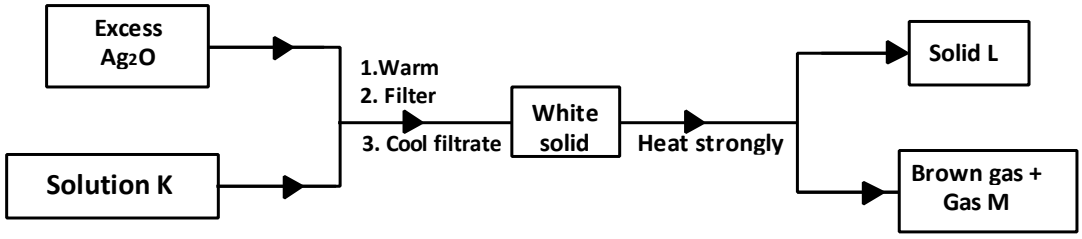
13. Some sodium chloride was found to be contaminated with copper (ll) oxide. Describe how a sample of sodium chloride can be separated from the mixture (3 marks)

14. Carbon (IV) dioxide can be dissolved in water under pressure to make an acidic solution.

(a) What is meant by an acidic solutions? (1 mark)

(b) Aqueous lead (II) nitrate reacts with the acidic solution to form a precipitate. Write anionic equation for the reaction. (1 mark)

15. Study the flow chart below and answer the question that follows.



Identify:

(a) Solution K

(b) Solid L (3 marks)

(c) Gas M

16. Starting with sodium metal, describe how a sample of crystals of sodium hydrogen carbonate may be prepared. (3 marks)

17. Starting with copper metal, describe how a sample of crystals of copper (II) chloride may be prepared in the laboratory. (3 marks)

18. When solid $\mathbf{B}_1$ was heated, a gas which formed a white precipitate when passed through lime water was produced. The residue was dissolved in dilute nitric (V) acid to form a colourless solution $\mathbf{B}_2$. When dilute hydrochloric acid was added to solution $\mathbf{B}_2$ a white precipitate which dissolved on warning was formed.

(a) Write the formula of the;

I. Cation in solid $\mathbf{B}_1$

II. Anion in solid $\mathbf{B}_1$ (2 marks)

(b) Write an ionic equation for the reaction between the residue and dilute nitric (V) acid. (1 mark)

19. a) Write an equation to show the effect of heat on the nitrate of:

(i) Potassium (ii) Silver (2 mark)

b) The table below gives information about elements A_1, A_2, A_3, and A_4

Element	Atomic Number	Atomic Radius (nm)	Ionic radius (nm)
A_1	3	0.134	0.074
A_2	5	0.090	0.012
A_3	13	0.143	0.050
A_4	17	0.099	0.181

(i) In which period of the periodic table is element A_2? Give a reason. (2 marks)

(ii) Explain why the atomic radius of:

I A_1 is greater than that of A_2;

II A_4 is smaller than its ionic radius (2 marks)

(iii) Select the element which s in the same group as A_3 (1 mark)

(iv) Using dots (.) and crosses(x) to represent outermost electrons. Draw a diagram to show the bonding in

the compound formed when A_1 reacts with A_4 (1 mark)

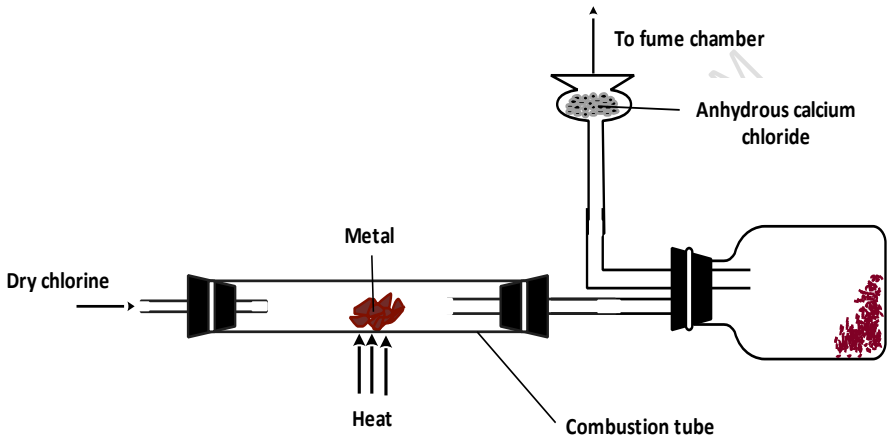
20. (a) Distinguish between a deliquescent and a hygroscopic substance. (2 marks)
(b) Give **one** use of hygroscopic substance in the laboratory. (1 mark)

21. Describe how a solid sample of the double salt, ammonium iron(II) sulphate, can be prepared using the following reagents; Aqueous ammonia, sulphuric(VI) acid and iron metal. (3 marks)

22. Distinguish between the terms deliquescent and efflorescent as used in chemistry. (2 marks)

23. Write equations to show the effect of heat on each of the following:
(a) Sodium hydrogen carbonate; (1mark)
(b) Silver nitrate (1mark)
(c)Anhydrous iron (II) sulphate (1mark)

The diagram below illustrates a method of preparing salts by direct synthesis.



(a) This method can be used to prepare aluminium chloride or iron (iii) chloride. Explain why it cannot be used to prepare sodium chloride. (1mark)
(b) Describe how a sample of sodium chloride can be prepared in the laboratory by direct synthesis. (2marks)

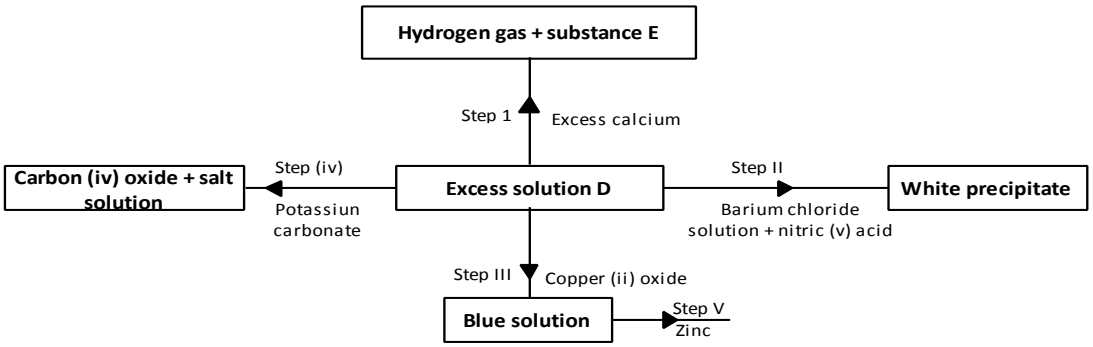
24. By using aqueous sodium chloride, describe how a student can distinguish calcium ions from lead ions.(2marks)

25. (a) Describe **one** method that can be used to distinguish between sodium sulphate and sodium hydrogen sulphate. (2marks)
(b)Describe how a pure sample of lead (II) sulphate can be prepared in the laboratory starting with lead metal. (3marks)

When dilute hydrochloric acid was reacted with solid **B**, a colourless gas which extinguished a burning splint was produced. When an aqueous solution of solid **B** was tested with a blue litmus paper, the paper turned red/ pink.

a) Identify the anion present in solid B. (1 mark)
b) Write an ionic equation for the reaction between solid B and dilute hydrochloric acid. (1 mark)

26. (a) The scheme below shows some of the reactions of solution **D**. Study it and answer the questions that follow.



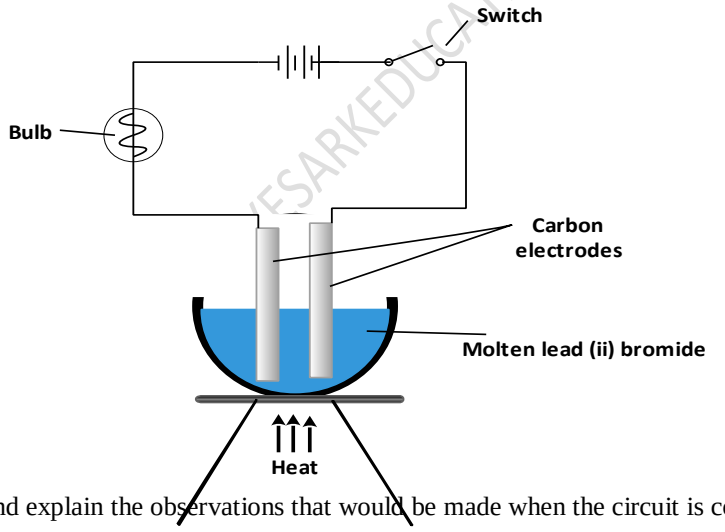
(i) Give a possible cation present in solution **D**. (1 mark)
(ii) Write an ionic equation for the reaction in Step II. (1 mark
(iii) What observations would be made in Step V? Give a reason. (2 marks)
(iv) Explain why the total volume of hydrogen gas produced in step 1 was found to be very low although calcium and solution **D** were in excess. (2 marks)
(v) State **one** use of substance **E**. (1 mark)

(b) Starting with solid sodium chloride, describe how a pure sample of lead (II) chloride can be prepared in the laboratory. (3 marks)

(c) (i) State a property of anhydrous calcium chloride which makes it suitable for use as a drying agent for chlorine gas. (1 mark)
(ii) Name another substance that can be used to dry chlorine gas. (1 mark)

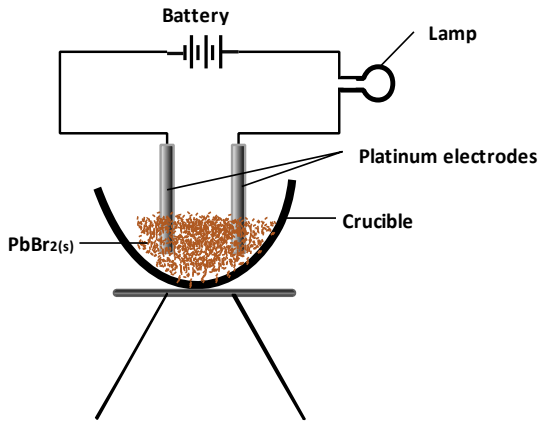
11. EFFECT OF AN ELECTRIC CURRENT ON SUBSTANCES

1. Study the set – up below and answer the question that follows.



State and explain the observations that would be made when the circuit is completed. (3marks)

2. In an experiment to investigate the conductivity of substances, a student used the set – up shown below.



The Student noted that the bulb did not light (1mk)

(a) What had been omitted in the set- up?

(b) Explain why the bulb lights when the omission is corrected (2 marks)

3. Explain why the following substances conduct an electric current.

(a) Magnesium metal. (1 mark)

(b) Molten magnesium chloride. (1 mark)

4. Bottles of sodium carbonate, sodium chloride and sugar have lost their labels.
A student prepares and tests an aqueous solution of a sample from each bottle. The results obtained are as shown in the table below.

Bottle	P^H	Electrical Conductivity	Correct label
1	7	Conducts	
2	7	Does not conduct	
3	10	conducts	

Complete the table by filling the correct label for each bottle. (3 marks)

5. Charcoal is a fuel that is commonly used for cooking. When it burns it forms two oxides.

(a) Name the **two** oxides. (2 marks)

(b) State **one** use of any of the two oxides. (1 mark)

6. A student investigated the effect of an electric current by passing it through some substances. The student used inert electrodes, and connected a bulb to the circuit. The table below shows the substances used and their states.

Experiment	Substances	State
1	Potassium Carbonate	Solid
2	Copper (II) sulphate	Solution
3	Sugar	Solution
4	Lead (II) iodide	Molten

(a) In which experiment did the bulb **not** light? (1 mark)

(b) Explain your answer in (a) above. (2 mark)

7. Explain how conduction of electricity takes place in the following:

(a) iron metal; (1 mark)

(b) molten lead II iodide, (1 mark)

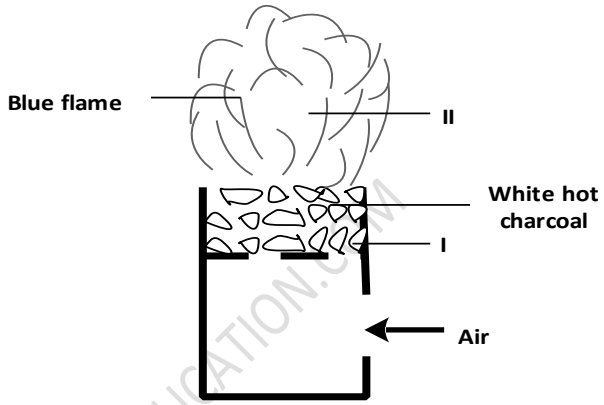
12. CARBON AND ITS COMPOUNDS

1. Give a reason why calcium hydroxide solution is used to detect the presence of carbon (IV) oxide gas while sodium hydroxide in **NOT**. (1 mark)

2. Write an equation for the reaction that takes place when carbon monoxide gas is passed over heated lead (II) oxide. (1mark)

3. When extinguishing a fire caused by burning kerosene, carbon dioxide is used in preference to water .Explain (2 marks)

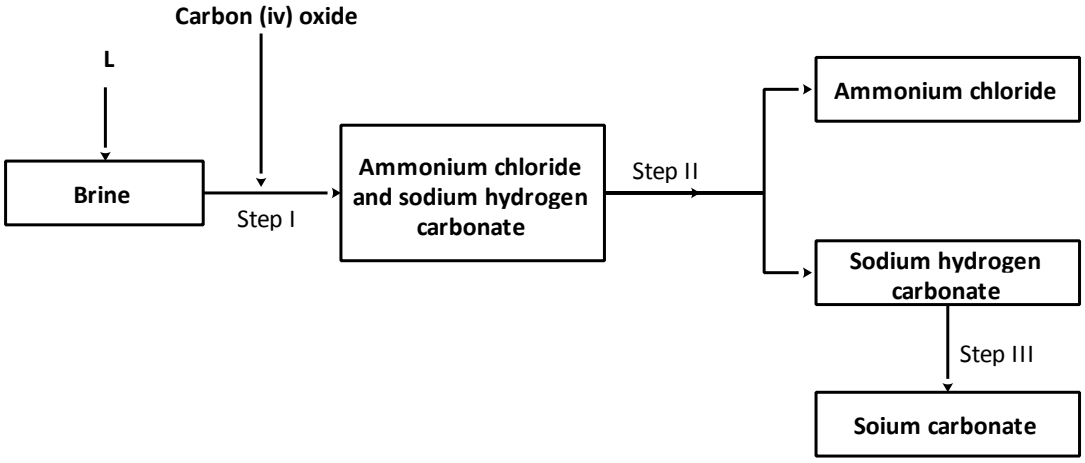
4. The diagram below represents a charcoal burner. Study it and answer the questions that follow:

5. 

Write equations for the reactions taking place at I and I and II. (2marks)

6. When excess carbon monoxide gas was passed over heated lead (II) oxide in combustion tube, lead (II) oxide was reduced
   (a) Write an equation for the reaction, which took place (1 mark)
   (b) What observation was made in the combustion tube when the reaction was complete? (1 mark)
   (c) Name another gas, which could be used to reduce lead (II) oxide. (1 mark)

7. The simplified flow chart shows some of the steps in the manufacture of sodium carbonate by the Solvay process



(a) Identify substance **L** (1 mark)
(b) Name the process – taking place in step II (1 mark)
(c) Write an equation for the reaction, which takes place in step III (1 mark)

8. Study the information in the table below and answer the questions that follow. (The letters do not represent the actual symbols of the elements)

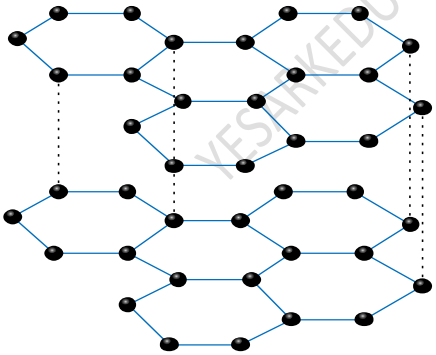
Element	Electrical conductivity	Ductility	Action of water
A	Good	Good	No reaction
B	Good	Poor	No reaction
C	Good	Good	Reacts

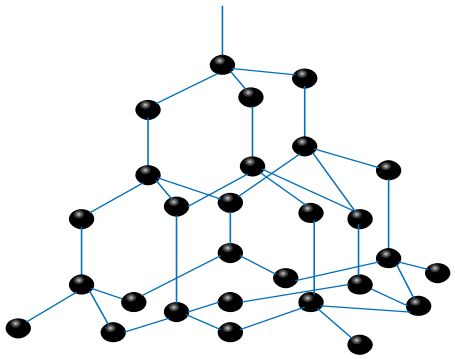
Select an element which.
(a) Is likely to be sued in group II of the periodic table (1 mark)
(b) Could be used to make electric cables (1 mark)
(c) Likely to be graphite (1 mark)

9. Explain why it is not advisable to leave a Jiko with burning charcoal in a closed room where one is sleeping. (2 marks)

10. State and explain the function of tartaric acid in baking powder (2 marks)

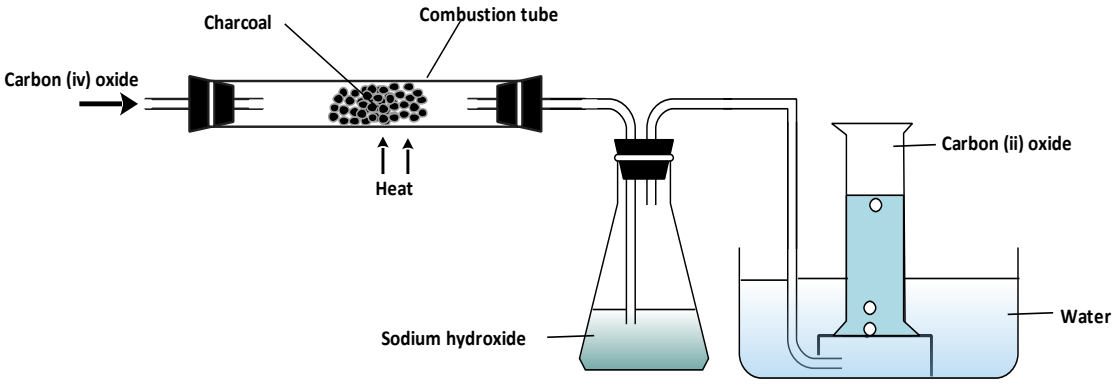
11. (a) The following diagrams show the structures of two allotropes of carbon. Study them and answer the questions that follow.


Allotrope M


Allotrope N

(i) Name allotrope **M** and **N** (2 marks)
(ii) Give one use of **N** (1 mark)
(iii) Which allotrope conducts electricity? Explain. (2 marks)

(b) In an experiment, carbon dioxide gas as passed over heated charcoal and the gas produced collected as shown in the diagram below

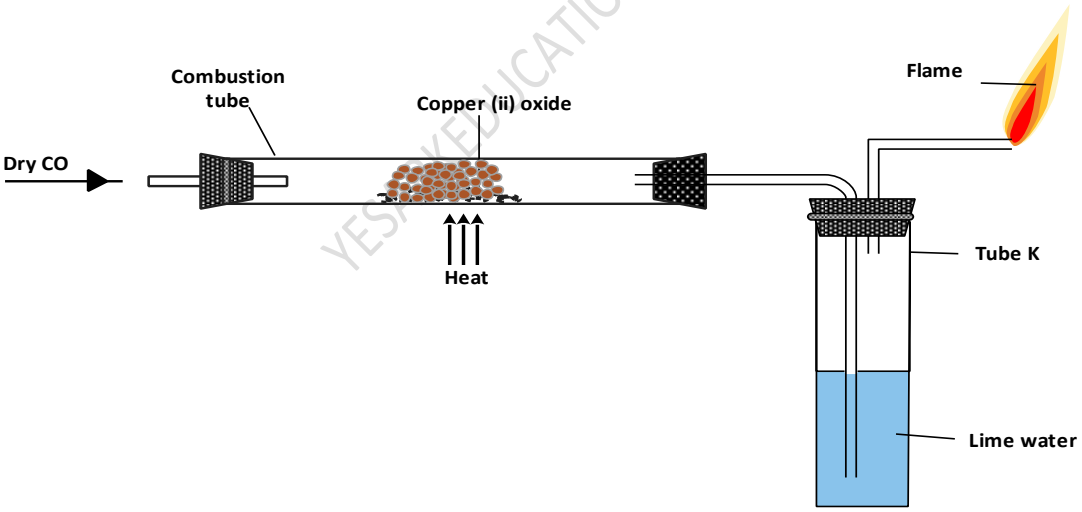


i. Write an equation for the reaction that took place in the combustion tube. (1 mark)
ii. Name another substance that can be used instead of sodium hydroxide. (1 mark)
iii. Describe a sample chemical test that can be used to distinguish between carbon (IV) oxide and carbon (II) oxide (1 mark)
iv. Give **one** use of carbon (II) oxide (1 mark)

12. Explain why burning magnesium continues to burn a gas jar containing sulphur (IV) oxide while a burning splint is extinguished. (3 marks)

13. **(**a) What observation would be made if hydrogen sulphide gas was bubbled through a solution of zinc nitrate? (1 mark)
(b) Write an equation for the reaction that takes place in (a) above. (1 mark)

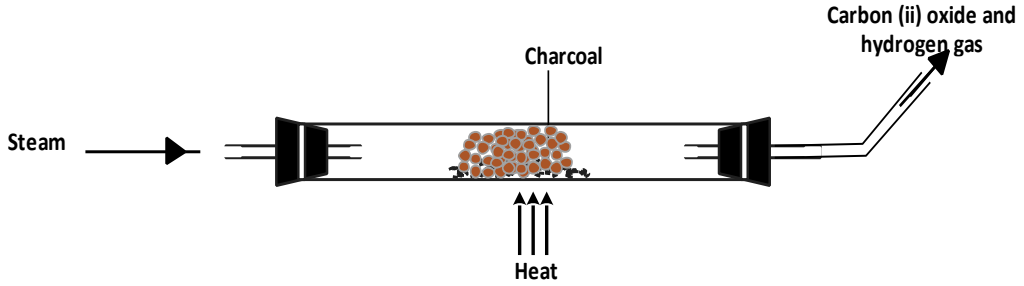
14. The apparatus shown below shown below was used to investigate the effect of carbon monoxide on copper (II) oxide.



(a) State the observation that was made in the combustion tube at the end of the experiment. (1 mark)
(b) Write an equation for the reaction that took place in the combustion tube. (1 mark)
(c) Why is it necessary to burn the gas coming out of tube **K**? (1 mark)

15. When carbon dioxide gas was passed through aqueous calcium hydroxide a white suspension was formed.
(a) Write an equation for the reaction that took place. (1 mark)
(b) State and explain the changes that would occur when carbon dioxide gas is bubbled through the white suspension. (2 marks)

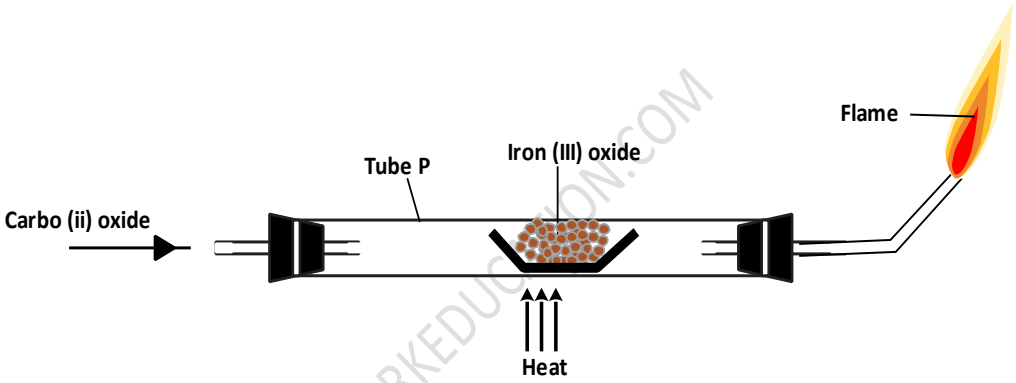
16. When steam was passed over heated charcoal as shown in the diagram below, hydrogen and carbon (II) oxide gases were formed.



(a) Write the equation for the reaction which takes place (1 mark)
(b) Name two uses of carbon monoxide gas, which are also uses of hydrogen gas (2 marks)

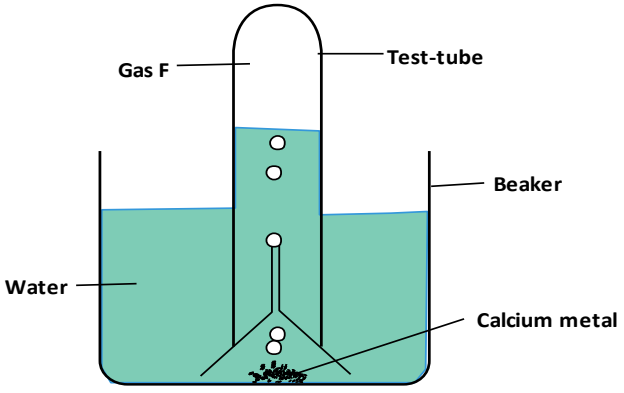
17. Both diamond and graphite have giant atomic structures. Explain why diamond is hard while graphite is soft. (3 marks)

18. Carbon (II) oxide gas passed over heated Iron (III) oxide as shown in the diagram below.



(a) Give the observation made in tube P. (1 mark)
(b) Write the equation for the reaction which takes place in tube P. (1 mark)

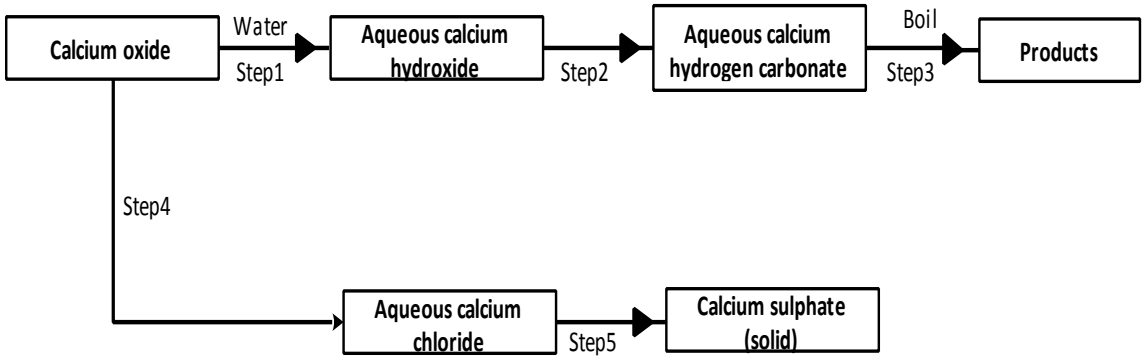
19. (a) The set-up below was used to collect gas F, produced by the reaction between water and calcium metal.



(i) Name gas F. (1 mark)
(ii) At the end of the experiment, the solution in the beaker was found to be a weak base. Explain why the solution is a weak base. (2 marks)

(iii) Give one laboratory use of the solution formed in a beaker. (1 mark)

(b) The scheme below shows some reactions starting with calcium oxide. Study it and answer the questions that follow.



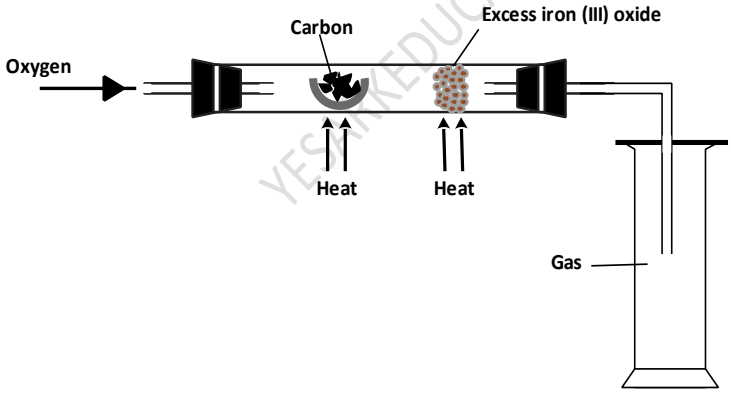
(i) Name the reagents used in steps 2 and 4. (2 marks)

(ii) Write an equation for the reaction in step 3. (1 mark)

(iii) Describe how a solid sample of anhydrous calcium sulphate is obtained in Step 5. (2 marks)

20. In terms of structure and bonding, explain why graphite is used as a lubricant. (2 marks)

21. The set – up below was used to obtain a sample of iron.



Write two equations for the reactions which occur in the combustion tube. (2 marks)

22. Dry carbon (II) oxide gas reacts with heated lead (II) oxide as shown in the equation below

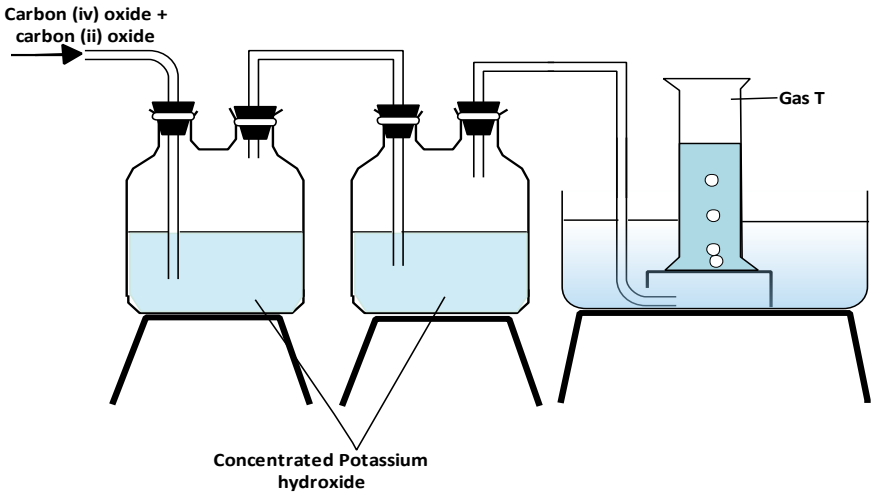
$$\mathbf{PbO(s) + CO(g) \rightarrow Pb\ (s) + CO_2\ (g)}$$

(a) Name the process undergone by the lead (II) oxide (1 mark)

(b) Give a reason for your answer in (a) above (1 mark)

(c) Name another gas that can be used to perform the same function as carbon (II) oxide gas in the above reaction. (1 mark)

23. The diagram below represents part of a set – up used to prepare and collect gas T.

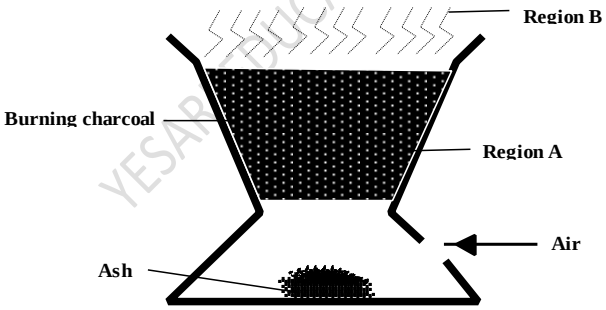


(a) Name two reagents that are reacted to produce both carbon (IV) oxide and carbon (II) oxide. (1 mark)

(b) Write the equation for the reaction which takes place in the wash bottles. (1 mark)

(c) Give a reason why carbon (II) oxide is not easily detected. (1 mark)

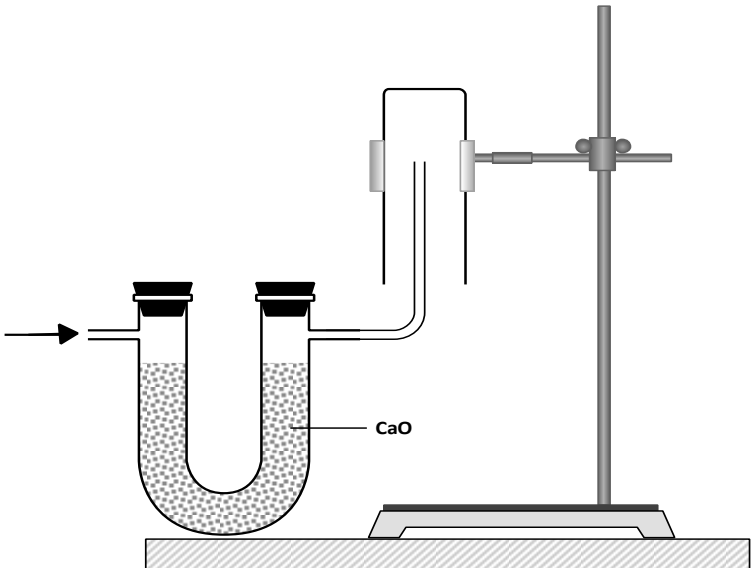
24. The diagram below shows a "Jiko" when in use. Study it and answer the questions that follow.



(a) Identify the gas formed at region **A**. (1 mark)

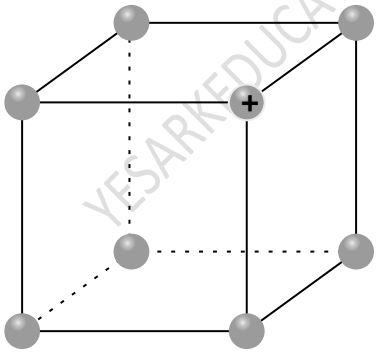
(b) State and explain the observation made at region **B**. (2 marks)

25. The set-up below was used to collect a dry sample of a gas.



Give **two** reasons why the set-up cannot be used to collect carbon (IV) oxide gas. (2 marks)

26. (a) The diagram below represents part of the structure of a sodium chloride crystal.
The position of one of the sodium ions in the crystal is shown as ⊕

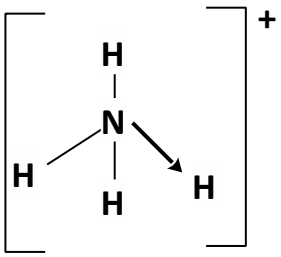


(i) On the diagram, mark the position of the other three sodium ions. (2 marks)

(ii) The melting and boiling points of sodium chloride are 801^0C and 1413^0C respectively. Explain why sodium chloride does not conduct electricity at 25^0C, but does so at temperatures between 801^0 C and 1413^0C. (2 marks)

(b) Give a reason why ammonia gas is highly soluble in water (2 marks)

(c) The structure of an ammonia ion is shown below:



Name the type of bond represented in the diagram by N → H (1 mark)

(d) Carbon exists in different crystalline forms. Some of these forms were recently

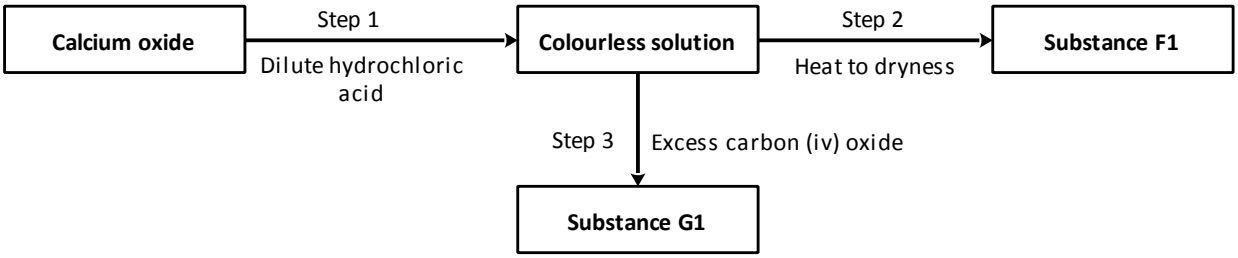
discovered in soot and are called fullerenes.

(i) What name is given to different crystalline forms of the same element? (1 mark)

(ii) Fullerenes dissolve in methylbenzene while the other forms of carbon do not. Given that soot is a mixture of fullerenes and other solid forms of carbon, describe how crystals of fullerenes can be obtained from soot. (3 marks)

(iii) The relative molecular mass of one of the fullerenes is 720. What is the molecular formula of this fullerene? (C=12.0). (1 mark)

27. Study the flow chart below and answer the questions that follow.



(a) Give the name of the process that takes place in step 1. (1 mark)

(b) Give;

(i) the name of substance G_1 (1 mark)

(ii) one use of substance F_1 (1 mark)

28. Carbon (II) oxide is described as a "silent killer"

(a) State **one** physical property of carbon (II) oxide that makes it a "silent killer" (2marks)

(b) State and explain **one** chemical property that makes carbon (II) oxide poisonous to human beings (2 marks)

29. Graphite is one of the allotropes of carbon.

(a) Name one other element which exhibits allotropy. (1 mark)

(b) Explain why graphite is used in the making of pencil leads. (2 marks)

30. (a) Diamond and graphite are allotropes of carbon. What is meant by an allotrope? (1 mark)

(b) Explain way graphite can be as a lubricant while diamond cannot. (2 marks)