1990

CHEMISTRY

YEAR 11

TRIAL EXAM

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CANDIDATE'S NAME_____

CHEMISTRY ASSOCIATES

YEAR 11 CHEMISTRY TRIAL EXAMINATION 1990
(not to be used before Wednesday August 1, 1990)

Time allowed for examination = 2.5 hours.

MULTIPLE CHOICE ANSWER SHEET SECTION A

Instructions:(1) Mark letters with a single pencil line
EXAMPLE A B C ~~D~~

(2) Completely erase any mistakes.

(3) One and only one letter should be marked for each item.

(1)	A	B	C	D	(16)	A	B	C	D
(2)	A	B	C	D	(17)	A	B	C	D
(3)	A	B	C	D	(18)	A	B	C	D
(4)	A	B	C	D	(19)	A	B	C	D
(5)	A	B	C	D	(20)	A	B	C	D
(6)	A	B	C	D	(21)	A	B	C	D
(7)	A	B	C	D	(22)	A	B	C	D
(8)	A	B	C	D	(23)	A	B	C	D
(9)	A	B	C	D	(24)	A	B	C	D
(10)	A	B	C	D	(25)	A	B	C	D
(11)	A	B	C	D	(26)	A	B	C	D
(12)	A	B	C	D	(27)	A	B	C	D
(13)	A	B	C	D	(28)	A	B	C	D
(14)	A	B	C	D	(29)	A	B	C	D
(15)	A	B	C	D	(30)	A	B	C	D

DETACH THIS ANSWER SHEET AT THE START OF THE EXAMINATION

CHEMISTRY ASSOCIATES

CANDIDATE'S NAME _____

YEAR 11 CHEMISTRY TRIAL EXAMINATION 1990
Time allowed for examination = 2.5 hours

Structure of examination paper: Number of booklets = 1
Number of Sections = 2

SECTION	NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	PERCENTAGE OF EXAMINATION
A	30	30	30
B	12	12	70

There is a Multiple Choice Answer Sheet attached to the front of this booklet.

DIRECTIONS TO CANDIDATES

(1) Answer ALL questions.

(2) Section A questions must be answered on the Multiple Choice Answer Sheet provided.

(3) Section B questions must be answered in the spaces provided.

(4) At the end of the examination, place the Multiple Choice Answer Sheet inside the back cover of this booklet and hand them in.

(5) Please ensure that you write your name on this booklet AND on the Multiple Choice Answer Sheet.

(6) Approved calculators may be used.

SPECIFIC INSTRUCTIONS FOR SECTION A

(1) Section A consists of 30 multiple choice items and is worth 30 marks and therefore 30% of the total marks available for this examination.You should therefore spend about 45 minutes on Section A.

(2) Choose the response you consider is correct or best, and mark your choice on the Multiple Choice Answer Sheet according to the instructions on that sheet.

(3) A correctly answered item scores 1, an incorrect item scores 0. No credit will be given for an item if two or more letters are marked for that item. Marks will NOT be deducted for incorrect answers and you are urged to attempt every item.

(4) Jottings should be done in the WORKING SPACES in this booklet.

Item 1
The fundamental particles found in the nucleus of the atom are
A. protons only.
B. protons and neutrons.
C. neutrons only.
D. electrons and neutrons.

Item 2
An atom becomes a NEGATIVE ion when
A. it gains electrons.
B. its mass number changes.
C. it gains protons.
D. its atomic number changes.

Item 3
The electronic configuration of the ion , O^{2-}, is
A. $1s^2\ 2s^2\ 2p^4$
B. $1s^2\ 2s^2\ 2p^6\ 3s^1$
C. $1s^2\ 2s^2\ 2p^2$
D. $1s^2\ 2s^2\ 2p^6$

Item 4
The Pauli Principle states that
A. orbitals must have either 1 or 2 electrons.
B. orbitals must contain 2 electrons.
C. orbitals may have up to 2 electrons.
D. orbitals must follow the octet rule.

Item 5
A PERIOD in the period table is identified as
A. elements with different numbers of valence electrons.
B. a column of the periodic table.
C. elements with the same electronegativity.
D. a row of the periodic table.

Item 6
Sodium (Na) and Fluorine (F) have very different chemical properties because
A. they have different mass numbers.
B. they have different shells as their outershell.
C. they have atoms that are different in size.
D. they have different numbers of outershell electrons.

Item 7
Ionic bonding involves
A. a transfer of electrons between a metal and a non-metal.
B. a sharing of electrons between two non-metals.
C. a transfer of electrons between two non-metals.
D. a sharing of electrons between a metal and a non-metal.

Item 8
The main type of force holding the molecules of water together in ice (solid water) is
A. nuclear.
B. electrostatic.
C. gravitational.
D. magnetic.

Item 9
The most important types of chemical bonding present in a sample of ammonia gas dissolved in water are
A. covalent bonding and dispersion forces.
B. ionic bonding and hydrogen bonding.
C. ionic bonding and covalent bonding.
D. covalent bonding and hydrogen bonding.

Item 10
Metal M forms a compound with the formula M_2CO_3.Which one of the following formulae is correct?
A. M_2NO_3
B. $M(OH)_2$
C. MSO_4
D. MCl

Item 11
Which one of the following is NOT an empirical formula?
A. $C_6H_{12}O_6$
B. H_2SO_4
C. H_3PO_4
D. C_3H_8

Item 12
The elements carbon and hydrogen make up a compound. 28 g of this compound contains 24 g of carbon and 4 g of hydrogen. Given that the relative atomic masses of carbon and hydrogen are 12 and 1 respectively, the empirical formula of this compound is
A. CH
B. CH_3
C. CH_2
D. CH_4

Item 13
In one mole of $Ca_3(PO_4)_2$ there is
A. eight mole of oxygen atoms.
B. four mole of oxygen atoms.
C. four mole of phosphorus atoms.
D. one mole of calcium atoms.

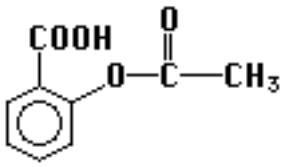
Item 14
Two molecules of ethanol, CH_3CH_2OH, contain a total of

A. 6 atoms.
B. 18 atoms
C. 9 atoms.
D. 24 atoms.

Item 15
The molar mass of $Ca_3(PO_4)_2$ is (O = 16 , P = 31, Ca = 40)

A. 199.
B. 310.
C. 279.
D. 430.

Item 16
The number of hydrogen atoms in the structure of aspirin shown below is



ASPIRIN

A. 1
B. 4
C. 10
D. 8

Item 17
A solution of iron(III) nitrate, $Fe(NO_3)_3$, contains

A. equal numbers of iron and nitrate ions.
B. three times as many nitrate ions as iron ions.
C. twice as many nitrate ions as iron ions.
D. nine times as many nitrate ions as iron ions.

Item 18

The molar mass of hydrated copper(II) sulfate, $CuSO_4.5H_2O$, is

(H = 1, O = 16, S = 32, Cu = 63.5)

A. 249.5
B. 185.5
C. 201.5
D. 177.5

Item 19

If one mole of oxygen atoms has a mass of 16 g, what mass of oxygen molecules is there in 16 g of oxygen atoms? (Oxygen molecules are diatomic, O_2, and the relative atomic mass of oxygen = 16)

A. 8 g
B. 32 g
C. 16 g
D. 64 g

Item 20

A gas occupies 6.0 dm^3 at STP. At 25^{o}C and 120000 Pa, this volume would be

A. (101325/120000) x (298/273) x 6 dm^3
B. (120000/101325) x (273/298) x 6 dm^3
C. (120000/101325) x (298/273) x (1/6) dm^3
D. (120000/101325) x (273/298) x (1/6) dm^3

Item 21

5 g of sodium hydroxide is dissolved in 5 dm^3 of water. The molarity of the hydroxide ion in solution is approximately

(Molar mass of NaOH = 40 g mol^{-1})

A. 10.00 M
B. 0.25 M
C. 1.00 M
D. 0.025 M

Item 22

A acid would best be described as

A. an electron acceptor.
B. a proton acceptor.
C. an electron donor.
D. a proton donor.

Item 23

Which one of the following is a conjugate acid-base pair?

A. NH_3 and OH^-
B. H_3O^+ and OH^-
C. HNO_3 and H_2O
D. HNO_3 and NO_3^-

Item 24
The AVERAGE oxidation number of carbon in glucose, $C_6H_{12}O_6$, is

A. +2
B. +1
C. 0
D. -1

Item 25
Which one of the following reactions represents a REDOX reaction?

A. $Zn + 2H^+ = Zn^{2+} + H_2$
B. $CaCO_3 = CaO + CO_2$
C. $Ag^+ + Cl^- = AgCl$
D. $Al(OH)_3 + 3HCl = AlCl_3 + 3H_2O$

Item 26
Nitrogen reacts with hydrogen to produce ammonia according to the equation:

$$x\ N_2(g) + y\ H_2(g) = z\ NH_3(g)$$

The values of x , y , z which will balance this equation are respectively
A. 2 , 3 , 1
B. 1 , 3 , 2
C. 2 , 1 , 3
D. 3 , 2 , 1

Item 27
The balanced equation for the reaction between aluminium hydroxide and hydrochloric acid is

A. $AlOH + HCl_2 = AlCl_2 + H_2O$
B. $AlOH + HCl = AlCl + H_2O$
C. $Al(OH)_3 + H_2Cl = AlCl + 5H_2O$
D. $Al(OH)_3 + 3HCl = AlCl_3 + 3H_2O$

Item 28
The chemical formulae for ethane and ethene are respectively:

A. C_2H_6 and C_2H_4
B. C_3H_8 and C_4H_{10}
C. C_3H_6 and C_4H_8
D. C_2H_6 and C_3H_8

Item 29
When one mole of ethane gas reacts completely with oxygen gas, the products are
A. 1 mole of carbon dioxide and 1 mole of water.
B. 2 mole of carbon dioxide and 3 mole of water.
C. 1 mole of carbon dioxide and 2 mole of water.
D. 2 mole of carbon dioxide and 4 mole of water.

Item 30
The number of structural isomers of the substituted **alkane**, $C_2H_4Cl_2$, is
A. 1
B. 3
C. 2
D. 4

END OF SECTION A

SPECIFIC INSTRUCTIONS FOR SECTION B

(1) Section B consists of 12 questions and is worth 70 marks and therefore 70% of the total marks available for the examination. You should therefore spend about 105 minutes on Section B.
A suggested time allocation is given for each question and the marks allotted to each question are also indicated.

(2) Answers must be written in the spaces following each question in this booklet.

(3) You should show all working in numerical questions. No credit can be given for incorrect answers unless they are accompanied by details of the working.

(4) Full credit will **not** be given for unsimplified answers. When stating an answer, appropriate precision (number of significant figures) must be used and the units included.

(5) When chemical symbols are used in equations they must be accompanied by correct symbols of state, for example $H_2(g)$ for hydrogen gas.

QUESTION 1 (9 minutes, 6 marks)

Write balanced chemical equations for each of the following:

(a) silver nitrate solution is added to potassium chloride solution and a precipitate forms.

_____

(b) propane gas (C_3H_8) burns in oxygen gas to produce carbon dioxide gas and water vapour.

_____

(c) hydrogen gas reacts explosively with oxygen gas to produce water vapour

_____

(d) dilute hydrochloric acid is neutralised by calcium hydroxide solution.

_____

(e) write the IONIC EQUATION for the reaction in (d)

_____

(f) write the IONIC EQUATION for the reaction in (a)

_____

QUESTION 2 (7 minutes, 5 marks)

Name the following compounds:

(a) K_2SO_3 _____ (f) NaI _____

(b)$NaNO_3$ _____ (g)$(NH_4)_2Cr_2O_7$ _____

(c)$Fe_2(SO_4)_3$ _____ (h)CH_3COOH _____

(d)KCl _____ (i)CH_3OH _____

(e)CO_2 _____ (j)H_2SO_4 _____

QUESTION 3 (7 minutes, 5 marks)

(a) An element has been discovered on the first visit of a human being to Mars. The scientists on the trip have called it **canalium**. They find that it has two isotopes. The isotope with a relative mass of 106.9 has an abundance of 51.8%. The other isotope has a relative mass of 108.9
Calculate the relative atomic mass of **canalium**.

(b) One of the scientists suggests that canalium is a new element. Is this possible?
Give reasons for your answer.

_____

_____

_____

_____

_____

_____

QUESTION 4 (8 minutes, 5 marks)
Write the electronic configuration of each of the following:

(a) He _____ (b) Ar_____

(c) Ne_____(d) Ca^{2+}_____

(e) Al^{3+}_____(f) Cl_____

(g) Mg_____(h) O^{-}_____

(i) N^{3-}_____(j) B _____

QUESTION 5 (11 minutes, 7 marks)
Write a brief account of the history of the development of the Periodic Table.
Why is the Periodic Table so important in the study of Chemistry?

QUESTION 6 (11 minutes, 7 marks)

(a) Draw diagrams showing the *INTRAMOLECULAR* and*INTERMOLECULAR* bonding in **nitrogen gas.**

(b) Draw the structures of the following molecules and describe the shape of each.

(1) **HCl** (2) $\mathbf{H_2}$ (3) $\mathbf{H_2O}$ (4) $\mathbf{CO_2}$

Indicate clearly whether the molecules are POLAR or NON-POLAR.

QUESTION 7 (6 minutes, 4 marks)
A liquid is found to contain 37.5% carbon by mass and 12.5% hydrogen by mass. The only other element in the liquid is oxygen. Calculate the empirical formula of the liquid, assuming that it is a pure substance.
(C = 12, H = 1, O = 16)

QUESTION 8 (12 minutes, 8 marks)

Copper metal reacts with nitric acid to produce nitrogen monoxide gas according to the equation:

$$3Cu(s) + 8HNO_3(aq) = 3Cu(NO_3)_2(aq) + 2NO(g) + 4H_2O(l)$$

(a) What is the concentration of the nitric acid if 11 cm^3 is required to react exactly with 2.0 g of copper according to the above equation? (Cu = 63.5)

(b) What volume of nitrogen monoxide gas at 101 325 Pa and 100^oC would be produced in this reaction? (R = 8.31 J K^{-1} mol^{-1})

QUESTION 8 (continued)

(c) Is this an oxidation-reduction reaction? Explain.

_____

_____

_____

_____

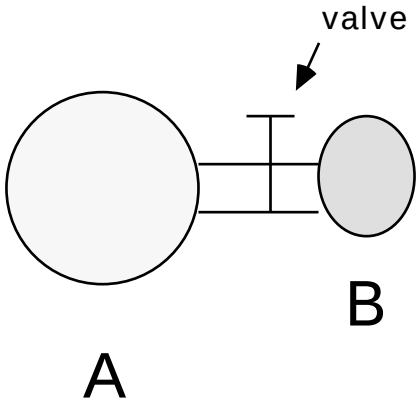
_____

_____

_____

QUESTION 9 (9 minutes, 6 marks)

Two flasks are connected by a valve as shown in the diagram below.



Flask **A** has a volume of 21.00 dm^3 and contains hydrogen gas at a pressure of 1×10^6 Pa. Flask **B** has a volume of 7.00 dm^3 and contains helium gas at a pressure of 5×10^5 Pa. The temperature is 100K.

(a) Calculate the pressure in flask **B** when the contents of flask **A** are pumped into flask **B**. (Assume that the temperature remains constant).

(b) Calculate the pressure in flask **A** when the contents of flask **B** are pumped into flask **A** and the temperature is reduced to 50 K.

QUESTION 10 (9 minutes, 6 marks)

In each of the following reactions, state whether the first named chemical is acting as an ACID , a BASE or NEITHER. Give a reason for your answer in each case.

(a) $NH_4^+ + OH^- = NH_3 + H_2O$

(b) $KOH + (1/2)H_2 = K + H_2O$

(c) $HPO_4^{2-} + H_3O^+ = H_2PO_4^- + H_2O$

QUESTION 10 (continued)

(d) $Zn^{2+} + H_2 = 2H^+ + Zn$

(e) $H_3O^+ + HCO_3^- = H_2O + H_2CO_3$

(f) $AgCl + NaNO_3 = AgNO_3 + NaCl$

QUESTION 11 (7 minutes, 5 marks)
Calculate the oxidation numbers of SULFUR and CARBON in the following:

(a) Na_2S _____ (f) CO_3^{2-} _____

(b) H_2SO_3 _____ (g) C_3H_8 _____

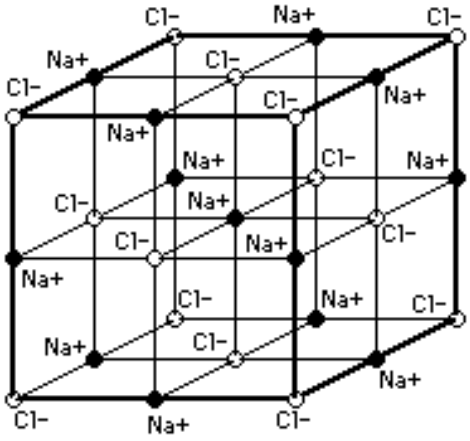
(c) K_2SO_4 _____ (h) CO _____

(d) S_8 _____ (i) C_2H_2 _____

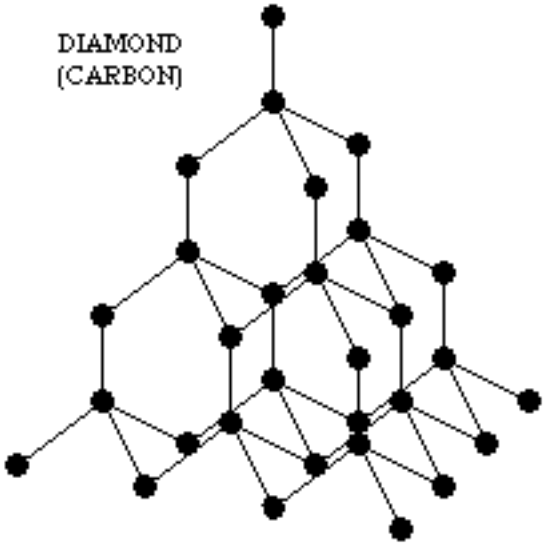
(e) SO_2 _____ (j) CH_3OH _____

QUESTION 12 (9 minutes, 6 marks)

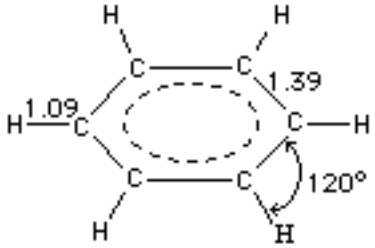
For each of the three structures drawn below, describe type of chemical bonding present.



COMMON SALT
(SODIUM CHLORIDE)



QUESTION 12 (continued)



BENZENE

END OF 1990 CHEMISTRY YEAR 11 TRIAL EXAM

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SECTION A 1B 2A 3D 4C 5D 6D 7A 8B 9D 10D 11A 12C 13A 14B 15B 16D 17B 18A 19C 20A 21D 22D 23D 24C 25A 26B 27D 28A 29B 30C

SECTION B

1. (a) $AgNO_3(aq) + KCl(aq) = AgCl(s) + KNO_3(aq)$
   (b) $C_3H_8(g) + 5O_2(g) = 3CO_2(g) + 4H_2O(g)$
   (c) $2H_2(g) + O_2(g) = 2H_2O(g)$
   (d) $2HCl(aq) + Ca(OH)_2(aq) = CaCl_2(aq) + 2H_2O(l)$
   (e) $H^+(aq) + OH^-(aq) = H_2O(l)$
   (f) $Ag^+(aq) + Cl^-(aq) = AgCl(s)$

2. (a) potassium sulfite (b) sodium nitrate (c) iron(III) sulfate
   (d) potassium chloride (e) carbon dioxide (f) sodium iodide
   (g) ammonium dichromate (h) ethanoic acid (acetic acid)
   (i) methanol (methyl alcohol) (j) dihydrogen sulfate (sulfuric acid)

3.(a) Relative Atomic Mass = (51.8/100) x 106.9 + (48.2/100) x 108.9
= (5537.42 + 5248.98)/100
= 107.9
= 108 (3 significant figures)

(b) This cannot be a new element since it has an relative atomic mass within the range of the known elements and therefore, must have a number of protons equal to one of the known elements. There are no gaps in the elements up to number 105 (approximately). In fact, **canalium** is the element **silver**.

4. (a) $1s^2$ (b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ (c) $1s^2\ 2s^2\ 2p^6$
   (d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ (e) $1s^2\ 2s^2\ 2p^6$ (f) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
   (g) $1s^2\ 2s^2\ 2p^6\ 3s^2$ (h) $1s^2\ 2s^2\ 2p^5$ (i) $1s^2\ 2s^2\ 2p^6$ (j) $1s^2\ 2s^2\ 2p^1$

5. The Periodic Table is an attempt to classify the elements according to their physical and chemical properties. DOBEREINER discovered triads of chemically similar elements in which the relative atomic mass of the middle element was the average of the other two. NEWLANDS arranged the known elements in order of increasing atomic weight (relative atomic mass) and claimed that chemically similar elements occurred every eighth element (Law of Octaves). MENDELEEV proposed the Periodic Law:"The properties of the elements are a periodic function of atomic weight". He arranged the elements in a table, left spaces for elements yet to be discovered and predicted the properties of some of these elements. In the modern periodic table, atomic number has replaced atomic weight in Mendeleev's Periodic Law.
The Periodic Table is vital in modern chemistry for the classification and organisation of the vast quantities of information about each of the elements. It provides a key link between the atomic theory of the elements, in particular, the electron arrangements in the elements, and the properties of the elements. Without the Periodic Table, our chemical knowledge would lack a unifying theme.

6. (A **nitrogen gas** **-N ≡ N -**
Strong covalent bonding within the molecules, but weak dispersion forces between the molecules.

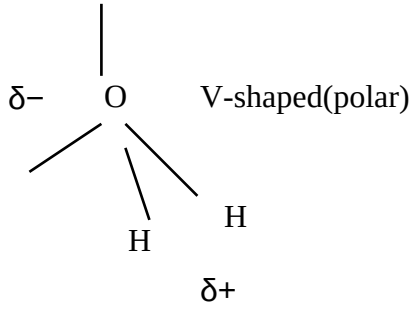
-N ≡ N -

-N ≡ N -

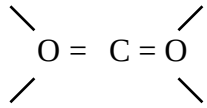
6.(b) (1) linear , polar $\delta+$ H – Cl $\delta-$

(2) linear , non-polar H - H

(3)



(4)



linear (non-polar)

7. n(C) : n(H) : n(O) = (37.5/12) : (12.5/1) : (50/16) = 3.125 : 12.5 : 3.125

Simplest whole number ratio = 1 : 4 : 1

Hence, **empirical formula is CH_4O**

8. (a) $n(HNO_3)$ = (8/3) x n(Cu) = (8/3) x (2.0/63.5)
$c(HNO_3)$ = n/V = (8/3) x (2.0/63.5) x (1000/11) = 7.6M
= 7.6M(2 significant figures) **ANS**

(b) n(NO) = (2/3) x n(Cu) = (2/3) x (2.0/63.5)
V(NO) = nRT/P = (2/3) x (2.0/63.5) x 8.31 x (373/101325) x 1000 dm^3
= 0.64 dm^3 (2 s.f.) **ANS**

(c)In this reaction the oxidation number of Cu has changed from 0 to +2 and the oxidation number of N has changed from +5 to +2. Therefore, this is an oxidation-reduction reaction

9. (a) $n(H_2)$ = PV/RT = 10^6 x 21/RT and n(He) = PV/RT = 5 x 10^5 x 7/RT
= 2.1 x10^7/RT = 3.5 x 10^6/RT
Pressure in **B** = nRT/V
= 2.45 x 10^7/RT x RT/7
= 3.5 x 10^6 Pa **ANS**

(b) Pressure in **A** = nRT/V = (2.45 x 10^7/100R) x (50R/10)
= 1.23 x 10^6 Pa **ANS**

10. (a) acid - proton donor (b) neither- no transfer of protons
(c) base - proton acceptor (d) neither - no transfer of protons
(e) acid - proton donor (f) neither - no transfer of protons

11. (a) -2 (b) +4 (c) +6 (d) 0 (e) +4 (f) +4 (g) -2.7 (average) (h) +2
(i) -1 (j) -2

12. Chemical bonding is entirely electrostatic in character. That is, it involves the attraction between positive and negative charges.The bonding in sodium chloride is IONIC. There are forces of attraction between the positively charged sodium ions and the negatively charged chloride ions. Each sodium ion is surrounded by six chloride ions and each chloride ion is surrounded by six sodium ions. Dispersion forces are also present but they are weak compared with the ionic bonding. The bonding in diamond is COVALENT. One pair of electrons is shared between each pair of carbon atoms. Each carbon atom has four nearest neighbours.Dispersion forces are also present, but they are weak compared with the covalent bonding. Both sodium chloride and diamond are examples of giant three dimensional molecules. On the other hand, benzene is a discrete molecule with strong covalent bonding within the molecule and weak dispersion forces between neighbouring molecules. Each carbon atom within the molecule has three single covalent bonds and one delocalised electron which belongs to the entire hexagonal ring. While the bond angles in benzene are 120^o as shown, the bond angles in diamond are approximately 109^o and the bond angles in sodium chloride are 90^o.

END OF 1990 CHEMISTRY YEAR 11 TRIAL EXAM SOLUTIONS

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