MINISTRY OF EDUCATION AND HIGHER EDUCATION

GRADE 12 EXAMS, 2006

# CHEMISTRY

2006

P/LAND NATIONAL EXAMINATION BOARD

Name .....School .....

Roll Number.....

# Puntland State of Somalia

## Ministry of Education
### Puntland National Examination Board

# Chemistry Examination
## June 2006

**2½ hours**

**PLUS 10 MINUTES** before the exam for reading through the paper

**TOTAL TIME 2 hours 40 minutes**

## INSTRUCTIONS TO CANDIDATES

This paper consists of 16 PRINTED pages.
Count them now. Inform the invigilator if there are any missing.

This paper consists of two parts:
Section A: 10 marks
Section B: 90 marks TOTAL 100 marks

- Answer ALL questions.
- All answers must be written on this paper in the spaces provided immediately after each question. ONLY WRITE ON THIS EXAM PAPER.
- ALL WORKING SHOULD BE CLEARLY SHOWN IN THE SPACE AFTER THE QUESTION.
- Rough work can be done on page 2. This will not be marked
- NO extra paper is allowed.
- NO CALCULATORS are allowed.
- If you make a mistake cross out the incorrect answer clearly and write your correct answer.

**USE THIS PAPER FOR ROUGH WORK. IT WILL NOT BE MARKED.**

## Section A: Multiple choice questions

- For each question in this section, circle the correct answer.
- If you change your mind cross out the answer you have wrongly chosen and clearly circle the correct answer.
- If the examiner thinks you have marked two answers you will not receive a mark for that question.
- For each question there is only one correct answer. Each question is worth one mark.

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1 Which of the following is an example of **chemical change**?

A heating ice to make water
B frying an egg
C filtering solid copper from salt solution
D chromatography

2 Which pair of **atoms** has the same number of **neutrons**?

A $^{12}_{6}C$ and $^{24}_{12}Mg$
B $^{19}_{9}F$ and $^{20}_{10}Ne$
C $^{23}_{11}Na$ and $^{39}_{19}K$
D $^{59}_{27}Co$ and $^{59}_{28}Ni$

3 **Atoms** can form **negative ions** by:

A proton gain
B electron loss
C proton loss
D electron gain?

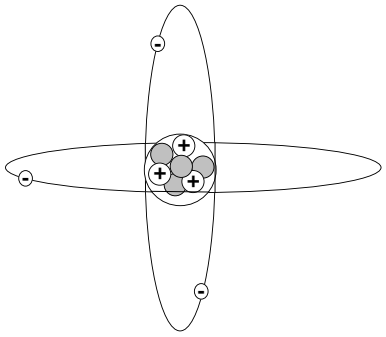
4 Which of the following **elements** is the *most* **electronegative**?

A Fluorine
B Chlorine
C Oxygen
D Nitrogen

5 An **electron** in the *second* **energy level** and the *second* **subshell** is described as:

A 1s
B 2s
C 1p
D 2p ?

6 The following diagram represents an atom of **lithium**.



Which of the following statements is **true**?

A A lithium atom has 4 electrons
B Neutrons carry a charge of +4
C The atomic number is 4
D A lithium atom has 3 protons

7 A **pure substance** that cannot be **chemically decomposed** is called:

A an element
B a compound
C a mixture
D an isotope?

8 When **sodium chloride solution** is electrolysed, what forms at the **cathode**?

A sodium
B oxygen
C chlorine
D hydrogen

9 $AgNO_3$ (aq) + KI (aq) $\rightarrow$ AgI (s) + $KNO_3$ (aq)

The reaction shown above is an example of:

A Dissociation
B Decomposition
C Precipitation
D Neutralization?

10 When **rainwater** is **acidic** it is called *acid rain*. Which of the following **oxides** will **NOT** be found in acid rain?

A $CO_2$
B $NO_2$
C CaO
D $SO_2$

Total 10 marks

## Section B: Structured questions

- Answer all of the questions below as fully as possible. You must write all your answers in the spaces provided on the paper.
- The mark awarded for each part question is shown at the end of the space provided e.g. (2) means 2 marks.

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Question 1

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **H** | | | | | | | | | | | | | | | | | |
| | **Be** | | | | | | | | | | | | **N** | | | **Ne** | |
| | | | | | | | | | | | | **Al** | | | | **Cl** | |
| **K** | | | | | | | | | | | **Zn** | | | | | | |
| | | | | | | | | | | | | | | | | | **Xe** |

Use **only** the elements **given** in the outline **Periodic Table** above. You can use a chosen element more than once to answer the questions below.

Put the **symbol** *or* the **name** of **one element** *only* to answer the question in each case.

A A metal — Any of:- K, Be, Zn, Al (1)

B A Halogen — Cl (1)

C A gas at room temperature with diatomic molecules — Cl or N (1)

D Used to sterilize drinking water — Cl (1)

E A Transition Element — Zn (1)

F In the same group of the periodic table as magnesium — Be (1)

G

| | | | |
|---|---|---|---|
| | In the same period of the periodic table as calcium | K or Zn | (1) |
| H | A Noble gas | Ne or Xe | (1) |
| I | Has 5 electrons in its valency shell | N | (1) |
| J | Reacts violently with cold water to form hydrogen gas | K | (1) |

Total 10 marks

Question 2

Name the **method** you would use in each case to **separate** each of the following mixtures:-

| | | | |
|---|---|---|---|
| A | A solution of water and ethanol | Distillation | (1) |
| B | A mixture of sand and water | Filtration | (1) |
| C | Salt solution | Evaporation | (1) |
| D | An immiscible mixture of oil and ethanol | Separating funnel | (1) |
| E | To separate a mixture of several different coloured inks | Chromatography | (1) |

F. From the list below:-

Aluminium, copper, ammonia, carbon dioxide, sulphur and water

[i] Name the elements

Aluminium[1], copper[1], sulphur[1] .....minus[1] for any mistake.....(3)

[ii] Name the compounds

water[1], ammonia[1], carbon dioxide[1], .....minus[1] for any mistake.....(3)

[iii] Write the formulae for the gases in the list

$NH_3$[1], $CO_2$[1].....(2)

Total 13 marks

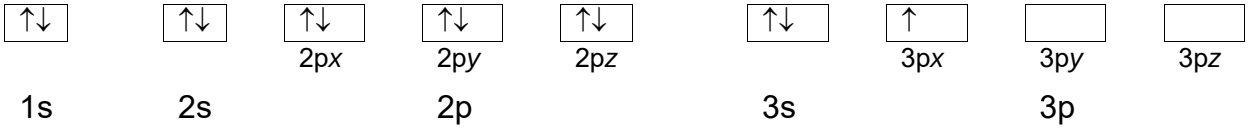
Question 3

The *electronic configuration* (arrangement of electrons) of aluminium (atomic number 13) can be shown as:-

**Bohr structure** 2,8,3 *or*

**spdf notation** $1s^2, 2s^2 2p^6, 3s^2 3p^1$ *or*

**Electrons in boxes notation**



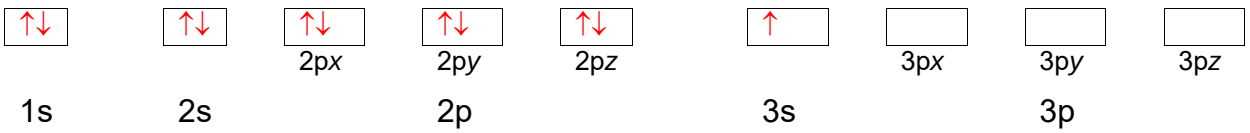

Give the Bohr, spdf notation and electrons in boxes notation to show the **electronic configurations** (arrangement of electrons) of the following elements:-

(a) Sodium (atomic number 11) (3)

**Bohr structure** 2,8,1

**spdf notation** $1s^2, 2s^2 2p^6, 3s^1$

**Electrons in boxes notation**

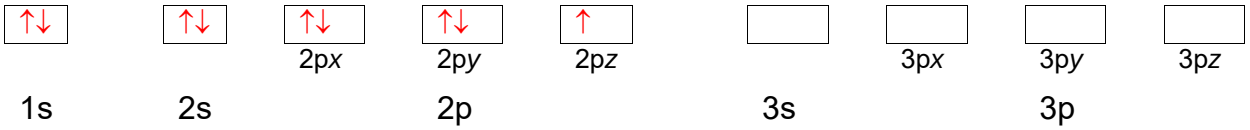


(b) Fluorine (atomic number 9) (3)

**Bohr structure** 2,7,

**spdf notation** $1s^2$, $2s^22p^5$,

**Electrons in boxes notation**




(c) What type of bonding is present in a fluorine ($F_2$ ) molecule? (1)

covalent .....

(d) Write a *half equation* to show a fluorine atom gaining electrons to become a fluoride ion.

(1)

$F + e^- \rightarrow F^-$ .....

(e) Write a *half equation* to show a sodium atom losing electrons to become a sodium ion.

(1)

$Na \rightarrow Na^+ + e^-$ .....

(f) Which *half equation* is showing **reduction**?

(1)

$F + e^- \rightarrow F^-$ .....

(g) Which *half equation* is showing **oxidation**?

(1)

$Na \rightarrow Na^+ + e^-$ .....

(h) Give **two** properties of sodium fluoride.

High melting point .....(1)

Conducts electricity when molten or in solution .....(1)

Total 13 marks

Question 4

The order of reactivity of the Group VII non-metals (Halogens) is:-

F > Cl > Br > I (most to least reactive)

The table shows what happens when each of the Halogens (elements) is added to a solution of a different potassium halide. If there is a reaction '**Yes**' is written if no reaction '**No**' is written. The table is incomplete.

| **Halogen added** | **Solution of potassium halide (aq)** | | |
|---|---|---|---|
| | **Potassium chloride** | **Potassium bromide** | **Potassium iodide** |
| **Bromine (aq)** | No | No | Yes |
| **Chlorine (g)** | No | Yes | Yes |
| **Iodine (aq)** | No | No | No |

(a) Complete the table by writing **in the table** 'Yes' (*reaction*) or 'No' (*no reaction*) for each of the following:

[i] Chlorine and potassium bromide (1)

[ii] Chlorine and potassium iodide (1)

[iii] Iodine and potassium chloride (1)

[iv] Iodine and potassium bromide (1)

(b) What type of reaction is taking place when bromine reacts with potassium iodide?

Displacement or redox reaction ..... (1)

(c) Write a **balanced** *symbols* **equation** for the reaction between bromine (aq) and potassium iodide (aq). *Show state symbols*.

$2KI\ (aq) + Br_2\ (aq) \rightarrow 2KBr\ (aq) + I_2\ (aq)$ ..... (3)

One mark for correct formulae, one for balancing, one for state symbols

Total 8 marks

Question 5

The reaction between an acid and an alkali can be summed up as:

Acid (aq) + Alkali (aq) → Salt (aq) + Water (l)

(a) Name this type of reaction.....neutralization.....(1)

(b) Name the salt formed when hydrochloric acid (aq) reacts with potassium hydroxide (aq)

potassium chloride..... (1)

(c) Name the acid (aq) and alkali needed to make the salt potassium sulphate (aq)

sulphuric acid and potassium hydroxide..... (2)

(d) Complete the following word equations:

[i] nitric acid (aq) + sodium hydroxide (aq) → sodium nitrate (aq) + water (l)

[ii] zinc (s) + sulphuric acid (aq) → zinc sulphate (aq) + hydrogen (g)

[iii] hydrochloric acid (aq) + magnesium carbonate (s) → magnesium chloride (aq) + water (l) + carbon dioxide (g)

(4)

(e) Hydrochloric acid, (0.50 mol/dm$^3$,15.00 cm$^3$), neutralizes a solution of sodium hydroxide, (10.00 cm$^3$).

[i] Write a **balanced** *symbols* **equation** for the reaction (2)

(This gives you the ratio of no. moles of acid to no. moles of alkali)

HCl (aq) + NaOH (aq) → NaCl (aq) + $H_2O$ (l)

[ii] How many moles of hydrochloric acid were used? (1)

0.50 x 15/1000 = 0.0075 mol of HCl.....

.....

[iii] How many moles of sodium hydroxide were used? (1)

0.0075 mol of NaOH.....

[ii] What is the concentration of sodium hydroxide in mol/dm$^3$? (1)

0.0075/10 x 1000 = 0.75 mol/dm$^3$ or 0.075 M .....

.....

Total 13 marks

Question 6

Use the table below to answer the questions that follow.

| | Electrical Conductivity | | | | |
|---|---|---|---|---|---|
| **Substance** | **Solid** | **Molten** | **In solution (water)** | **Melting point (°C)** | **Boiling point (°C)** |
| **T** | Good | Good | Insoluble | 1540 | 2740 |
| **U** | Poor | Poor | Insoluble | 115 | 444 |
| **V** | Good | Good | Fizzes & conducts | 98 | 890 |
| **W** | Poor | Poor | Poor | 0 | 100 |
| **X** | Poor | Good | Good | 808 | 1465 |
| **Y** | Poor | Poor | Good | -114 | -85 |

Use the **letter** only to identify a substance, e.g. **Y**

(a) Chose **one substance** which at room temperature which is a:

[i] solid...Any of T, U, V or X..... (1)

[ii] gas...W.....(1)

[iii] liquid...Y.....(1)

(b) Which substance is an ionic solid? …X……(1)

Give one reason why you have chosen your substance.

Does not conduct electricity as a solid but does when molten or in solution…… (1)

……

(c) Which two substances are metals? ……T and V……(2)

Explain why have you chosen your substances

Both conduct electricity when solid or molten……(1)

(d) Which substance could be from Group I of the periodic table? … V……(1)

Explain why you have chosen your substance.

Conducts electricity when solid or molten and reacts with water……(1)

……

Total 10 marks

Question 6

Ethane burns in air according to the following equation:

$$C_3H_8\,(g) + 5O_2\,(g) \rightarrow 3CO_2(g) + 4H_2O(l) \qquad \Delta H = \text{negative}$$

(a) What name is given to reactions in which ΔH is negative? (1)

Exothermic[1]

(b) The following tables show the energy changes that take place when bonds are broken and formed.

Energy **used** (taken in) to break bonds:

| Bond | Number of the bonds | Bond dissociation energy kJ $mole^{-1}$ | Energy needed in kJ |
|---|---|---|---|
| C – H | 8 | 413 | 3304[1] |
| C – C | 2 | 330 | 660[1] |
| O = O | 5[1] | 497 | 2485 |
| | | Total energy used (take in) | 6449[1] |

Energy **given out** when new bonds are formed:

| Bond | Number of the bonds | Bond dissociation energy kJ $mole^{-1}$ | Energy given out in kJ |
|---|---|---|---|
| C = O | 6 | 740 | 4440[1] |
| H – O | 8[1] | 463 | 3704 |
| | | Total energy given out | 8144[1] |

[i] Complete the tables to find the total energy taken in and the total energy given out.
1 mark for each correct answer in the tables (7)

[ii] Use your answers to calculate the energy **given out** by the complete combustion of **1 mole** of ethane. (2)

(-8144+6449) = -1695 kJ/mol

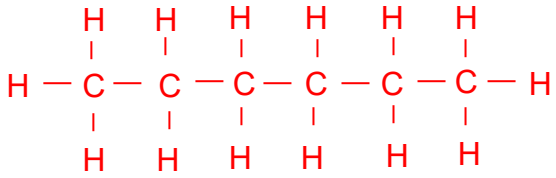
1 mark for mathematical formula and substitution

1 mark for correct answer

Total 10 marks

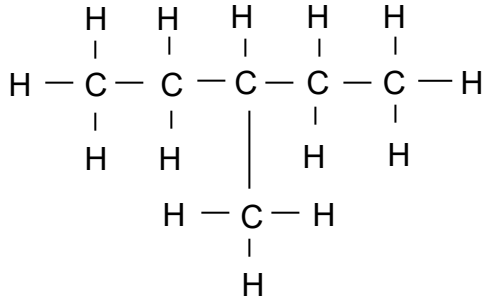
Question 8

(a) Draw the structure of a hexane molecule. (1)



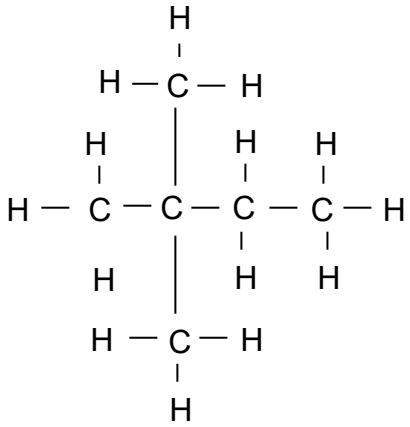
(b) Name the two isomers of hexane (given below)

A



A = 3-Methylpentane[1]

B



B = 2,2'-Dimethylbutane[1]

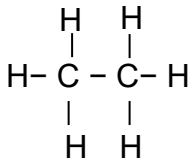
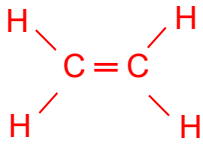
(2)

(c) Name the remaining two isomers of hexane

2,3-Dimethylbutane..... (1)

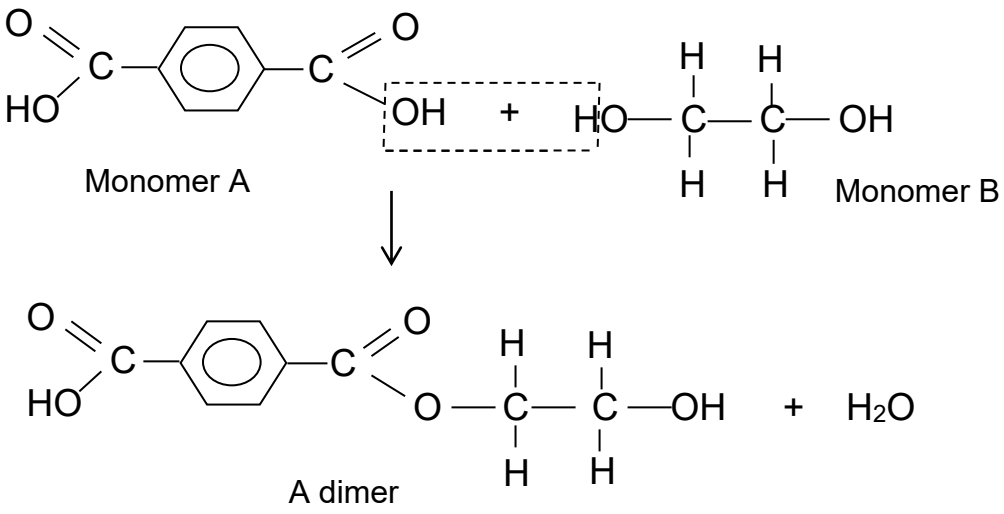
2,-Methylpentane..... (1)

(d) Complete the table below for each of the given hydrocarbons:- (5)

| **Compound:-** | **Ethane** | **Ethene** | **Ethyne** |
|---|---|---|---|
| **Homologous Series:-** | Alkane | Alkene | Alkyne |
| **Molecular Formulae:-** | $C_2H_6$ | $C_2H_4$ | $C_2H_2$ |
| **Structural Formulae:-** |  |  | H– C ≡ C– H |
| **Type of Covalent Bonding:-** | *Single* | *Single and Double* | *Single and Triple* |
| **Is the Carbon to Carbon bonding saturated or unsaturated?** | *Saturated* | *Unsaturated* | *Unsaturated* |

5 x 1 mark for each correct answer

(a) The following reaction shows the first stage in the formation of a *polyester* in which an alcohol and a carboxylic acid group combine to form an ester with the loss of water:-



(b) Which monomer is the alcohol? (A or B) (1)

Monomer B

(c) Which monomer is the carboxylic acid? (A or B) (1)

Monomer A

(d) What type of polymerization is taking place? (1)

Condensation polymerization

Total 13 marks