SH 402 S.H.S.C.E.
May 2009
CHEMISTRY 1 & 2
Objective Test and Essay
2½ hours

Name.....

Identification Number.....

THE WEST AFRICAN EXAMINATIONS COUNCIL

Senior High School Certificate Examination

May 2009 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 spaces 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* 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* 1½ *hours.*

PAPER 1

1 hour

OBJECTIVE TEST
[60 MARKS]

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 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 John Khali GBOTOE. His *identification number* is 001011375, his first entry is in 2009 and he is offering *Chemistry.*

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TOM JONES HIGH SCHOOL	981001
CENTER NAME	CENTER No.
JOE BLOE HIGH SCHOOL	001011
SCHOOL NAME	SCHOOL No.
GBOTOE JOHN KHALID	379
STUDENT NAME	STUDENT No.
CHEMISTRY	12TH
SUBJECT	GRADE

IDENTIFICATION NUMBER

0 0 1 1 3 7 5

YEAR OF FIRST ENTRY

2 0 0 9

SUBJECT CODE

4 0 2

For Supervisors only
If candidate is absent shade this space

Shade the space marked M (for male) or F (for female) in this box — M ■ F

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 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.*
An example is given below.

Which of the following elements reacts with water?
A. Carbon
B. Sulphur
C. Iodine
D. Sodium

The correct answer is Sodium *which is lettered* D *and therefore answer space* D *would be shaded.*

⊏A⊐ ⊏B⊐ ⊏C⊐ ■D■ ⊏E⊐

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:

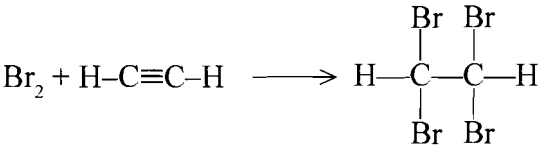
1. Which of the following reaction is characteristic of Alkanes?
A. Substitution reaction
B. Addition reaction
C. Polymerization reaction
D. Dissociation reaction

2. All of the following are properties of organic compounds **except**
A. organic compounds are more easily decomposed by heat .
B. most organic compounds do not dissolve in water.
C. organic reactions generally proceed at much slower rates.
D. organic compounds exist as molecules consisting of atoms joined by ionic bonds.

3. Which of the following organic compound have the **highest** boiling point?
A. N-butane
B. N-hexane
C. Propane
D. Ethane

4. Orange has a pH of 3, therefore it is said to be
A. strongly basic.
B. weakly basic.
C. strongly acidic.
D. weakly acidic.

5. How many moles of bromine are required to convert ethyne *to*
1, 1, 2, 2 tetrabromoethane



A. 1
B. 2
C. 3
D. 4

6. What is the pH of a solution with the hydronium concentration of 1.0×10^{-10}?
A. 9
B. 1
C. 10
D. 8

7. The acid anhydride of H_2CO_3 is
A. H_20
B. H_3O^+
C. O_2
D. CO_2

8. Which of the following factors does **not** influence the rate of a chemical reaction?
A. Nature of reactants
B. Effect of concentration
C. Effect of pressure
D. Effect of temperature

9. A compound is found by analysis to consist of 5.9% hydrogen and 94.1% oxygen. Its molecular weight is 34.0. What is the **correct** formula?

A. H_2O_2
B. HO_2
C. $(HO)_3$
D. H_2O

10. The decomposition of 11.47 g of a compound of copper and oxygen yield 9.16 g of copper. What is the empirical formula for the compound? [Cu = 63.5; O = 16]

A. Cu_2O
B. CuO
C. CuO_2
D. Cu_2O_2

11. What is the oxidation state of *Fe* in $FeSO_4$?

A. +2
B. +3
C. +1
D. +4

12. How many atoms of oxygen are in the compound magnesium sulphate decehydrate $MgSO_4.10H_2O$?

A. 10
B. 4
C. 14
D. 6

13. The common name for *calcium (II) oxide* (CaO) is

A. Soaked lime
B. Quicklime
C. Gypsium
D. Gelenate

14. What is the oxidation number of an atom with the following electronic configuration $1s^2 2s^2 2p^6 3s^2$

A. 2
B. 1
C. 3
D. 6

15. How many moles of atoms are there in 6.195 g of phosphorus? [Hint: P = 30.97g]

A. 0.20
B. 0.24
C. 0.30
D. 0.35

16. Which of the following is **not** an inert gas?

A. Neon
B. Oxygen
C. Argon
D. Helium

17. Alpha particles are represented by

A. helium nuclei.
B. positron.
C. electrons.
D. neutrons.

18. The capacity of the *p*-subshell is

A. 72
B. 64
C. 98
D. 50

19. The correct formula for calcium phosphate is

A. Ca_3PO_4
B. $CaPO_4$
C. Ca_2PO_4
D. $Ca(PO_4)_2$

20. Which of the following is **not** a postulate of the Kinetic Theory?

A. Matter is composed of very tiny particles.
B. The particles of matter are in continual motion.
C. The particles of matter do not lose energy in collisions.
D. The particles of matter do lose energy in collisions.

21. A 200 ml sample of hydrogen is collected when the pressure is 805 mm of mercury. What volume will the gas occupy at 760 mm pressure?

A. 211 ml
B. 200 ml
C. 250 ml
D. 300 ml

Turn over

22. What is the volume of 10 g of carbon dioxide gas, CO_2 at 20°C and 740 mm? [R = 0.0821 L atm/mol]
A. 5.1 liters
B. 6.02 liters
C. 5.6 liters
D. 4.5 liters

23. What is the molecular mass for $CuSO_4.5H_2O$?
[Cu=63.5; S=32; O=16; H=1]
A. 109.5 g
B. 141.6 g
C. 190.6 g
D. 249.5 g

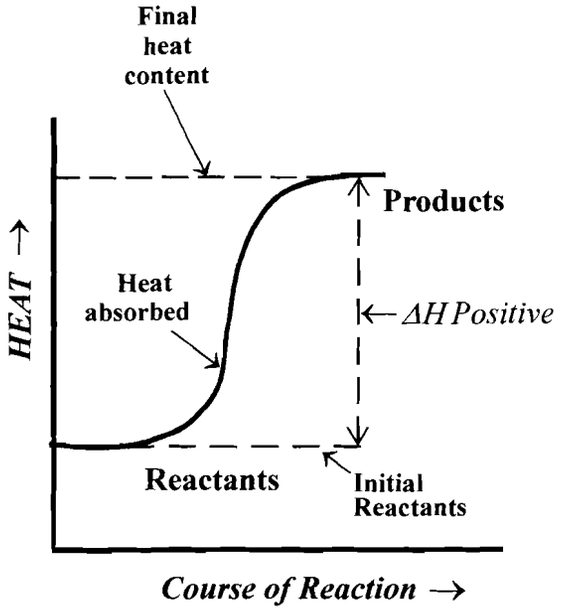
24. The measure of the tendency of an atom in a molecule to attract shared electrons is known as
A. ionization energy.
B. electron affinity.
C. electro negativity.
D. ionization potential.

25. Which of the following substances will change blue litmus paper to red?
A. HCl
B. NaOH
C. Na_2SO_4
D. $CaCO_3$

26. The acid which is found in butter is
A. citric acid.
B. butyric acid.
C. acetic acid.
D. propanoic acid.

27. How many milliliters of a 0.150 N solution of a metallic hydroxide are required to neutralize 30.0ml of a 0.500 N solution of an acid?
A. 100 ml
B. 30 ml
C. 10 ml
D. 50 ml

28. Which of the following is **not** a use of carbon dioxide? It is
A. used in most fire extinguishers.
B. necessary for photosynthesis.
C. contained in most carbonated beverages.
D. used in making fertilizers.



Use the diagram above to answer Questions **29** *to* **31.**

29. What does ΔH represent?
A. Change in the heat content
B. Enthalpy
C. Entropy
D. Dissociation constant

30. The diagram above is illustrative of
A. exothermic change.
B endothermic change.
C heat change.
D potential energy change.

31. The heat content of the product is
A Less than zero
B Greater than zero
C Equal to zero
D The same as the initial heat content

32. What is the equilibrium constant expression for the reaction below?
$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$,

A $K = \frac{[HI]^2}{[H_2][I_2]}$

B $K = \frac{[HI]^2}{[I_2]}$

C $K = \frac{[H_2][I_2]}{[HI]^2}$

D $K = \frac{[HI]^2}{[H_2]}$

33 An equilibrium mixture of H_2, I_2, and HI gases at 425°C is determined to consist of 4.5647×10^{-3} mole/liter of H_2, 0.737×10^{-3} mole/liter of I_2 and 13.544×10^{-3} mole/liter of HI. What is the equilibrium constant for the system at this temperature?

A. 13.544
B. 4.5647
C. 54.46
D. 50.46

34. In the electrolysis of aqueous salt solution, what substance is released at the cathode?

A. Sodium
B. Chloride
C. Hydrogen gas
D. Chlorine gas

35. Which of the following is **not** a technique for identifying a pure organic compound?

A. Chromatography
B. Fractional distillation
C. Melting point determination
D. Lassaigne sodium fusion

36. Give the correct IUPAC name for an organic compound with the structure shown below:

$CH_3CH(CH_3)CHP{=}CHCH_2OH$

A. 4 methyl–2–penten–l–ol
B. 3 methyl–2–pentenol
C. 2 methyl –2–penten–l–ol
D 3 methyl –2–penten–l–ol

37. Which of the following is **not** a product when chlorine is bubbled into hot concentrated aqueous potassium hydroxide?

A. Cl^-
B. ClO_3
C. H_2O
D. O_2

38. **X** is an element in the period from sodium to argon across the periodic table. **X** forms a solid chloride that reacts immediately with water to evolve hydrogen chloride. **X** also forms a solid oxide that reacts vigorously with water to given an aqueous weak acid. Element **X** is

A. aluminum.
B. magnesium.
C. phosphorus.
D. silicon.

39. For the reaction between calcium trioxocarbonate (Iv) and hydrochloric acid

$CaCo_{3(s)} + 2HCl_{(aq)} \circledR CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(a)}$,

Which of the following would **not** increase the rate?

A. Increasing the pressure
B. Increasing the temperature
C. Stirring the mixture vigorously
D. Increasing the concentration of the acid.

40. How many coulombs of electricity would be needed to deposit 3.6 g of aluminum by the electrolysis of aluminum oxide dissolved in molten cryolite?

[Al =27; The faraday constant = 96500 C mol^{-1}].

A. 19300
B. 38600
C. 48250
D. 57300

41. According to Dalton's Law of partial pressures, a mixture of two gases with partial pressures of $\mathbf{P}_x$ and $\mathbf{P}_y$ would have a total pressure of

A. $\mathbf{P}_x \times \mathbf{P}_y$
B. $\mathbf{P}_x + \mathbf{P}_y$
C. $1/\mathbf{P}_x + 1/\mathbf{P}_y$
D. $\mathbf{P}_x + \mathbf{P}_y/\mathbf{P}_x \times \mathbf{P}_y$

42. How many moles are contained in 1.20×10^{25} molecules of NH_3?

A. 19.9 moles
B. 1.20 moles
C. 12.0 moles
D. 1.99 moles

43. Which of the following equations is **correctly** balanced?

A. $2Sb + 3H_2O \rightarrow Sb_2O_3 + 3H_2$
B. $2CuO + H_2 \rightarrow 2Cu + H_2O$
C. $4O_2 + Sb_2S_3 \rightarrow Sb_2O_4 + 3SO_2$
D. $2PaI_5 + \rightarrow 2Pa + 3I_2$

44. The substance added to iron to produce stainless steel is

A. aluminum.
B. carbon.
C. chromium.
D. limestone.

Turn over

45. The process of converting glucose to ethanol by the use of enzymes in yeast is known as
A. combustion.
B. cracking.
C. fermentation.
D. oxidation.

46. Which of the following pairs of gases are pollutants produced by car engines?
A. Ammonia and hydrogen chloride
B. Carbon dioxide and sulfur dioxide
C. Carbon monoxide and nitrogen dioxide
D. Hydrogen and oxygen

47. Which of the following ions is responsible for *temporary hardness* in water?
A. HCO_3^- ions
B. SO_4^{2-} ions
C. Fe^{2+} ions
D. Na^+ ions.

48. *Permanent hardness* can be removed by
A. the use of lime water.
B. boiling.
C. fractional distillation.
D. evaporation.

49. All of the following elements are radioactive **except**
A. uranium.
B. radium.
C. polonium.
D. palcium.

50. Who is credited with the discovery of natural radioactivity?
A. Marie Curie
B. J. J. Thompson
C. Henri Becquerel
D. Alexander Flemin

51. The destructive distillation of bones produce
A. coke.
B. charcoal.
C. boneblack.
D. ethanol.

52. Which of the allotropes of carbon is used in the rubber industry?
A. Carbon black
B. Asphalt
C. Coke
D. Charcoal

53. Which of the following is **not** a use of graphite? It is
A. a good lubricant.
B. used in making pencil.
C. used in electrodes.
D. used in making fertilizer.

54. Consider the reaction
$2KClO_3 \rightarrow 2KCl + 3O_2$.
What is the ratio of moles of potassium chlorate to the moles of oxygen?
A. 2 : 2
B. 1 :1
C. 2 : 1
D. 2 :3

55. The loss of some or all molecules of water of crystallization when a hydrate is exposed to the air is called
A. efflorescence.
B. deliquescence.
C. hygroscopic.
D. dissociation.

56. An atom has the electron configuration $1s^2 2s^2 2p^6 3s^1$. To which period and group does it belong?
A. First period and third group
B. Fourth period and first group
C. Third period and first group
D. Eighth period and third group

57. The two rows of elements placed below the main body of the Periodic Table is/are the
I. lanthanides
II. actinides
III. f-block elements

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

58. Kokodolo, a curious chemistry student, analyzed an organic compound to contain mainly carbon, hydrogen and oxygen, which were in the ratio 1:2:1. What is the molecular formula of the compound if its molecular weight is 180?

A. $C_6H_{12}O_6$
B. CH_2O
C. $C_3H_8O_6$
D. $C_{12}H_{22}O_{11}$

59. What is the equivalent weight of one mole of aluminum sulfate?
[Hint Al =27, S= 32, O=16]

A. 67
B. 57
C. 77
D. 47

60. An isotope of oxygen has an atomic number of 8 and mass number of 18. What is the number of neutrons?

A. 8
B. 18
C. 26
D. 10

END OF OBJECTIVE TEST

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

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

PAPER 2

1½ hours

ESSAY
[40 marks]

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

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

SECTION I
[COMPULSORY]
[24 marks]

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

1. There are **three** common theories of acids and bases. Explain how **each** of the following theories defines acids and bases.

   (*a*) Arrhenius theory

   (*b*) Lewis theory

   (*c*) Bronsted-Lowry theory

2. Calculate the volume of oxygen produced at s.t.p. by the decomposition of 10 g of potassium chlorate ($KClO_3$):

   $$2KClO_3 \rightarrow 2KCl + 3O_2$$

3. Define the following terms:

   (a) standard heat of formation;

   (*b*) chain reaction;

   (*c*) desiccant;

   (*d*) critical temperature.

4. (*a*) Draw the structure of 2-methyl-2-pentene.

   (*b*) Draw the electron configuration for calcium (20).

   (*c*) Draw the electron dot diagram for CH_2Cl_2.

SECTION II
[7 marks]

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

5. Draw the structures and write the IUPAC names of the following compounds:

(*a*) a tertiary alcohol with five carbons;

(*b*) a ketone with four carbons;

(*c*) an ether with five carbons;

(*d*) aldehyde with four carbons.

6. Calculate the molarity of sodium chloride solution made by mixing 3.51 g of sodium chloride in enough water to prepare 750 ml of the solution.

7. A sample of an unknown gas which filled a 0.500 litre flask at 0°C and 1.00 atm weighed 0.670 g.

(a) Determine the mass of 22.4 litres of this gas.

(b) Which of the following gases could it be: N_2, O_2, NO or CO?

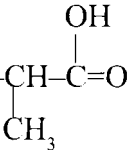
SECTION III
[9 marks]

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

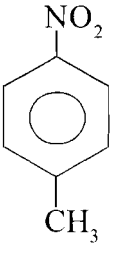
8. Calculate the mass of barium chloride required to react completely with 42.75 g of aluminum sulfate according to the equation:

$$Al_2(SO_4) + BaCl_2 \rightarrow AlCl_3 + BaSO_4$$

9. Determine the molar mass of each of the following compounds.
[C=12; O=16; N=14; H =1]

(*a*) 

(*b*) 2–methyl–1–propanol

(*c*) 

Turn over

10. (a) The hydrogen ion concentration (H^+) of fruit juice is 5.2×10^{-5} mol/liter. What is the pH of the juice?

(b) Assign oxidation numbers to the indicated elements in each of the following compounds

(i) **S** in Na_2SO_3

(ii) **N** in $Ca(NO_3)_2$

(iii) **C** in $C_{12}H_{22}O_{11}$

END OF PAPER