402 S. H. S. C. E.
MAY 2012
CHEMISTRY **1&2**
Objective and Essay Tests
2½ hours

Name:.....

Identification Number: .....

THE WEST AFRICAN EXAMINATIONS COUNCIL

Senior High School Certificate Examination

May 2012 **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 male candidate whose *name* is Michael J. GAYTLOR.
   His *identification number* is 101123456, his first entry is in 2012 and he is offering *CHEMISTRY.*

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SOMAH TAMBA INSTITUTE	500104
CENTER NAME	CENTER No.
TUKPEI PREPARATORY SCHOOL	101123
SCHOOL NAME	SCHOOL No.
GAYFLOR, MICHEAL J.	456
STUDENT NAME	STUDENT No.
CHEMISTRY	12TH
SUBJECT	GRADE

IDENTIFICATION NUMBER

1	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨
0	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨
1	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨
1	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨
2	⇨	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨
3	⇨	⇨	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨
4	⇨	⇨	⇨	⇨	■	⇨	⇨	⇨	⇨	⇨
5	⇨	⇨	⇨	⇨	⇨	■	⇨	⇨	⇨	⇨
6	⇨	⇨	⇨	⇨	⇨	⇨	■	⇨	⇨	⇨

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

YEAR OF FIRST ENTRY

2	⇨	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨
0	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨
1	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨
2	⇨	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨

SUBJECT CODE

4	⇨	⇨	⇨	⇨	■	⇨	⇨	⇨	⇨	⇨
0	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨	⇨
2	⇨	⇨	■	⇨	⇨	⇨	⇨	⇨	⇨	⇨

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

PAPER 1 *1 hour*

OB JECTIVE

[40 marks]

*Answer **all** the 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 and 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. An example is given below.*

Which of the following is **not** obtained through biotechnology?

A. Kenkey
B. Methane
C. Wine
D. Ethanol

The correct answer is methane which is lettered B and therefore answer space B would be shaded.

[A] [**B**] [C] [D]

Think carefully before you shade the spaces; erase completely any answer you wish to change. Do all rough work on this question paper. Now answer the following questions.

1. The atomic numbers of two elements **A** and **B** are 11 and 17 respectively. The type of bond formed between **A** and **B** is
   A. ionic.
   B. covalent.
   C. metallic.
   D. co-ordinate covalent.

2. Which of the following is an acid salt?
   A. KCl
   B. $NaHSO_4$
   C. Mg(OH)Cl
   D. ZnS

3. Which of the following apparatus is **not** used in volumetric analysis?
   A. Pipette
   B. Burette
   C. Desicator
   D. Conical flask

4. If 25.0 mL of 0.10 M NaOH is titrated to its end point with 16.0 mL of HCl, what is the molarity of the HCl?
   A. 0.25 M
   B. 0.18 M
   C. 0.16 M
   D. 0.10 M

5. The name of the compound $CH_3(CH_3)_2CH_2CH_2CH_3$ is
   A. 2-methylbutane.
   B. 2,2-dimethylbutane.
   C. 2-methylpentane.
   D. 2,2-dimethylpentane.

6. Which of the following compounds represents an unsaturated hydrocarbon?
   A. C_2H_6
   B. C_4H_8
   C. C_7H_{16}
   D. C_2H_4Cl

7. In which of the following is the oxidation of oxygen different from its value in water?
   A. O^{2-}
   B. H_3O^+
   C. OH^-
   D. H_2O_2

8. Manganese (IV) oxide is known to hasten the decomposition of hydrogen peroxide. Its main action is to
   A. lower the activation energy of the reaction.
   B. increase the surface area of the reactants.
   C. lower the heat of the reaction(ΔH) of the reaction.
   D. increase the concentration of the reactants.

9. Which of the following samples will react faster with dilute hydrochloric acid?
   A. 5g of lumps of $CaCO_3$ at 50°C.
   B. 5g of powdered $CaCO_3$ at 25°C.
   C. 5g of powdered $CaCO_3$ at 50°C
   D. 5g of lumps of $CaCO_3$ at 25°C

10. All of the following belong to the same group in the periodic table **except**
    A. Li.
    B. Na.
    C. Al.
    D. K.

11. In electrolysis, electrons are always lost at the
    A. cathode.
    B. electrolyte.
    C. anode.
    D. electrode.

12. How many grams are there in 0.13 mole of copper? (Cu = 63.5g mol^{-1})
    A. 5.38 grams
    B. 8.26 grams
    C. 10.23 grams
    D. 63.26 grams

13. Which of the following chlorides is covalently bonded?
    A. Sodium chloride
    B. Hydrogen chloride
    C. Potassium chloride
    D. Calcium chloride.

14. Which of the following arranges the elements in order of decreasing reactivity?
    A. I<Br<F<Cl
    B. F<Cl<Br<I
    C. Br<Cl<F<I
    D. I<Br<Cl<F

15. Air is
    A. a mixture.
    B. a compound.
    C. an atom.
    D. an element.

16. Calculate the mass of anhydrous Na_2CO_3 present in 300 cm^3 of 0.10 M Na_2CO_3
    [Na= 23, C= 12, O=16]
    A. 106 grams
    B. 10.6 grams
    C. 3.18 grams
    D. 0.318 grams

17. Which of the following will liberate hydrogen from steam or dilute hydrochloric acid?
    A. Copper
    B. Mercury
    C. Lead
    D. Iron

18. A chemical reaction is represented by the reaction:

$$N_2(g) + O_2(g) \rightleftarrows 2NO_2(g)$$

What is the expression for the rate of disappearance of the N_2 molecule?

A. Rate = $\frac{\Delta[N_2]}{\Delta t}$

B. Rate = $-\frac{1}{2}\frac{\Delta[N2]}{\Delta t}$

C. Rate = $-\frac{\Delta[N2]}{\Delta t}$

D. Rate = $\frac{1}{2}\frac{\Delta[N2]}{\Delta t}$

Turn Over

19. The scientist who studied reversible reaction in equilibrium was
    A. Le Chatelier.
    B. Gay-Lussac.
    C. Graham.
    D. Dalton.

20. Which of the following statements about positive ions is **not** correct?
    A. They are also known as cations.
    B. They are formed when electrons are removed from the parent atoms.
    C. They are larger than the parent atoms.
    D. They are smaller than the parent atoms.

21. Chemical equilibrium position is affected by the following **except**
    I. catalyst
    II. temperature
    III. concentration

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

22. An element **X** is a metal. An oxide of **X** has a formula $\mathbf{X_2O_3}$. Which group of the periodic table does **X** belong to?
    A. Group IA
    B. Group IIA
    C. Group IIIA
    D. Group IVA

Below are four definitions of words associated with nuclear chemistry. Use them to answer questions **23 and 24**.

I. The principal source of the energy of the sun
II. Splitting of a large atom into smaller fragments
III. The amount of fissionable material that will support self-sustaining chain reaction
IV. Produces a fissionable than it consumes

23. Fission is best defined by
    A. I
    B. II
    C. III
    D. IV

24. Fusion is related to
    A. I
    B. II
    C. III
    D. IV

25. A diagram showing the arrangement of valence electrons being shared among atoms in a molecule or compound is called
    A. electron configuration.
    B. Lewis structure.
    C. bond order.
    D. electron-dot- notation.

26. The pH of sea water is 8.3. What is the $[OH^-]$ of sea water?
    A. 8.3×10^{-14}
    B. 5.0×10^{-9}
    C. 2.0×10^{-6}
    D. 1.0×10^{-4}

27. The list of elements according to their tendency to react is called
    A. Periodic table.
    B. Chemical reactivity table.
    C. Activity series.
    D. Chemical periodicity table.

28. What will the standard potential of the cell be when the half-cells below are suitably connected?

    $\mathbf{Br_2(l) + 2e^- \rightarrow 2Br^-(aq)} \quad \mathbf{E^\circ = +1.0652V}$

    $\mathbf{Au^{3+}(aq) + 3e^- \rightarrow Au(s)} \quad \mathbf{E^\circ = +1.5V}$

    A. +2.57 V
    B. -0.20 V
    C. +0.20 V
    D. +0.43 V

29. Which of the following correctly represents **x** in the below nuclear reaction?

    $^{9}_{4}\text{Be} + \mathbf{X} \longrightarrow {}^{12}_{6}\text{C} + {}^{1}_{0}\text{n}$

    A. $^{0}_{1}\text{e}$
    B. $^{1}_{0}\text{n}$
    C. $^{1}_{1}\text{H}$
    D. $^{4}_{2}\text{He}$

30. How many significant figures are there in 0.00009?
    A. 4
    B. 1
    C. 3
    D. 5

31. Which of the following illustrates the Law of Multiple proportion?
    A. HNO_3
    B. HCl
    C. H_2O_2
    D. H_2CO_3

32. Which of the following contains the highest number of atoms?
    [C= 12, Na= 23, He=4, S= 32]
    A. 1.2 grams of carbon
    B. 0.4 grams of helium
    C. 3.2 grams of sulfur
    D. They all have the same number of atoms.

33. A solution turned blue litmus paper red. The pH of the solution is
    A. 3
    B. 7
    C. 8
    D. 14

34. Three different hydrocarbons. **A**,**B**, and **C** were passed into three separate test tubes containing acidified **$KMnO_4$** while **C** shows no visible reaction, **A** and **B** must be
    A. alkanols.
    B. saturated.
    C. unsaturated.
    D. carbohydrates.

35. Which type of bond is present in NH_4Cl?
    A. Ionic only
    B. Covalent only
    C. Covalent and dative
    D. Covalent, dative and ionic

36. Which of the following substances will **not** be decomposed by heat to give carbon (IV) oxide?
    A. H_2CO_3
    B. $CaCO_3$
    C. $Ca(HCO_3)_2$
    D. $MgCO_3$

37. The poisonous nature of carbon (II) oxide is due to the fact that it
    A. has practically no smell.
    B. combines with hemoglobin in the blood.
    C. has a choking smell.
    D. burns to give CO_2.

38. Calculate the density of carbon dioxide at STP
    [C=12, O= 16, molar volume = 22.4 L]
    A. 1.96 gL^{-1}
    B. 22gL^{-1}
    C. 192gL^{-1}
    D. 985gL^{-1}

39. How many moles of saltpeter(KNO_3) are present in 2020 grams of the salt?
    [K= 39.1, N= 14.0, O=16.0]
    A. 0.050 mol
    B. 17.26 mol
    C. 20.00 mol
    D. 23.76 mol

40. Sulfur oxides bleaches by
    A. hydration.
    B. reduction.
    C. adsorption.
    D. oxidation.

41. Which of the following is **not** an air pollutant?
    A. nitrogen (IV) oxide
    B. sulfur (IV) oxide
    C. argon
    D. carbon (IV) oxide

42. The following compounds are hydrocarbon **except**
    A. methylpropanate.
    B. 2-methylbutane.
    C. benzene.
    D. cyclohexane.

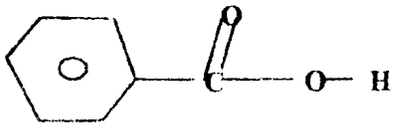
43. Alloys used for metal works and plumbing contain
    A. lead.
    B. iron.
    C. tin.
    D. lead and tin.

Turn Over

44. What is the mass number of an element having 40 neutrons, 30 protons and 30 electrons?
    A. 40
    B. 60
    C. 70
    D. 100

45. An alcohol solution that cannot easily change to vapor is called a
    A. colloid.
    B. mixture.
    C. tincture.
    D. suspension.

46. Determine the molar mass of the following compound **[C= 12, H=1, O=16]**



    A. 45g/mol
    B. 61g/mol
    C. 110g/mol
    D. 122g/mol

47. How many atoms of sodium are contained in 0.6gram of sodium?
    [1 mole Na = 6.02×10^{23} atoms]
    A. 3.60×10^{23} atoms
    B. 3.60×10^{22} atoms
    C. 1.56×10^{23} atoms
    D. 1.56×10^{22} atoms

48. How many electrons are lost by Cr in the equation below?
    [$2\,Cr^{3+} \longrightarrow Cr_2O_7^{2-}$]
    A. 2
    B. 3
    C. 6
    D. 14

49. Which of the following metals is the **most** reactive?
    A. Zn
    B. Cd
    C. Hg
    D. Ag

50. If the rate equation is(**Rate = $K[X]^m[Y]^n$**) and the rate is first order in **X** and first order in **Y**, then the overall order of the reaction is
    A. zero order.
    B. first order.
    C. second order.
    D. third order.

51. In an electrochemical cell, the half-cell where reduction occurs is known as the
    A. anode.
    B. anion.
    C. cathode.
    D. cation.

52. A reaction may be thermodynamically spontaneous for the expression
    [$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$] if the
    A. enthalpy change is negative and the entropy change is negative and less than the magnitude of the enthalpy change at a lower temperature.
    B. enthalpy change is positive and less than the magnitude of a positive value of the entropy change at higher temperature .
    C. enthalpy change is positive and the entropy change is negative.
    D. both the magnitudes of the enthalpy and the entropy changes are positive.

53. Which of the following metals possesses a high magnetic property?
    A. Al
    B. Cr
    C. Cu
    D. Ni

54. Zn metal is produced commercially by
    A. electrolysis of molten $ZnCl_2$.
    B. reduction of ZnO with coal(carbon)
    C. reduction of $ZnCl_2$ with metallic sodium.
    D. decomposition of ZnO with heat.

55. Which element below is **most** abundant in t universe?
    A. carbon
    B. hydrogen
    C. nitrogen
    D. oxygen

56. Credit for the discovery of oxygen is usually given to
    A. Henry Cavendish.
    B. Joseph Prestley.
    C. Robert Boyle.
    D. Antoine Lavoisier.

57. Explosion can occur when pure oxygen comes in contact with
    A. combustible materials.
    B. noble gas.
    C. deoxygenated materials.
    D. carbon dioxide.

58. In a titration experiment, 18.15 mL of 0.150 M HCl solution was required to completely neutralize 25.0 mL of KOH solution. What was the molarity of the KOH solution?

    A. 0.009 M
    B. 0.125 M
    C. 0.109 M
    D. 0.150 M

59. When matter is heated to a very high temperature (>5000°C), collisions between particles are so violent that electrons are knocked away from atoms, such a state of matter composed of electrons and cations is called a
    A. vapor state.
    B. gaseous state.
    C. plasma state.
    D. high energy state.

60. Bond breaking in molecules is a(n)
    A. spontaneous process.
    B. exothermic process.
    C. endothermic process.
    D. equal energy process.

END OF OBJECTIVE TEST

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

PAPER 2 **1 $\frac{1}{2}$ hours**

ESSAY

[60 marks]

Paper 2 consists of **nine** essay questions divided into **three** sections: **I, II and 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 only** (**blue** or **black**)

SECTION I

[Compulsory]

[36 marks]

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

1. (a)
   (i) Discuss the term **pH.**
   (ii) If sodium hydroxide solution were added to a solution of a strong acid, what would happen to the **pH** of the solution?

   (b) Give **one** example of each of the following.
   (i) **acid** oxide
   (ii) acid salt

2. (a) What is the change in oxidation state of chromium in the reaction represented by the following equation?

   $3SO_2 + Cr_2O_7^{2-} + 2H^+ \longrightarrow 3SO_4^{2-} + 2Cr^{3+} + H_2O$

   (b) Use the half-equations given below to deduce the equation for the reaction between iron(**II**) and heptaoxodichromate (**IV**) ions in acidic solution.

   (i) $Fe^{2+} \longrightarrow Fe^{3+}$

   (ii) $Cr_2O_7^{2-} \longrightarrow 2Cr^{3+}$

3. (a) Write the electronic configuration of an element with atomic number 15, indicating the distribution of electrons in the energy sub-levels.

   (b) Give **two** reasons why carbon (IV) oxide is used as a fire extinguisher

   (c) Balance the nuclear equation below and identify **Y**.

   $U \longrightarrow Th + Y$

   (d) In a tabular form, state **two** of the observations and their corresponding deductions in the Cathode-Ray experiment.

4. (a) Given $K_c = \frac{[Zn^{2+}(aq)]}{[Cu^{2+}(aq)]}$, as an equilibrium expression for a reaction between Zinc and copper , write a complete equation for the reaction.

(b) How many protons, neutrons, and electrons are present in each of the following atomic species? $^{39}_{19}K$, $^{35}_{17}Cl^-$

(c) The mass spectrum of carbon show two peaks at 12.00 and 13.00. Calculate the relative atomic mass of carbon given that the relative abundance of the two isotopes are 95% and 5% respectively.

(d) An organic compound with relative molecular mass 136 g/mol contains 70.58% carbon, 5.93% hydrogen and 23.49% oxygen. Determine its
(i) empirical formula
(ii) molecular formula
[C= 12.0 O= 16.0, H=1.0]

SECTION II

[16 marks]

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

5. Name **one** pollutant from each of the following industries and suggest in each case one method of reducing the effect of this pollutant.
   (a) Cement factory
   (b) Textile factory
   (c) Furniture factory

6. (a) Describe briefly the preparation and collection of a dry sample of NH_3 in the laboratory.
   (b) A sample of NH_3 gas at a pressure of 650 mmHg and a temperature of 15°C has mass of 56.8 grams. Calculate the volume occupied by the gas.
   [Molar mass of NH_3= 17.0 g/mol, R= 8.31 JK^{-1} mol^{-1}, R= 0.0821Latm$mol^{-1}K^{-1}$]

Turn Over

7. (a) Consider the following electronic configurations:

$[Ar]2s^1$, $[Ar]5s^14d^3$, $[Ar]4s^23d^{10}4p^4$

(i) In each case, indicate, whether the given configuration describes an atom in the ground state or excited state.

(ii) State your reason in each case.

(b) Using carbon as an example, explain what is meant by the terms

(i) isotopes

(ii) allotropes

SECTION III

[8 marks]

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

8. Use the information provided in the table below to answer the questions that follow:

Element/(atom)	Mass number	Atomic number
A	16	8
X	37	17
R	31	15
Y	18	8
Q	23	11

(a) Which of the elements is an alkali metal?

(b) Which atom will readily form an ion with a single negative charge?

(c) How many electrons are there in **R**?

(d) Which of the atoms are isotopes of the same element?

(e) What type of bond exist between **Q** and **X** in a compound **QX**?

(f) Write the formula of the compound formed when **Q** combines with **Y**.

(g) What type of bond exists between atoms of **A** in its diatomic molecule?

(h) Which of the following elements is a halogen?

9. Oil of wintergreen (**methyl salicyclate**) is used in a variety of commercial products for its flavor and aroma. It is made by heating salicyclic acid , C_7H_6OH, with methanol, CH_3OH according to the equation:

$$C_7H_6O_3 + CH_3OH \longrightarrow C_8H_8O_3 + H_2O$$

A chemist starts with 1.75 grams of salicyclic acid and excess methanol and calculated the maximum possible yield to be 1.93 grams. However, after the reaction is run to completion, the chemist finds that the amount of methyl salicyclate produced and isolated was only 1.42 grams. What is the percentage yield of the process?

END OF PAPER.