Structure and bonding

1. Ethanol is a liquid at room temperature but does not conduct electricity. Explain.
2. a) Distinguish between a covalent bond and a co-ordinate bond.
   b) Draw a diagram to show bonding in an ammonium ion. (N = 7, H = 1)
3. a) Explain why the metals magnesium and aluminium are good conductors of electricity.
   b) Other than cost, give **two** reasons why aluminium is used for making electric cables while magnesium is not.
4. Explain why the boiling point of ethanol is higher than that of hexane.
   (Relative molecular mass of ethanol is 46 while that of hexane is 86).
5. a) What is meant by **dative covalent bond**?

6. Sodium and Magnesium belong to the same period on the periodic table and both are metals. Explain why magnesium is a better conductor of electricity than sodium.
7. Using dots and crosses to represent electrons, draw the structures of the following:
   (a) Phosphorous chloride (PCl_3)
   (b) Hydroxonium ion (H_3O^+)
8. Between aluminium and copper which one is a better conductor? Explain
9. Water has a boiling point of 100^{o}C while hydrogen chloride has a boiling point of -115^{o}C. Explain

10. Explain why luminous flame is capable of giving out light and soot
11. When blue litmus paper is dipped in a solution of aluminium chloride it turns red. Explain
12. Carbon and Silicon are in the same group of the periodic table. Silicon (IV) Oxide melts at 2440^{o}C while solid Carbon (IV) Oxide sublimes at -70^{o}C. In terms of structure and bonding, explain this difference

13. Element **A** has an atomic number of 6 and b has an atomic number of 9:
    (i) Write the electron arrangements for elements **A** and **B**
    (ii) Using dot (•) and cross (X)diagram, show how **A** and **B** combine to form a compound

14. (a) Explain why aluminium is a better conductor of electricity than magnesium
    (b) Other than cost and ability to conduct, give a reason why aluminium is used for making cables while magnesium is not
15. Explain how electrical conductivity can be used to distinguish between magnesium oxide and silicon (IV) oxide
16. a) The diagram below represents part of the structure of sodium chloride crystal

The position of one of the sodium ions in the crystal is shown as;

i) On the diagram, mark the positions of the other three sodium ions

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

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

c) The structure of ammonium ion is shown below;

Name the type of bond represented in the diagram by N H

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

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

iii) The relative molecular mass of one of the fullerenes is 720. What is the molecular mass of this fullerene

17. (a) Explain the following observations:-

(i) NaCl allows electric current to pass through them in molten state

(ii) Graphite is a non-metal yet it is a conductor of electricity

18. Study the table below and answer the questions that follow:-

Substance		**A**	**B**	**C**	**D**	**E**	**F**
Melting Point (^oC)		801	113 119	-39	5	-101	1356
Boiling point (^oC)		1410	445	457	54	-36	2860
Electrical	Solid	Poor	Poor	Good	Poor	Poor	Poor
Conductivity	liquid	Good	Poor	Good	Poor	Poor	Poor

I Identify with reasons the substances that:

(i) Have a metallic structure (1½mk)

(ii) Have a molecular structure and exist in the liquid state at room temperature and pressure(

(iii) Suggest a reason why substance **B** has two melting points

(iv) Substances **A** and **C** conduct electric current in the liquid state. State how the two substances differ as conductors of electric current *

19. (I) Sodium metal tarnishes when exposed to the air where a white powder is formed on its surface. A small piece of this sodium metal was dropped into 25g of ethanol and 1200cm^3 of hydrogen gas was evolved at r.t.p. The unreacted ethanol was evaporated and a white solid remained. (Na=23, molar gas volume at r.t.p = 24dm^3, C=12, O =16, H=1)

(a) Write a chemical equation for the reaction between ethanol and sodium metal

(b) Determine the mass of sodium that reacted with ethanol

(c) What mass of ethanol evaporated?

(d) The ethanol was evaporated at 80^{o}C, while the white solid remained unaffected at this temperature. What is the difference in structure of ethanol and the white solid?

(II) (a) Name an inorganic liquid which liberates hydrogen gas with sodium metal

(b) What **two** differences would you observe if similar pieces of sodium were dropped separately into small beakers containing equal amount of ethanol and the liquid named in **(II)(a)** above respectively

(III) (a) Give the name of the white powder formed on the original piece of sodium metal

(b) Explain how the white powder named in **(III)(a)** is formed

20. The grid below represents part of the periodic table. The letters do not represent actual symbols of the elements. Study it and answer the questions that follow:-

(a) What type of bond would you expect in the compound formed between **H** and **F**. Explain

(b) (i) Which of the elements **J** and **M** will have a greater atomic radius? Explain

(ii) Elements **F** and **N** are in the same group of periodic table. How do their atomic radius compare? Explain

(c) An element **W** has atomic number **15**. Indicate the position it would occupy in the table above

(d) What is the name given to elements **X – Z?**

(e) Why is **J** used in electric cables where **Q** is not

(f) **P** and **J** are termed as metalloids. What does the term metalloid mean?

(g) How would you expect the reactivity of **H** and **M** to compare? Explain

21. (a) Part of the periodic table is given below study it and answer the questions that follow. The letters do not represent the actual elements

(i) What type of bond is formed when **Y** reacts with **Z**. Explain

(ii) Explain the difference in the atomic radii of element **A** and **B**

(iii) Explain the difference in the reactivity of **Z** and **B**

(b) 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	Electronic configuration	Ionization energy $KJmol^{-1}$
P	2:1	519
Q	2:8:1	494
R	2:8:8:1	418

(i) What is meant by ionization energy?
(ii) Element **R** has the lowest ionization energy. Explain
(iii) When a piece of element **Q** is placed on water it melts and a hissing sound is produced as it moves on the water surface. Explain these observations
(iv) Write the equation for the reaction between element **Q** and water

22. The table below shows the elements in the third period, the oxides of the third period and their properties. The letters are not the actual symbols of the elements. Study the information and answer the questions that follow:

Element	Atomic number	Atomic radius(nm)	Oxide	State at RT	oxide melting point ºC
M	11	0.191	M_2O	Solid	1132
N	……	0.160	NO	Solid	2852
P	13	0.130	……	Solid	2072
Q	14	0.118	QO_2	…….	1610
R	……	0.110	……	Solid	580
S	16	0.102	SO_2	……	-75
T	17	0.099	TO_2	Gas	-60
V	18	0.095	X	X	X

a) i) Complete the table above
ii) Explain the trend in the atomic radius across the period
iii) Explain why the oxide of element **V** does not exist
b) Name the type of structure and bond in the following oxide

Oxide	Structure	Bond type
NO		
TO_2		

ii) Using dots and crosses to represent electrons. Show the bonding in the oxide, $\mathbf{QO_2}$
c) i)Explain why elements **P** conducts electricity but **T** does not
ii) The oxide of **P** reacts both acids and alkalis. Give the name of this kind of oxide

23. 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	0.74
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

(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

III. Select the element which is in the same group as A_3

IV. Using dots (●) and cross (**x**) to represent outermost electrons, draw a diagram to show the bonding in the compound formed when A_1 reacts with A_4

24. The atomic number of element **P** is **11** and that of **Q** is **8**

a) Write down the possible formula of the compound formed between **P** and **Q**

b) Using dots (·**)** and crosses(**x**) to represent electrons draw a diagram to represent the bonding in the compound in **(a)** above

25. Name the type of bonding and structure found in: -

(a) Ice

(b) Magnesium chloride

26. Name the type of bonding and structure found in: -

(a) Ice

(b) Magnesium chloride

27. Use the scheme to answer the questions that follow:

(a) Identify solid **N** …….

(b) Write a balanced equation for the formation of **Q**

(c) Write the formula of the complex ion formed when sodium hydroxide is added to solution **L** in excess

28. (a) Using dots (•) and crosses (**x**) to represent electrons show bonding in:

NH^-_2 (N=7, H=1) S_8 (S = 16)

(b) Show bonding in Carbon (II) Oxide by use of (–) or ( ) to represent bonds.

29. In terms of structure and bonding, explain why diamond is the hardest naturally occurring Substance

30. Identify the bond types in the diagram

31. Elements **A, B, C**, and **D** are not actual symbols, have atomic numbers **19, 9, 12** and **10** respectively.

(a) Which **two** elements represent non-metals

(b) Write the formula of the compound formed between elements **B** and **C** and identity the bond present in the compound

32. (a) Distinguish between a covalent and dative bond
(b) Explain why nitrogen gas reacts with oxygen at very high temperature

33. Draw a dot ( ) and cross (**x**) diagram to show bonding in:-
(i) Ammonium ion (NH_4^+
(N = 7.0, H= 1)
(ii) Silane (SiH_4)

(Si= 14, H = 1)

34. Below is a table oxides of some period three elements

Oxides	Na_2O	P_4O_6	SO_2	Cl_2O
State at room temp	Solid	Solid	Gas	Gas

(a) Give the systematic name of Cl_2O
(b) Explain why Na_2O exists as a solid whereas SO_2 is a gas at room temperature

35. The table below shows properties of period three chlorides

Formular of compound	NaCl	$MgCl_2$	$AlCl_3$	$SiCl_4$
Bp ^oC	1470^oC	1420^oC	180^oC	60^oC

Explain why $AlCl_3$ solid has a much lower boiling point than $MgCl_2$ solid