

SC 5052&105  
WASSCE 2025  
CHEMISTRY 2&1  
Essay and Objective  
3 hours

# 2&1

Name .....

Index Number .....

- ❖ TOPIC BASE, MOCK & PAST QUESTIONS
- ❖ NOTES
- ❖ SYLLABUS
- ❖ CHIEF EXAMINERS' REPORT
- ❖ LESSON NOTES
- ❖ COURSES
- ❖ CAREER/SCHOLARSHIP OPPORTUNITIES
- ❖ CAMPUS NEWS

## THE WEST AFRICAN EXAMINATIONS COUNCIL

### West African Senior School Certificate Examination for School Candidates

SC 2025

CHEMISTRY 2&1  
Essay and Objective  
[100 marks]

3 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 index number in ink in the spaces provided above.*

*This booklet consists of two papers. Answer Paper 2 which comes first, in your answer booklet and Paper 1 on your Objective Test answer sheet. Paper 2 will last 2 hours after which the answer booklet will be collected. Do not start Paper 1 until you are told to do so. Paper 1 will last 1 hour.*

2  
PAPER 2  
ESSAY  
[100 marks]

Answer four questions in all: Question 1 in Section A and three questions from Section B.  
All questions carry equal marks.  
Credit will be given for clarity of expression and orderly presentation of material.

SECTION A

Answer all the questions in this section.

1. (a) Balance the following chemical equations:
- (i)  $\text{Na}_2\text{SO}_{3(\text{aq})} + \text{HCl}_{(\text{aq})} \rightarrow \text{NaCl}_{(\text{aq})} + \text{SO}_{2(\text{g})} + \text{H}_2\text{O}_{(\text{l})}$
- (ii)  $\text{Au}_{(\text{s})} + \text{CN}^{-}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} \rightarrow [\text{Au}(\text{CN})_2]_{(\text{aq})} + \text{OH}^{-}_{(\text{aq})}$  [2 marks]
- (b) Explain why the bond energy of C = C in ethene is **greater** than the C–C bond energy in ethane but **not** twice as much. [3 marks]
- (c) List **two** essential parts of the mass spectrometer. [2 marks]
- (d) Why are gamma rays more injurious to health than alpha particles? [2 marks]
- (e) The atomic mass unit of Carbon-12 is  $1.6603 \times 10^{-24}$  g. If the mass of an atom is  $5.313 \times 10^{23}$  g, determine the relative atomic mass. [2 marks]
- (f) (i) Give **two** physical properties of metals.  
(ii) Indicate how **each** of the properties given in (i) contribute to the use of the metal. [4 marks]
- (g) Explain why sulphur can show valencies of 2, 4 and 6, whereas oxygen is restricted to a valency of 2.  
[O = 8, S = 16] [4 marks]
- (h) State the charge on the complex ion formed by:
- (i) Ni(II) in  $[\text{Ni}(\text{NH}_3)_5\text{Cl}]$ ;  
(ii) Cr(III) in  $[\text{CrCl}(\text{H}_2\text{O})_5]$ . [2 marks]
- (i) Define the term *enthalpy of combustion*. [2 marks]
- (j) Write the formula of the functional group in:
- (i) alkanols;  
(ii) alkanolic acids. [2 marks]

3  
SECTION B

Answer **three** questions **only** from this section.

2. (a) The table below gives some of the physical properties of solid substances A, B and C.

Substance	Boiling point/ °C	Melting point/ °C	Solubility in water at 25°C
A	117	30	insoluble
B	160	31	insoluble
C	1200	861	soluble

C and B react when warmed.

A and B are miscible when melted.

- (i) Using the information provided, describe **briefly** how a mixture of A, B and C could be separated into their pure components.
- (ii) When 25.25 g of a mixture of A, B and C was separated, 7.52 g of A, and 8.48 g of B were recovered. Assuming there was no loss of components during the separation, calculate the percentage by mass of C in the mixture.

[9 marks]

- (b) Account for the following observation:

$\text{BCl}_3$  and  $\text{PCl}_3$  are **both** covalent compounds but  $\text{BCl}_3$  acts as a Lewis acid while  $\text{PCl}_3$  acts as a Lewis base.

[4 marks]

- (c) If  $25.0 \text{ cm}^3$  of  $0.1 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$  neutralized  $20.0 \text{ cm}^3$  of impure NaOH containing 3.0 g of impure NaOH in  $250 \text{ cm}^3$  of solution:

- (i) calculate the percentage purity of sodium hydroxide;
- (ii) write the equation for the reaction.

[Na = 23.0; O = 16.0; H = 1.0]

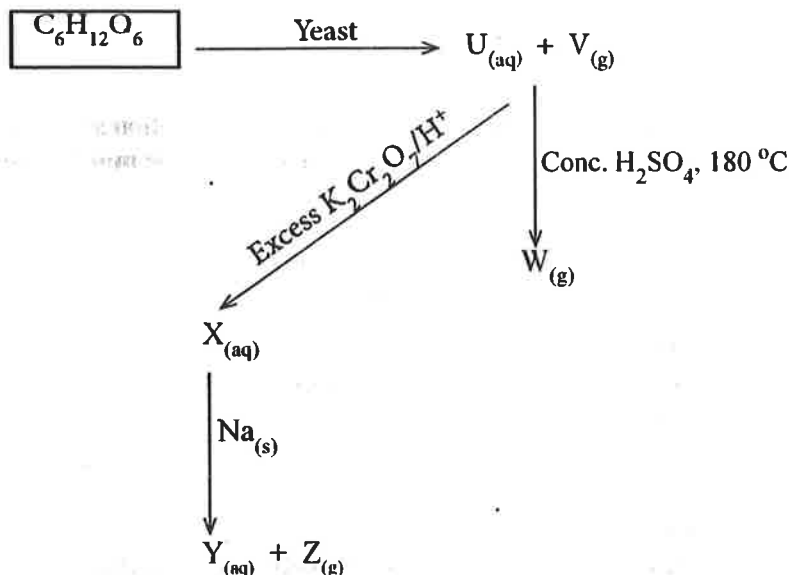
[8 marks]

- (d) Name the process for obtaining:

- (i) soap from fat or oil;
- (ii) polyethene from ethene;
- (iii) petrol from long chain hydrocarbons;
- (iv) different fractions from crude oil.

[4 marks]

3. (a) (i) Explain the term *cracking*.  
 (ii) State **one** application of cracking in the petroleum industry.  
 (iii) Consider the following reaction scheme:

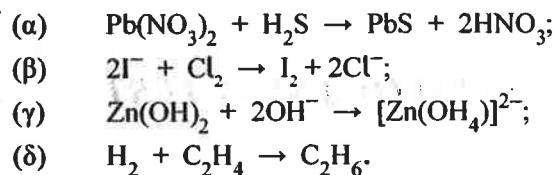


Name substances U, V, W, X, Y and Z.

- (iv) Write an equation for the reaction of:  
 (α) conc.  $\text{H}_2\text{SO}_4$  with the substance represented by U;  
 (β)  $\text{CH}_3\text{OH}$  with the substance represented by X.

[14 marks]

(b) Consider the following reaction equations:



- (i) State the *redox reactions*.  
 (ii) State the changes in oxidation numbers of all species that are oxidized and reduced in **each** of the reactions in (i).

[9 marks]

(c) Arrange the following compounds in order of **increasing** boiling point:



[2 marks]

4. (a) Describe how the percentages of carbon and hydrogen in an organic compound are determined. State the measurements which are made.

[8 marks]

- (b) (i) State *Hess's law of constant heat summation*.  
 (ii) From the following enthalpy values, determine the amount of energy liberated when 1 mole of ethanol is completely burnt under standard conditions.

$$\Delta H_c^\circ \text{C}_{(\text{s})} = -393.5 \text{ kJ mol}^{-1}$$

$$\Delta H_c^\circ \text{H}_{2(\text{g})} = -285.8 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ \text{C}_2\text{H}_5\text{OH}_{(\text{l})} = -227.6 \text{ kJ mol}^{-1}$$

[7 marks]

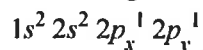
- (c) Naturally occurring nuclides emit three kinds of radiations:
- Name **each** of the radiations;
  - State the nature of **each** of the radiations.

[6 marks]

- (d) (i) Write the electron configuration of the +2 and +3 oxidation states of iron.  
 (ii) State with reason which of the oxidation states would be **more stable**.

[4 marks]

5. (a) The electron configuration of carbon may be written as:



- Explain **each** of the symbols in  $2p_x^1$ ;
- Considering the configuration of carbon stated, explain why carbon forms four equivalent bonds.

[8 marks]

- (b) (i) What is *inductive effect*?  
 (ii) Explain why chloroethanoic acid is a **stronger acid** than ethanoic acid.

[5 marks]

- (c) (i) Classify the following species into nucleophiles and electrophiles:  
 $H_2O$ ,  $NH_3$ ,  $Br^+$ ,  $H^+$ ,  $AlCl_3$ ,  $OH^-$   
 (ii) Explain why the reactions of alkenes are described as electrophilic addition reactions.

[10 marks]

- (d) Distinguish between the terms *homolytic fission* and *heterolytic fission*.

[2 marks]

**END OF ESSAY TEST**

# BLANK SHEET

# 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.**

**WHILE YOU ARE WAITING, READ THE FOLLOWING  
INSTRUCTIONS CAREFULLY**

PAPER 1  
OBJECTIVE TEST  
[50 marks]

1 hour

1. Use 2B pencil throughout.
2. On the pre-printed answer sheet, check that the following details are correctly printed:
  - (a) In the space marked Name, check your **surname** followed by your **other names**.
  - (b) In the spaces marked *Examination*, *Year*, *Subject* and *Paper*, check 'WASSCE', 'SC 2025', 'CHEMISTRY', and '1' respectively.
  - (c) In the box marked Index Number, your index number has been printed vertically in the spaces on the left-hand side, and each numbered space has been shaded in line with each digit. **Reshade** each of the shaded spaces.
  - (d) In the box marked *Subject Code*, the digits 505213 are printed vertically in the spaces on the left-hand side. **Reshade** the corresponding numbered spaces as you did for your index number.
3. An example is given below. This is for a male candidate whose name is Ben Abu TETTEH. His *index number* is 7102143958 and he is offering *Chemistry 1*.

## THE WEST AFRICAN EXAMINATIONS COUNCIL ANSWER SHEET

<b>PRINT IN BLOCK LETTERS</b>	
Name: <b>TETTEH BEN ABU</b>	GHA
Examination: <b>WASSCE</b>	Year: <b>2025</b>
Subject: <b>CHEMISTRY</b>	Paper: <b>1</b>

**INSTRUCTIONS TO CANDIDATES**

1. Use grade 2B pencil throughout.
2. Answer each question by choosing one letter and shading like this: A B C D
3. Erase completely any answer you wish to change.
4. Leave extra spaces blank if the answer spaces provided are more than you need.
5. Do not make any markings across the heavy black marks at the right hand edge of your answer sheet.

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**For Supervisors only**

If candidate is absent shade this space

Answer all the questions.

Each question is followed by four options lettered A to D. Find 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 elements reacts with water?

- A. Carbon
- B. Sodium
- C. Sulphur
- D. Iodine

The correct answer is Sodium 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 in this question paper.

Now answer the following questions.

1. When pale-yellow dinitrogen(IV) oxide is heated in a closed container, the colour changes to dark brown because
  - A. moisture is absorbed.
  - B. nitrogen(IV) oxide is produced.
  - C. a precipitate is formed.
  - D. dissociation has taken place.
  
2. The gas that would form a white precipitate with acidified silver trioxonitrate(V) is
  - A.  $\text{NH}_3$ .
  - B.  $\text{CO}_2$ .
  - C.  $\text{SO}_2$ .
  - D.  $\text{HCl}$ .
  
3. The properties that describe the high lattice energy of a salt are
  - A. low melting point and high energy.
  - B. high melting point and high boiling point.
  - C. high melting point and low boiling point.
  - D. low melting point and low boiling point.
  
4. Consider the following equation of an equilibrium system:
 
$$2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$$
 A condition that favours high yield of  $\text{SO}_{3(g)}$  is
  - A. increase in pressure on the system.
  - B. increase in concentration of the reactants.
  - C. increase in temperature of the system.
  - D. addition of a catalyst.
  
5. What is the molecular formula of a compound whose empirical formula is  $\text{CH}_2\text{O}$  and has molar mass of 180?
 

[H = 1.0, C = 12.0, O = 16.0]

  - A.  $\text{C}_4\text{H}_8\text{O}_2$
  - B.  $\text{C}_6\text{H}_{10}\text{O}_5$
  - C.  $\text{C}_4\text{H}_8\text{O}_3$
  - D.  $\text{C}_6\text{H}_{12}\text{O}_6$

6. Which of the following liquids is a good conductor of electric current?
- Glucose solution
  - Ethanol
  - Potassium chloride solution
  - Petrol
7. What mass of magnesium oxide is required to neutralize  $25.0 \text{ cm}^3$  of  $0.1 \text{ mol dm}^{-3}$  hydrochloric acid? [MgO = 40, HCl = 36.5]
- 0.025 g
  - 0.100 g
  - 0.050 g
  - 0.250 g
8. Which of the following atoms would lose electrons most readily?
- Aluminium
  - Sodium
  - Chlorine
  - Silicon
9. Ethane does **not** undergo addition reaction because it
- is an organic substance.
  - decolourizes bromine water.
  - is a saturated hydrocarbon.
  - is an unsaturated hydrocarbon.
10. Consider the following reaction equation:
- $$2X_{(s)} + Cl_{2(g)} \rightarrow 2XCl_{(s)}$$
- Which group of elements does X belong?
- Group I
  - Group III
  - Group II
  - Group IV
11. Consider the following reaction equation:
- $$CuSO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Cu(OH)_{2(s)} + Na_2SO_{4(aq)}$$
- This is an example of a/an
- substitution reaction.
  - neutralization reaction.
  - double decomposition reaction.
  - addition reaction.
12. Which of the following gases is produced when calcium hydroxide is heated with solid ammonium chloride?
- $NH_3$
  - $H_2$
  - $Cl_2$
  - $O_2$

13. The deposition of ammonium chloride crystals on the walls of a test tube after heating is due to
- evaporation.
  - sublimation.
  - recrystallization.
  - fractional precipitation.
14. The product of decarboxylation of  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COONa}$  is
- propanoic acid.
  - propene.
  - butane.
  - propane.
15. If a heavy metal has an unstable nucleus, the instability could be reduced by
- making neutrons and protons approximately equal
  - increasing its nuclear size
  - making the nuclide undergo decay
- I and II only
  - II and III only
  - I and III only
  - I, II and III
16. The process involved in the production of ethanol from sugarcane is
- esterification.
  - neutralization.
  - fermentation.
  - saponification.
17. Which of the following statements about allotropes is correct?
- Atoms with different number of neutrons but same number of protons.
  - Different forms of an element in the same physical state.
  - Molecules with the same molecular formula but different structures.
  - Molecules that absorb water vapour on exposure to air.
18. Gas X diffuses twice as fast as gas Y under the same conditions. If the relative molecular mass of X is 28, the relative molecular mass of Y would be
- 120.
  - 56.
  - 112.
  - 14.
19. Which of the following gases turns red litmus paper blue?
- $\text{CO}_2$
  - $\text{NH}_3$
  - $\text{HCl}$
  - $\text{SO}_2$

20. Which of the following substances is **not** a diatomic gas at room temperature?
- A.  $O_2$ .
  - B.  $Cl_2$ .
  - C.  $F_2$ .
  - D.  $Br_2$ .
21. Carbon(II) oxide is a poisonous gas due to its ability to
- A. remove oxygen from blood.
  - B. form stable compound with haemoglobin.
  - C. destroy the red blood cells.
  - D. attack haemoglobin of red blood cells.
22. Alkenes are relatively **more** reactive than alkanes because
- A. alkenes are more stable than alkanes.
  - B. the double bond in alkenes is susceptible to nucleophilic attack.
  - C. the C-H bond in alkenes are more polar than in alkanes.
  - D. there is a high electron density at the double bond in alkenes.
23. The element that has **no** electron in the *p*-orbital is
- A. helium.
  - B. neon.
  - C. nitrogen.
  - D. carbon.
24. Which of the following statements about group 7 elements is **correct**? They
- A. are monoatomic.
  - B. have low electron affinity.
  - C. are highly electronegative.
  - D. are good reducing agents.
25. Consider the reaction represented by the equation:
- $$2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$$
- The mass of  $H_2O_2$  that would be required to produce  $22.4 \text{ dm}^3$  of oxygen at s.t.p is  
[O = 16.0, H = 1.0,  $V_m = 22.4 \text{ dm}^3$ ]
- A. 16 g.
  - B. 34 g.
  - C. 32 g.
  - D. 68 g.
26. Which of the following metals can be extracted by electrolysis?
- A. Gold
  - B. Copper
  - C. Iron
  - D. Sodium
27. Polymerization of ethyne gives
- A. benzene.
  - B. polyethene.
  - C. cyclohexane.
  - D. polystyrene.

28. The quantity of electricity that would deposit 2.7 g of aluminium during electrolysis is [Al = 27.0 g, 1F = 96500 C]
- A. 289500 C.
  - B. 18950 C.
  - C. 28950 C.
  - D. 2895 C.
29. What is the pH of a solution containing  $0.001 \text{ mol dm}^{-3}$  sodium hydroxide?
- A. 12
  - B. 7
  - C. 11
  - D. 3
30. A neutral atom of neon with atomic number 10 has the same number of electrons as
- A.  $\text{K}^+$ .
  - B.  $\text{Ca}^{2+}$ .
  - C.  $\text{Mg}^{2+}$ .
  - D.  $\text{Pb}^{2+}$ .
31. Which of the following compounds would **not** decompose on heating?
- A. Calcium trioxocarbonate(IV)
  - B. Calcium hydroxide
  - C. Calcium chloride
  - D. Calcium trioxonitrate(V)
32. Which of the following atoms has the **highest** number of electrons in its valence shell?
- A.  ${}_{19}\text{K}$
  - B.  ${}_{8}\text{O}$
  - C.  ${}_{9}\text{F}$
  - D.  ${}_{7}\text{N}$
33. The soil around a battery manufacturing factory is **likely** to contain a high concentration of a salt of
- A.  $\text{Ca}^{2+}$ .
  - B.  $\text{Mg}^{2+}$ .
  - C.  $\text{Pb}^{2+}$ .
  - D.  $\text{Al}^{3+}$ .
34. An example of a heavy chemical is
- A. calcium chloride.
  - B. ammonia.
  - C. polyvinyl chloride.
  - D. iodine.

35. When sodium hydroxide solution was added in drops and then in excess to solution X, a pale green precipitate insoluble in excess was produced, solution X is likely to contain
- iron(III) ions.
  - copper(II) ions.
  - lead(II) ions.
  - iron(II) ions.
36. The following substances are soil pollutants except
- oil.
  - water.
  - lye.
  - plastics.
37. Which of the following molecules has a non-polar covalent bond?
- $\text{Cl}_2$
  - $\text{NH}_3$
  - $\text{HCl}$
  - $\text{H}_2\text{O}$
38. Traces of water can be removed from ethanol distillate by
- vacuum distillation.
  - evaporation.
  - fractional distillation.
  - decantation.
39. The enthalpy change when one mole of an ionic compound is formed from its constituent ions in the gaseous state is called
- lattice energy.
  - activation energy.
  - bond energy.
  - hydration energy.
40. The number of isomers that could be formed by  $\text{C}_6\text{H}_{14}$  is
- 5.
  - 3.
  - 4.
  - 2.
41. During electrolysis, the type of electrode used affects the
- quantity of products.
  - selective discharge of ions.
  - rate of electrolysis.
  - formation of hydrogen ions.
42. An increase in temperature of a gas causes an increase in its pressure because there is an increase in the
- average velocity of the molecules.
  - mean free path of the molecules.
  - number of collisions between the molecules.
  - density of the molecules.

43. Which of the following properties is exhibited by the ions listed:  $\text{Al}^{3+}$ ,  $\text{Mg}^{2+}$  and  $\text{Na}^+$ ?
- Allotropy
  - Isoelectronic
  - Isotopy
  - Isomerism
44. Giant macromolecules contain
- ionic bonds.
  - metallic bonds.
  - covalent bonds.
  - dative bonds.
45. Which of the following compounds would produce a fruity scent when warmed with ethanol and concentrated  $\text{H}_2\text{SO}_4$ ?
- $\text{CH}_3\text{CH}_2\text{OH}$
  - $\text{CH}_3\text{CH}_2\text{COOH}$
  - $\text{CH}_3\text{CH}_2\text{Cl}$
  - $\text{CH}_3\text{CH}_2\text{NH}_2$
46. Which of the following statements about non-electrolytes are correct?
- They do not conduct electricity.
  - They are covalent substances.
  - They do not form ions.
- I and II only
  - II and III only
  - I and III only
  - I, II and III
47. The percentage of oxygen in  $\text{C}_6\text{H}_{12}\text{O}_6$  is
- 40.0 %.
  - 53.3 %.
  - 41.4 %.
  - 55.2 %.
48. A substance which could be added to lemon juice to increase its pH is
- bromine water.
  - oxalic acid.
  - ethanoic acid.
  - baking powder.

