NATIONAL BUSINESS AND TECHNICAL EXAMINATIONS BOARD [NABTEB]

(GENERAL EDUCATION EXAMINATION)

MAY/JUNE 2005

SECTION B

CHEMISTRY (ESSAY)

ANSWER FOUR QUESTIONS:

ALL QUESTIONS CARRY EQUAL MARKS

1(ai). An experiment showed that 16.25g of iron chloride were obtained from the combination of 5.6g of iron with chlorine. What is the formula of the iron chloride? (fe=56, CL=35.5).

Solution

	Fe	CL
Mass (g)	5.6	16.25-5.6=10.65
Mole ratio	$\frac{5.6}{56}=0.1$	$\frac{10.65}{35.5}=0.3$
Divide by smaller	0.1/0.1	0.3/0.1=3
	=0.1	
∴ Formula =	$FeCl_3$	

(aii). Sulphur is soluble in ethanol but not in water while sodium chloride is soluble in water but not in ethanol. Describe how you will separate sodium chloride from a mixture of sulphur and sodium chloride.

Solution

(1b). Add water to the mixture in order to dissolve the sodium chloride. Filter to obtain the sodium chloride as the filtrate.

Evaporate the filtrate and the sodium Chloride solid is left behind in the evaporation dish. Put the sulphur residue in a filter paper and allow to dry.

Alternative method

Add ethanol to the mixture to dissolve the sulphur. Filter to obtain the sulphur as filtrated, expose filtrate to air for sometime/heat 60 below 50^c in order to evaporate the ethanol.

Wash the sulphur with water and spread on filter paper to dry.

(1c) A current of 0.156 ampere is passed through a solution of lead (ii) trioxotrate (v), calculate the time it will take for 1.0g of lead to be deposited at the cathode.

(Pb=207, N=14, 0=16; 1 mole of electrons=1 faraday.)

Solution

$Pb^{2+}(aq)+2e$------- pb(s)

∴ 2x96, 500c produces 207g of pb

∴ 1g Pb is produced by 193,000/207 = 932.367c.

Q=IT

0.156 xt =932.367C

:. t = 932.367/0.156

= 5976.7sec.

(2)i The same quantity of electricity was passed through two voltmeter. If 6.4g of copper was deposited in one cell, what mass of aluminum would be liberated in the other cell? (Al = 27.0, CU= 64.0,1 mole of electrons =1 faraday).

Solution

(2a) Cu^{2+} + 2e --------→ Cu(s)

Al^{3+} + 3e---------→ Al(s)

Mole of copper deposited =6.4g/64gmol^{-1}

0.1mole

Since the mole of elements are inversely proportional to the charges on the ions, then the no of moles of Aluminum deposited

$\frac{2}{3}$ x 0.1 = 0.0667mole

Mass of Aluminum = 0.667x2.7 = 1.80g

Alternative method.

Cu^{2+} (aq) + 2e------→ Cu(s)

Al^{3+} + 3e ----→ Al(s)

∴ 64g of copper is deposited by 2x 96, 500c

6.4g of copper is deposited by 2x96500x6.4/64

= 19300c

3x96500c deposited 27g of Al

∴ 19300 deposited $\frac{27}{3x96500} \times 19300$ **= 1.80g**

(bi) **Calculate** the molecular formula of a compound containing 38.75% carbon, 16.10% of hydrogen and 45.15% of nitrogen given that its molecular mass is 3l[c = 12. H =1, N =14]

(i) Write the structure for the compound

(ii) Write two chemical properties for the compound.

Solution

	C	*H*	*N*
Percentage	*38.75*	*16.10*	*45.15*
Mole ratio	*38.75*	*16.10*	*45.15*
	12	*1*	*14*
	=3.229	*= 16.10*	*=3.225*
Divide by	*3.229/3.225*	*16.10/3.225*	*3.225/3.225*
Smaller = 1		*= 4.992*	*= 1*

Empirical formulae = CH_5N

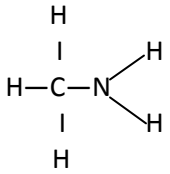
∴ 12X+5X=14X = 31

31x = 31

x= 31/31 = 1

∴ Molecular formula = CH_5N

1) The structure is



All bonds and atoms must be shown.

(iii) Chemical properties

(b) It reacts with acids to form salt

(E.g. nylon, polyamids) e.g. $CH3\ NH_2 + HCL \rightarrow CH_3 + NH_2\ CL^{(-)}$

3(ai) Define heat of combustion of a compound.

(ii) When 4.6g of ethanol, CH_3CH_2OH were burned in a calorimeter containing 1.0kg of water, the temperature rises from 291k to 316k. If the specific heat capacity of water is $4.18kj^{-1}k^{1}$ and the water equivalent of the calorimeter is $1.3kjk^{-1}$ and the relative molar mass of ethanol is 46. Calculate the enthalpy of combustion of ethanol.

Solutions:

3(ai) The heat of combustion of a compound is the heat evolved/ given off when one mole of the compound is completely burnt in oxygen.

(ii) Heat evolved on burning ethanol = the heat gained by the water and the calorimeter

Heat gain by Water = 1.00x4.18x25

= 104.5KJ

Heat gained by calorimeter = 1.3 x 25

= 32.5KJ

N0 of moles of ethanol burnt = 6.4/64

= 0.1

:. 0.1 mole ethanol burns to evolve (104.5 + 32.5) KJ = 137KJ

:. 1 Mole of ethanol burns to release 137.0/0.1 = 1370KJ

:. Heat of combustion of ethanol = $-1370KJmol^{-1}$

3b (i) state two physical differences between fats and oil.

(ii) Explain how vegetable oil is converted to margarine

List two reagents required for the conversion of propan-2-OL to propanone

Solution

1) Fats are solid at room temperature/have high melting points while oil are liquids at room temperature /have low melting points.

(ii) The vegetable oil is heated to about 180^{c} using nickel catalyst. Hydrogen in Bubbled in at 5 atoms. Pressure and the oil harden up. Then salts Vitamins/milk are added to form margarine

2) the two reagents are:

Tetraoxosulphate (vi) acid and potassium tetraoxomanganate (vii)/ potassium heptaoxochromate (vi).

[Accept formulae i.e. H_2SO_4 and $KMn0_4/k_2C_207$]

1) Write equation each for the preparation of a jar of

1) ethane
2) ethyne

Solution

a (i) $CH_3 C00Na (s) + Na oH(aq) \rightarrow Na_2 C0_3(s) + CH_4(g)$

(ii) $CaC_2(s) + 2H_2O$© $\rightarrow$ ca (0H) $_2$(aq) + $C_2H_2(g)$

(4b) Write equation for reaction of each of the gases in (a) with oxygen.

Solution

$CH_4 + 20_2 \rightarrow 2H_20 + C0_2$

$2C_2H_2+5O_2 \rightarrow 4CO_2+2H_2O$

(4c) which of the ethane orethyne is said to be unsaturated?

Solution

Ethyne is unsaturated

(4d) what is unsaturated.

Solution

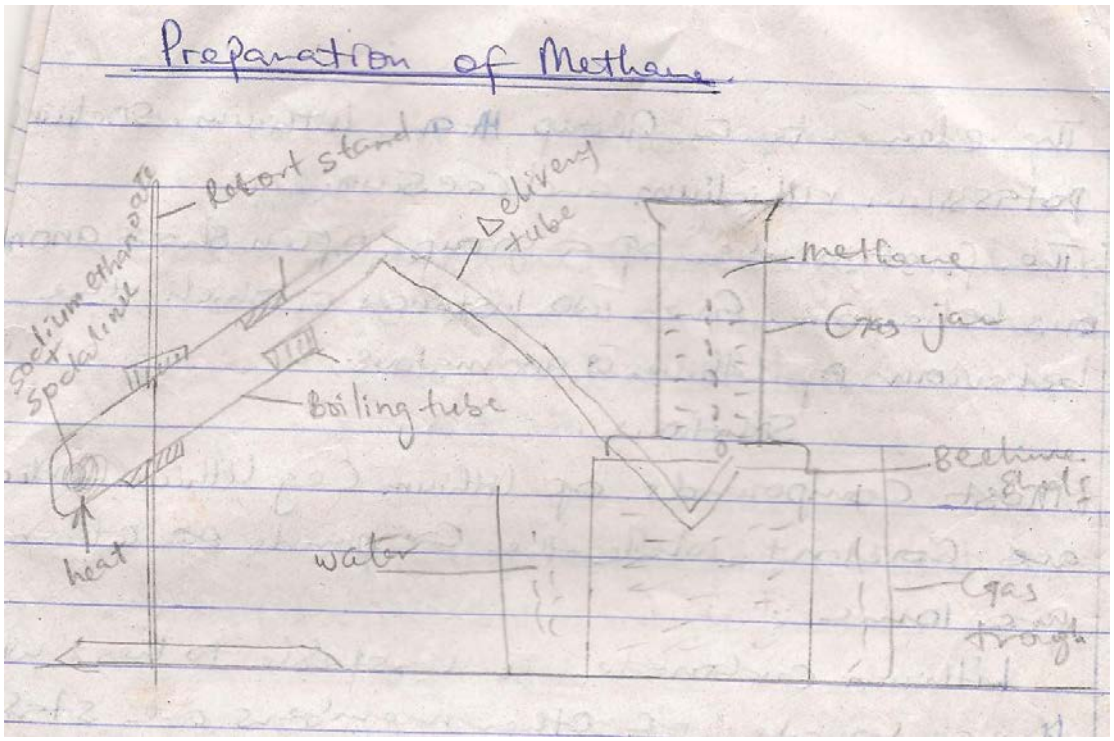
Unsaturation is a term/phenomenon used in describing a molecule that contains a multiply (double/triple) bond.

(4e) Describe a test which would enable you to demonstrate that an hydrogen is unsaturated.

Solution

(4e) I will pass the hydrocarbon into bromine/ bromine water which is purple in colour. If the bromine becomes decolourised, then the hydrocarbon is unsaturated.

(4f) Draw a labelled diagram of the apparatus you would used for the preparation of one of the gases in (a) in the laboratory.



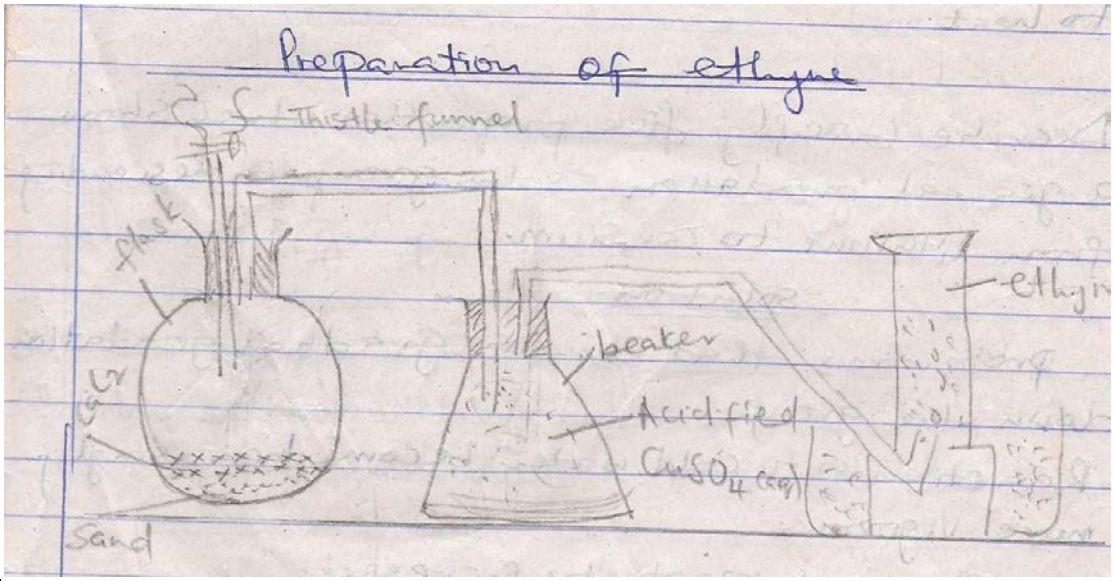


Figure (i) : preparation of methane

5) The elements in GROUP IA are lithium, sodium, potassium, rubidium and caesium.

a) The first member of a group often shows anomalous behaviour. Give two instances in which the behaviour of lithium is anomalous.

Solution

5(a) Most compounds of lithium (eg lithium iodide) are covalent while the compounds of others are ionic.

Lithium carbonate is unstable to heat while the carbonates of other members are stable to heat.

(5b) Describe briefly five properties which show a general gradation as the group is descending from lithium to caesium.

Solution

1) Properties that show a gradual gradation down the group.
   1. Reactions with cold water become increasingly more vigorous.
   2. The chemical reactivity increases.
   3. Solubility of their oxides to form hydroxides decreases.
   4. On heating, their nitrates decompose with increasing difficulty
   5. Melting point/boiling point decreases.
   6. Electronegatively decreases.
   7. Ionisation energy decreases.

(5c) Explain the meaning of Ionization energy.

Solution

Ionisation energy is the energy needed to remove the outer most electron from an atom/gaseous atom to form an ion/gaseous ion e.g. Na(g)---------→ $Na^{+}_{(g)}$+e

(5d) **How are ionization energies related to the reactivity of these elements?**

Solution

2) As the group is descending. The ionisation energy decreases, hence it becomes less difficult to form the ions. With the ease of formation of the ion, the metal becomes more reactive, hence reactivity increases down the group.

(5e) why is the ion Na^{+} form in normal chemical reactions rather than the ion Na^{2+}?

solution

3) The electronic configuration of sodium is $1S^2\ 2S^2\ 2p^6\ 3s^{1-}$ to form Na^{+}, the one Electron in the 3rd shell is lost leaving 8 electrons in the second shell which in a very stable configuration. It is very difficult to lose an electron from any octect configuration i.e. Na^{+} (g) ------ →Na^{2+} (g) is impossible to achieve.