402 S. H. S. C. E.
MAY 2011
CHEMISTRY **1&2**
Objective and Essay Tests
2½ hours

Name:..................................................

Identification Number: ...........................

# THE WEST AFRICAN EXAMINATIONS COUNCIL

**Senior High School Certificate Examination**

May 2011                    **CHEMISTRY**                    2½ hours

*Do **not** open this booklet until you are told to do so. While you are waiting, read and observe the following instructions carefully. Write your **name** and **identification number** in the space provided above.*
*This paper consists of two parts: Papers 1 and 2. Answer Paper 1 on your Objective Test Answer Sheet and Paper 2 in your Answer Booklet. **Paper 1** will last for **1 hour** after which the answer sheet will be collected. Do **not** start **Paper 2** until you are told to do so. **Paper 2** will last for 1½ **hours**.*

## PAPER 1
### OBJECTIVE TEST
### [40 marks]                                                        1 hour

1.  Use **2B** pencil throughout.
2.  On the objective answer sheet supplied, provide the following details **correctly:**
    (a)  Supply the information required in the spaces marked *CENTER NAME, CENTER No, SCHOOL NAME and SCHOOL No..*
    (b)  In the space marked *STUDENT'S NAME*, write your **surname** followed by your **other names.** Write your **identification number** in the space marked *STUDENT No.*
    (c)  In the spaces marked *SUBJECT and GRADE,* write CHEMISTRY and 12TH in that order.
    (d)  In the box marked *IDENTIFICATION NUMBER,* provide your **identification number** vertically in the spaces on the left-hand side, and shade each numbered space in line with each digit. This identification number must be the same as the one indicated on your Admission Slip. Repeat the process with the correct information for the box marked *YEAR OF FIRST ENTRY.*
    (e)  In the box marked *Subject Code,* write the digits 402 vertically in the spaces on the left-hand side.**Shade** the corresponding numbered spaces as you did for your identification number.
3.  An example is given below. This is for a female candidate whose *name* is Wynna A. FANIA .
    Her *identification number* is 001011210, her first entry is in 2011 and she is offering *CHEMISTRY.*

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| | |
|---|---|
| **DWEH SAGBEH ACADEMY**<br>CENTER NAME | 981001<br>CENTER No. |
| **BONDOE TELEE HIGH SCHOOL**<br>SCHOOL NAME | 001011<br>SCHOOL No. |
| **FANIA, WYNNA A.**<br>STUDENT NAME | 210<br>STUDENT No. |
| **CHEMISTRY**<br>SUBJECT | **12TH**<br>GRADE |

**IDENTIFICATION NUMBER**

**YEAR OF FIRST ENTRY**

**SUBJECT CODE**

For Supervisors only.
If a candidate is absent ☐
shade this space.

Shade the space marked
M (for Male) or F(for Female)          M          F
In this box                                               ☐          ■

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PAPER I
OBJECTIVE
[40 marks]

Time: 1 hour

*Answer all questions.*

*Paper 1 consists of **sixty** questions. Each question is followed by **four** options lettered A to D. Find out the correct option for each question then shade in **pencil** on your answer sheet, the answer space which bears the same letter as the option you have chosen. Give only **one** answer to each question..*

1.  When a typical solid such as a bar of iron is heated it increases in volume. This is due to the
    A.  number of atoms of iron increasing.
    B.  number of atoms of iron decreasing.
    C.  size of the atom of iron decreasing or increasing.
    D.  distance between the atoms of iron increasing.

2.  Which of the following electronic configurations represents that of a noble gas?
    A.  2,8,8,2
    B.  2,8,2
    C.  2,8
    D.  2,6

3.  Which separation method is used to obtain methylated spirits from a mixture of methylated spirits and water?
    A.  Evaporation
    B.  Distillation
    C.  Fractional distillation
    D.  Sublimation

4.  Which separation method is used to obtain solid sodium chloride from brine?
    A.  Evaporation
    B.  Filtration
    C.  Sublimation
    D.  Fractional distillation

5.  The valency of an element such as chlorine is due mainly to the
    A.  number of protons present in the nucleus of each atom.
    B.  total number of electrons present orbiting the nucleus of each atom.
    C.  number of electrons in the outermost orbit only of each atom.
    D.  number of neutrons present in the nucleus of each atom.

6.  Which of the following statements about covalent compound is **correct**?
    A.  All molecules of covalent compounds contain at least one shared of pair electrons.
    B.  All covalent compounds can be split up by electrolysis.
    C.  All covalent compounds ionize freely in the liquid state.
    D.  All covalent compounds are gases at normal room temperature and pressure.

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7. Magnesium burns in oxygen to produce magnesium oxide $[2Mg + O_2 \longrightarrow 2MgO]$. What would be the percentage of oxygen by weight in magnesium oxide? $[Mg = 24, O = 16]$

   A. 25%
   B. 40%
   C. 50%
   D. 80%

8. A certain metallic element 'M' burnt in oxygen to produce its oxide. The oxide was found to contain 50% by weight of M and 50% by weight of oxygen. What will be the empirical formula of the metal oxide? $[M = 40, O = 16]$

   A. $MO_2$
   B. $M_2O$
   C $MO$
   D. $M_2O_5$

9. Some chemical reactions are readily reversible without the addition of any new substance.
   Which of the following reactions is the least easy to reverse?

   A. $2H_2O + H_2O \longrightarrow H_2O + O_2$
   B. $3Fe + 4H_2O \longrightarrow Fe_2O_4 + 4H_2O$
   C. $NH_3 + H_2O \longrightarrow NH_4OH$
   D. $2SO_2 + O_2 \longrightarrow 2SO_3$

10. How many grams of oxygen can be obtained by the decomposition of 150grams of mercuric oxide?
    $2HgO \longrightarrow 2Hg + O_2$
    $[Hg = 200, O = 16]$

    A. 11.1g
    B. 7.40g
    C. 111.0g
    D. 740g

11. Which of the following is the general equation for double decomposition/ replacement reaction?

    A. $A + B \longrightarrow AB$
    B. $ABC \longrightarrow AC + B$
    C. $AB + CD \longrightarrow AC + BD$
    D. $AB + CD \longrightarrow AD + CB$

12. A metal oxide in which oxygen has the oxidation number of $-1/2$ is

    A. a peroxide.
    B. a super oxide.
    C. an acid oxide.
    D. an oxide.

13. According to the Kinetic Theory, as the temperature of a liquid increases, the average speed of the molecules

    A. increase in proportion to the temperature rise.
    B. decreases in proportion to the temperature rise.
    C. remains the same.
    D. reaches a maximum beyond which an increase in speed is not possible.

14. Which of the following electronic configuration has 1 unpaired electron?

    A. 2, 8, 7
    B. 2, 8, 2
    C. 2, 8
    D. 2, 5

15. The activation energy of a reaction may be lowered by

    A. raising the temperature.
    B. lowering the temperature.
    C. removing the product of the reaction.
    D. adding a catalyst.

**Turn Over**

16. In the electrolysis of silver oxide, what product would be obtained at the cathode?

    A. Oxygen gas
    B. Silver
    C. Silver ions
    D. Oxygen

17. Standard temperature and pressure (S.T.P.) have the following conditions:

    A. $T = 100^0C, P + 76cm$
    B. $T = 0^0C, P = 76mm$
    C. $T = 0^0C, P = 760mm$
    D. $T = 273\,K, P = 76cm$

18. Because water can promote certain reactions, it behaves very much like

    A. an oxidizing agent.
    B. a reducing agent.
    C. a catalyst.
    D. a universal solvent.

19. Calculate the molecular formula of a liquid that has an empirical formula, $N_2O$ and a molecular formula weight of 92g.

    A. $N_4O_2$
    B. $N_2O_2$
    C. $N_3O_2$
    D. $N_2O_4$

20. Which of the following statement about air is **not** correct?

    A. Air is a mixture.
    B. The air we breath in is mainly oxygen.
    C. The composition of air is not always constant.
    D. Air has weight.

21. One way to increase the average speed of the molecules of an ideal gas is to

    A. decrease the temperature.
    B. expand the gas against the piston.
    C. expand the gas into a vacuum.
    D. add heat, hold volume and pressure constant.

22. Which of the following statements is **correct** about saturated solution?

    A. More solute will always dissolve if the temperature of the solution is raised.
    B. All saturated solutions contain equal quantities of solute.
    C. Saturated solution of gases generally will dissolve if the temperature is lowered.
    D. For a solution to be saturated some undissolved solute must remain at the bottom of the container.

23. 298 K converted to degree Fahrenheit is

    A. $472^\circ F$
    B. $268\,^\circ F$
    C. $60\,^\circ F$
    D. $32\,^\circ F$

24. Which of the following is **not** a method of producing a salt?

    A. Acid + non-metal
    B. Acid + hydroxide
    C. Acid – oxide
    D. Acid + carbonate.

25. Which of the following salt is virtually insoluble in water and would be produced as a precipitate?

    A. Lead Nitrate
    B. Magnesium Chloride
    C. Sodium Carbonate
    D. Barium Sulfate

26. What is the normality of a sodium hydroxide solution if 25 mL of 0.08N hydrochloric acid solution exactly neutralize 20 mL of the solution of sodium hydroxide?

    A.   0.08N
    B.   0.1N
    C.   0.8N
    D.   1.0N

27. Oxidation may be stated as a reaction where oxygen is added to an element or compound.
    Which of the following equations shows oxidation of the first substance in the equation?

    I.    $2Mg + O_2 \longrightarrow 2MgO$
    II.   $PbO + H_2 \longrightarrow Pb + H_2O$
    III.  $2H_2 + O_2 \longrightarrow 2H_2O$
    IV.   $Fe_2O_3 + CO \longrightarrow 2Fe + CO_3$

    A.   I and II
    B.   I and III
    C.   II and III
    D.   I and IV

28. Which of the following would **not** normally be regarded as a reducing agent?

    A.   Hydrogen
    B.   Carbon
    C.   Carbon dioxide
    D.   Hydrogen sulfide

29. In the reaction [$3Fe + 4H_2O \longrightarrow Fe_2O_4 + 4H_2$], the equilibrium constant, K is equal to

    A.   $\dfrac{[Fe][H_2O]}{[Fe_2O_4][H_2]}$

    B.   $\dfrac{[Fe]^3[H_2O]^4}{[Fe_3O_4][H_2]^4}$

    C.   $\dfrac{[Fe_3O_4][H_2]^4}{[Fe]^3[H_2O]^4}$

    D.   $[Fe]^3[H_2O]^4[Fe_3O_4]$

30. Substances with the same molecular formula but different structures are called

    A.   isomers.
    B.   polymers.
    C.   isotopes.
    D.   catenation.

31. Exothermic reactions are reaction which proceed with an evolution of heat to the surrounding.
    Which of the below equations **best** show exothermic reaction?

    A.   $C + O_2 \longrightarrow CO_2$
    B.   $CaO + H_2O \longrightarrow Ca(OH)_2$
    C.   $NaOH \longrightarrow Na^+ + OH$
    D.   $2H + O_2 \longrightarrow 2H_2O$

32. The collision theory can be used to explain the factors that affect the rates of chemical reactions. Which of the below listed factors is **not** a collision theory?

    A.   Nature of reactant
    B.   Concentration
    C.   Surface area of reactant
    D.   Presence of light and absence of a catalyst

33. Reaction rates are measured by considering how

    A.   property which changes as the amount of reactants or products change.
    B.   quickly products are formed or reactants are used up in a chemical reaction.
    C.   a reaction rate increases.
    D.   a rise in temperature increases the rate of reaction.

**Turn Over**

34. The method by which animal charcoal is used to remove colored substances from solution is called

    A. absorption.
    B. precipitation.
    C. adsorption.
    D. filtration.

35. How many grams of $CO_2(g)$ can be obtained by the complete combustion of 150grams of methane?
    [ $CH_4 = 16$ g, $O = 16$ g $H = 1g$]

    A. 412.5g
    B. 825g
    C. 130g
    D. 150g

36. The property of matter that depends on how much matter is being considered is called

    A. physical property.
    B. intensive property.
    C. chemical property.
    D. ixtensive property.

37. Which of the following is **not** a compound of iron?
    A. Heamatite
    B. Magnetite
    C. Limonite
    D. Bauxite

38. Which of the following is **not** true about pure copper?

    A. It is malleable.
    B. It has a high conductivity for heat.
    C. It has a high conductivity for electricity.
    D. It is very brittle.

39. Which of these is not a property of zinc?

    A. Zinc is more active than iron.
    B. Zinc is used to make brass.
    C. Zinc loses electrons more readily than aluminum.
    D. Forms amphoteric compounds.

40. Certain metals liberate pure hydrogen when heated with concentrated sodium (or potassium) hydroxide. Which of these metals would be the most accepted?

    A. Copper
    B. Silver
    C. Iron
    D. Zinc

41. The modern periodic table has been widened to accommodate the group of elements known as

    A. halogens.
    B. alkali metals.
    C. lanthanides.
    D. inert gases.

42. Group 0 of the periodic classification contains the rare (or inert) gases. Which of the following features do they have in common?

    A. They have the same atomic mass.
    B. They have the same atomic number.
    C. The nucleus of each atom contains the maximum number of protons and neutrons.
    D. The outermost orbit of electrons is saturated.

43. The first three elements in Group 1A have the following atomic structures:
Lithium:3 protons, 4 neutrons and 2:1electrons Sodium: 11 protons, 12 neutrons and 2.8.1 electrons and Potassium:19 protons, 20 neutrons and 2.8.8,1 electrons.
Which of the following features causes them to have similar properties?

 A.   Each atom has more protons than neutrons.
 B.   Each atom has the same number of protons and electrons.
 C.   Each atom has 2 electrons in the first Orbit.
 D.   Each atom has 1 electron in the outermost Orbit.

44. A natural source of uncombined carbon is

 A.   petroleum.
 B.   carbonates.
 C.   diamond.
 D.   the earth.

45. The energy released when an electron is added to the outermost shell of a gaseous atom is called

 A.   ionization energy.
 B.   absorption energy.
 C.   potential energy.
 D.   electron affinity.

46. Nitrogen is normally obtained commercially by

 A    heating copper in a system of air free from carbon dioxide.
 B.   fractional distillation of liquid air.
 C.   warming a concentrated solution of ammonia.
 D.   the thermal decomposition of ammonium dichromate.

47. The principal quantum number **n**, indicates the

 A.   shape of the orbital.
 B.   orientation of the orbital.
 C.   configuration of the orbital.
 D.   distance between the nucleus and the electron(s) in each energy level.

48. Ammonia is manufactured by passing hydrogen and nitrogen through an iron catalyst at $500^0C$ and 250 atmospheres. The name of this process is the

 A.   Frasch Process.
 B.   Haber Process.
 C.   Bosch Process.
 D.   Contact Process.

49. Which of the following kinds of sulfur is produced when boiling sulfur is poured into cold water?

 A.   Plastic Sulfur
 B.   Monoclinic Sulfur
 C.   Rhombic Sulfur
 D.   Roll Sulfur

50. A solution of sulfur dioxide in water is called

 A.   sulfurous acid.
 B.   sulfurous acid.
 C.   hydrogen sulfuric acid.
 D.   fuming Sulfuric acid.

51. Ester can **best** be described as

 A.   organic salts of fatty acids.
 B.   fermentation products.
 C.   polymers.
 D.   unsaturated hydrocarbons.

**Turn Over**

52. The quantitative study of reactants and products in a chemical reaction is called

   A.   balancing equation.
   B.   stoichiometry.
   C.   chemical kinetics.
   D.   adding a catalyst.

53. The locally produced cane juice is obtained from sugar cane by a method of

   A.   fermentation
   B.   simple distillation
   C.   fractional distillation
   D.   cane juice production

54. The equivalence of 2000 kg in pounds is
   A.   2000lbs
   B.   910lbs
   C.   4,400lbs
   D.   1000lbs

55. 30 grams of ammonia was decomposed yielding nitrogen and hydrogen gas. How many grams of hydrogen was released. The equation for the reaction is :

   $NH_3(g) \rightarrow N_2(g) + O_2(g)$
   [ N = 14, H = 1, O = 16]

   A.   2.7 g
   B.   5.4g
   C.   16.2g
   D.   15g

56. Group VIII elements can be called by either of the following names **except**

   A.   Noble gases.
   B.   Inert gases.
   C.   Stable and unreactive gases.
   D.   Alkaline.

57. Which form of carbon below has mobile Electrons ?

   A.   Diamond
   B.   Graphite
   C.   Coke
   D.   Carbon black

58. 298K converted to degree Fahrenheit is

   A.   472°F
   B.   60°F
   C.   248°F
   D.   77°F

59. A given volume of methane diffuses in 20 sec . How long will it take the same volume of sulfur(IV)oxide to diffuse under the same conditions?
   [ $CH_4 = 16$, $SO_2 = 64$]

   A.   10 sec
   B.   80 sec
   C.   40sec
   D.   60sec

60. The combined enthalpy-entropy function of a system is called

   A.   Kinetic energy.
   B.   Combined energy.
   C.   Free energy.
   D.   Potential energy.

# END OF PAPER 1

# DO NOT TURN THIS PAPER OVER UNTIL YOU ARE TOLD TO DO SO.

# YOU WILL BE PENALIZED SEVERLY IF YOU ARE FOUND LOOKING AT THE NEXT PAGE BEFORE YOU ARE TOLD TO DO SO.

**PART 2**                                                    1$^1/_2$ hours
**ESSAY**
[60 marks]

Paper **2** consists of **nine** essay questions divided into **three** sections: **I, II, III**. You are required to answer **seven** questions in all: **four** questions from Section **I**, **two** questions from Section **II** and **one** question from Section **III**.

Write your answers in **ink** (**blue** or **black**)

**SECTION I**
[**Compulsory**]
[36 marks]

Answer all **four** questions in this section.

1.  There are some electrochemical processes in which chemical potential energy is converted into electric energy. A device that makes such a conversion is known as a voltaic cell.

    (a)     Draw a completely labeled voltaic cell consisting of zinc metal in a solution of zinc ions connected with a saltbridge and an external circuit to copper metal in a solution of copper ions. Show the direction of flow of electrons in the cell.

    (b)     Write a shorthand notation representing the cell reactions for the

            (i)     oxidation-half reaction;

            (ii)    reduction-half reaction; and

            (iii)   entire zinc-copper cell.

2. Discus each of the following hydrocarbon phenomenon.

    (a)      Aliphatic compounds

    (b)      Saturated chain hydrocarbon

    (c)      Unsaturated chain hydrocarbon

    (d)      Homologous series

    (e)      Hydrocarbon radical

3. Compute the boiling and freezing points of the following solution

    38.8 grams of $C_7H_{11}NO_7S$ ( 4-nitro-2-toluenesulfonic acid dihydrate)

    [C=12, H=1, N= 14, O= 16, S= 32]

4. Define/ state or discuss the following

    (a)      capillary rise

    (b)      surface tension

    (c)      Hess's Law

    (d)      entropy

    (e)      enthalpy

    (f)      free energy

    (g)      exergonic reaction.

Gibb's Free energy is expressed as : $\Delta G = \Delta H - T\Delta S$. In a tabular form, give at least **two** conditions for spontaneity of a reaction and values of $\Delta H$ and $\Delta S$ at either low or high temperature.

## SECTION II

[16 marks]

There are **three** questions in this section. You are required to **answer only two.**

5. Draw the structural formula (condensed form) for each of the following.

   (a)   2-methylpentane

   (b)   Tetramethylbutane

   (c)   2,2,4-trimethylpentane

   (d)   3-ethyl-2-methylpentane

   (e)   3-ethylhaxane

   (f)   3-propyl-1-heptene

6. From the Kinetic Theory of Gases, it is found that if two substances are at the same temperature, their average kinetic energies must be the same.

   Therefore, $KE_1 = KE_2 = \frac{1}{2} mv^2$

   (a)   Show that $V_1/V_2 = \sqrt{m2/m1}$

   (b)   [Kr = 83.3g/mol, Br= 79.9 g/mol]

   Find the relative rate of diffusion for the gases **Krypton and Bromine**
   Given that $KE_{Kr} = KE_{Br2}$

SECTION III

13

7. The molecular mass of a gas may be determined by using a modified form of the ideal gas equation.

   (a) Given that PV = nRT, find an expression for the molecular mass of the gas.

   (b) Given that density of a substance is defined as mass per unit volume, find an expression for the density of a gas using the ideal gas equation.

   (c) Suppose your chemistry class, during an experiment, measured the mass of the vapor of an unknown compound contained in a $546 \text{ cm}^3$ gas bulb. You find that the bulb contains 1.50 grams of gas, 184.4 kpa pressure and 122°C,

      (i) What is the molecular mass of the gas?

      (ii) What is the density of the gas?
      [$R = 0.0821 \text{L atm. mol}^{-1} \text{ K}^{-1}$, $R = 8.31 \text{dm}^3 \text{kpa mol}^{-1} \text{ K}^{-1}$, $1 \text{dm}^3 = 100 \text{cm}^3$, $1 \text{cm}^3 = 1 \text{mL}$]


**SECTION III**

[8 marks]

There are **two** questions in this section. You are required to do only **one**.

8. Discuss the following theories of acids and bases and give reaction representing each.

   (a)    (i) Arrhenius Theory,

          (ii) Brønsted-Lowry Theory, and

          (iii) Lewis Theory.

   (b)    Acetic acid is a weak acid and ionizes only slightly. The equation for the ionization of acetic acid at equilibrium is

   $$CH_3COOH(l) + H_2O(l) \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$$
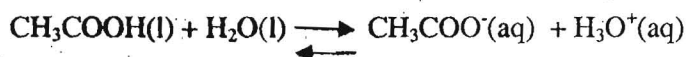
   Show that the expression for Ka is given by: $Ka = \dfrac{[H_3O^+][CH_3COO^-]}{[CH_3COOH]}$

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**9.** The specific heat of aluminum is given by: $0.903 Jg^{-1} {}^\circ C^{-1}$

   (a)   How many heat is lost when a solid aluminum ingot with a mass of 4110 grams cools from 66.0°C to 25.0 °C?

   (b)   Suppose a piece of iron with a mass of 42.0 grams at a temperature of 200.0 °C is dropped into an insulated container of water. The mass of the water is 264 grams and its temperature before adding the iron was 40.0 °C, what will be the final temperature of the system?

   [specific heat of iron = $0.44J g^{-1} {}^\circ C^{-1}$, specific heat of water = $4.184 Jg^{-1} {}^\circ C^{-1}$]

## END OF PAPER