

SC5052&1
WASSCE 2020
CHEMISTRY 2 &1
Essay and Objective
3 hours

2&1

THE WEST AFRICAN EXAMINATIONS COUNCIL

West African Senior School Certificate Examination
for School Candidates

SC 2020

CHEMISTRY 2&1

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 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.

Answer **four** questions in all: **Question 1** in Section A and **three** questions from Section B.

All questions carry equal marks. No marks will be awarded for answering questions not specified for your own Country.

Credit will be given for clarity of expression and orderly presentation of material.

SECTION A

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

1. (a) State Faraday's second law of electrolysis. [2 marks]
- (b) Separate the following redox reaction into balanced half equations:
$$\text{Cu} + \text{NO}_3^- \rightarrow \text{Cu}^{2+} + \text{NO} + \text{H}_2\text{O}.$$
 [3 marks]
- (c) Calculate the e.m.f. of the cell formed by combining the following half-equations:
$$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{SO}_2 + 2\text{H}_2\text{O} \quad E^\ominus = + 0.17 \text{ V}$$

$$\text{Br}_{2(\text{g})} + 2\text{e}^- \rightarrow 2\text{Br}^- \quad E^\ominus = + 1.07 \text{ V}$$
 [3 marks]
- (d) Explain **briefly** why sugar does **not** conduct electricity. [2 marks]
- (e) State **one** use of **each** of the following processes in the chemical industry:
(i) cracking;
(ii) hydrogenation of vegetable oil. [2 marks]
- (f) State **one**:
(i) physical property that would enhance the separation of a mixture of palm-oil and water;
(ii) neutral oxide that is a colourless liquid at room temperature. [2 marks]
- (g) In a reversible reaction, state how the rate of the forward reaction compares to that of the backward reaction
(i) at time zero;
(ii) before equilibrium;
(iii) at equilibrium. [3 marks]
- (h) Write a reaction equation to show the effect of heat on the following compound:
$$\text{Pb}(\text{NO}_3)_2(\text{s})$$
 [2 marks]
- (i) Draw the structural formulae of **two** isomers of $\text{C}_3\text{H}_7\text{OH}$. [2 marks]

- (j) Consider the following carbon compounds:
ethanol, ethane, butane
- Arrange them in **increasing** order of their boiling point;
 - Explain **briefly** your answer in (j)(i).

[4 marks]

SECTION B

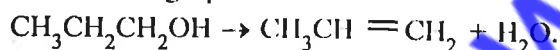
Answer three questions only from this section.

FOR ALL CANDIDATES

2. (a) (i) Define *atomic radius*.
(ii) Explain **briefly** why the ratio of ionic radii $\frac{\text{Na}^+}{\text{Mg}^{2+}}$ is greater than 1.

[5 marks]

- (b) Consider the following equation:



If 30.0 g of propan-1-ol produces 16.8 g of propene, calculate the percentage yield of propene.

$$[\text{H} = 1.0; \text{C} = 12.0; \text{O} = 16.0]$$

[6 marks]

- (c) What would be the final volume of a fixed mass of a gas if its initial pressure is halved and the absolute temperature doubled.

[5 marks]

- (d) (i) Identify the class of organic compound that could be detected using **each** of the following reagents:

- Biuret reagent;
- Ammoniacal silver trioxonitrate(v) solution;
- Bromine in tetrachloromethane.

- (ii) State what is observed in **each** of the cases stated in (d)(i).

[6 marks]

- (e) (i) Under what condition does water react with sodium?
(ii) Name the products formed when water reacts with sodium.

[3 marks]

3. (a) Consider the following table and use it to answer the questions that follow.

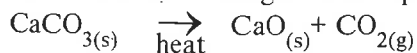
Elements	Atomic number	Mass number
A	10	20
B	12	24
C	17	35
D	20	40
E	25	50

- Which of the elements:
 - is an alkaline earth metal;
 - belongs to group VII;
 - belongs to the d-block of the periodic table;
 - would readily form an ion with a double positive charge?
- How many electrons are there in D?

- (iii) What type of bond would exist between D and C when they combine?
- (iv) Write the formula of the compound formed when B combines with C.
- (v) State the element which is inert.
- (vi) Select the element which has a catalytic property.

[11 marks]

(b) Consider the following reaction equation:



- (i) What type of reaction does the equation illustrate?
- (ii) Give a reason for the answer stated in (b)(i).
- (iii) What would be observed if
 - (α) water is sprinkled on CaO?
 - (β) excess water is added to CaO?
- (iv) Write a balanced chemical equation for the reaction in (b)(iii)(β).

[7 marks]

- (c) (i) The heat of solution for NH_4Cl is $+15.1 \text{ kJ mol}^{-1}$. State with reason the effect of increase in temperature on the solubility of NH_4Cl .
- (ii) If a salt of mass 5.10 g dissolves in distilled water of volume 7.70 cm^3 at 50°C , determine the solubility of the salt in mol dm^{-3} at the stated temperature.

[Mr of salt = 165.5]

[7 marks]

FOR CANDIDATES IN GHANA ONLY

4. (a) Explain briefly how molecules assume their shapes. [4 marks]

- (b) (i) State the difference between *polar covalent bond* and *coordinate covalent bond*.
- (ii) Illustrate dipole moment in **each** of the following molecules:
 - (α) NF_3 ;
 - (β) CO_2 ;
 - (γ) H_2O .

[5 marks]

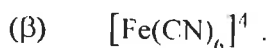
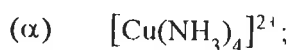
- (c) (i) Define **each** of the following terms:
 - (α) natural radioactivity;
 - (β) nuclear fusion.
- (ii) State **one** difference between *natural radioactivity* and *artificial radioactivity*.
- (iii) Give **two** uses of nuclear fusion.

[7 marks]

(d) The equilibrium constant for the reaction: $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)}$ at a certain temperature is 6.0. Calculate the equilibrium concentration of HI at that temperature when the equilibrium concentration of H_2 and I_2 are 0.2 mol dm^{-3} and 0.3 mol dm^{-3} respectively. [4 marks]

- (e) (i) Explain **briefly** why the $\text{C}=\text{C}$ bond energy is larger but **not** twice as large as the $\text{C}-\text{C}$ bond energy.

(ii) Give the IUPAC name of **each** of the following complex ions:



[5 marks]

5. (a) NaHCO_3 acts both as a weak acid and a weak base in aqueous solution.

(i) Write the:

(α) K_a expression for $\text{NaHCO}_{3(aq)}$;

(β) K_b expression for $\text{NaHCO}_{3(aq)}$;

(ii) Calculate the $[\text{H}_3\text{O}^+]$ for 0.100 mol dm^{-3} aqueous solution of NaHCO_3 at 25 °C.

$$[K_a \text{ at } 25^\circ\text{C} = 4.7 \times 10^{-11}]$$

[8 marks]

(b) Chlorine has two isotopes. The isotopic mass and percentage abundance of the heavier isotope are 36.98 and 24.95 % respectively.

(i) Calculate the isotopic mass of the lighter isotope.

(ii) Sketch the mass spectrum of chlorine.

$$[\text{Rel. At. mass of Cl} = 35.5]$$

[6 marks]

(c) (i) The standard enthalpy of combustion of ethanol is $-1368 \text{ kJ mol}^{-1}$. Explain briefly this statement.

(ii) Explain briefly why the bond energy of chlorine is **not** the same as its bond dissociation energy.

(iii) List two factors that favour ionic bond formation.

[6 marks]

(d) Benzene contains six carbon atoms and six hydrogen atoms:

(i) Draw **two** stable structures of benzene to show how these atoms are arranged;

(ii) State the concept behind these structures;

(iii) State **one** industrial source of benzene;

(iv) State **one** use of benzene.

[5 marks]

FOR CANDIDATES IN NIGERIA, SIERRA LEONE, THE GAMBIA AND LIBERIA

4. (a) Describe **briefly** how you would determine what proportion of hardness in a given sample of water is due to permanent hardness. [11 marks]
- (b) With the aid of chemical equations, explain **briefly** how iron is extracted in the blast furnace using iron ore, coke and limestone as raw materials. [8 marks]
- (c) (i) State the names of **two** allotropes of sulphur.
(ii) State what is observed when hydrogen sulphide is bubbled through acidified potassium tetraoxomanganate(VII) solution.
(iii) Explain **briefly** the observation stated in (c)(ii). [6 marks]
5. (a) (i) Name **two** products obtained directly from the destructive distillation of coal.
(ii) Give **one** use of **each** product named in (a)(i). [4 marks]
- (b) What conclusions can be drawn about a sample of water which
(i) did **not** lather readily with soap;
(ii) turned blue litmus paper pink,
(iii) gave a white cloudiness with barium chloride solution. [6 marks]
- (c) (i) Differentiate between a *fine chemical* and a *heavy chemical*.
(ii) Name **two** chemicals used in water works for the purification of water.
(iii) State the functions of the chemicals named in (c)(ii).
(iv) Mention **one** source of air pollution. [7 marks]
- (d) (i) In the preparation of trioxonitrate(V) acid in the laboratory from trioxonitrate(V) salts,
(α) what other reagent is required?
(β) state the reason why an all-glass apparatus must be used.
(ii) Give **two** uses of trioxonitrate(V) acid. [8 marks]

**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

- Use 2B pencil throughout.
- On the pre-printed answer sheet, check that the following details are correctly printed:
 - In the space marked *Name*, check your **surname** followed by your **other names**.
 - In the spaces marked *Examination*, *Year*, *Subject* and *Paper*, check, 'SC 2020', 'CHEMISTRY', and '1' in that order.
 - 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.
 - 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.
- An example is given below. This is for a male candidate whose *name* is Elliot Kofi AGBANA. His *index number* is 7102143958 and he is offering *Chemistry* 1.

**THE WEST AFRICAN EXAMINATIONS COUNCIL
ANSWER SHEET**

PRINTED IN BLOCK LETTERS	
Name: AGBANA ELLIOT KOFI	GHA
Examination: WASSCE	Year: SC 2020
Subject: CHEMISTRY	Paper: 1

INSTRUCTIONS TO CANDIDATES

- Use grade BB pencil throughout.
- Answer each question by choosing one letter and shading it like this: A B C D E
- Erase completely any answer you wish to change.
- Leave extra spaces blank if the answer spaces provided are more than you need.

INDEX NUMBER	
7	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
0	0 1 2 3 4 5 6 7 8 9
2	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
4	0 1 2 3 4 5 6 7 8 9
3	0 1 2 3 4 5 6 7 8 9
9	0 1 2 3 4 5 6 7 8 9
5	0 1 2 3 4 5 6 7 8 9
8	0 1 2 3 4 5 6 7 8 9

SUBJECT CODE	
5	0 1 2 3 4 5 6 7 8 9
0	0 1 2 3 4 5 6 7 8 9
5	0 1 2 3 4 5 6 7 8 9
2	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
3	0 1 2 3 4 5 6 7 8 9

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. Iodine
- C. Sulphur
- D. Sodium

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

A B C D E

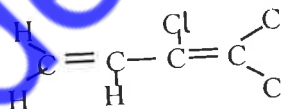
Think carefully before you shade the spaces; erase completely any answer you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

1. Which of the following substances is an example of a fine chemical?
 - A. Sodium hydroxide
 - B. Ethylene
 - C. Hydrochloric acid
 - D. Ammonia

2. The IUPAC name of the compound represented by the structure below is



- A. 3-chloro but-1, 3-diene.
 - B. 2-chloro but-diene.
 - C. but-1, 3-chlorodiene.
 - D. 2-chloro but-1, 3-diene.
3. Which of the following substances is a polypeptide?
 - A. Protein
 - B. Fats
 - C. Starch
 - D. Glycogen
 4. Which of the following products could be formed during incomplete combustion of a hydrocarbon?
 - I. Carbon
 - II. Hydrogen
 - III. Carbon(II) oxide
 - A. I only
 - B. I and III only
 - C. I and II only
 - D. II and III only

5. What quantity of electrons is lost when one mole of iron(II) ions is oxidized to iron(III) ions?
A. 3 moles
B. 2 moles
C. 0 mole
D. 1 mole
6. What is the mass of silver deposited when 24,125 C of electricity is passed through a solution of silver salt?
[Ag = 108; 1 F = 96,500 C]
A. 27 g
B. 54 g
C. 108 g
D. 432 g
7. Equal masses of calcium trioxocarbonate (IV) were added to dilute hydrochloric acid at the temperature specified. Under which of the following conditions would the reaction be **slowest**?
A. Calcium trioxocarbonate(IV) powder at 40 °C.
B. Calcium trioxocarbonate(IV) powder at 20 °C.
C. Calcium trioxocarbonate(IV) chips at 40 °C.
D. Calcium trioxocarbonate(IV) chips at 20 °C.
8. The high solubility of ethanol in water is due to
A. its low boiling point.
B. hydrogen bonding.
C. its low freezing point.
D. its covalent nature.
9. Which of the following metals reacts **slowly** with cold water?
A. Iron
B. Silver
C. Calcium
D. Potassium
10. Which of the following pairs of properties of alkali metals **decreases** down the group?
A. First ionization energy and melting point
B. Reactivity and electronegativity
C. Melting point and atomic radius
D. First ionization energy and reactivity
11. The **most** suitable process of obtaining water from an aqueous solution of sugar is
A. crystallization.
B. filtration.
C. decantation.
D. distillation.
12. Group VII elements in their **combined** states are called
A. halogens.
B. halides.
C. anions.
D. cations.

13. When an ionic bond is broken, bonding electrons are
- gained by the most electronegative atom.
 - shared between participating atoms.
 - gained by the most electropositive atom.
 - lost by both participating atoms.
14. The oxidation state of chlorine in NaClO_3 is
- + 1.
 - + 3.
 - + 6.
 - + 5.
15. A balanced chemical equation is based on the law of
- periodicity.
 - conservation of mass.
 - constant composition.
 - multiple proportion.
16. Which of the following pairs of elements has the **greatest** difference in electronegativity?
- Na and I
 - Na and Br
 - Na and F
 - Na and Cl
17. A factor that is considered **most** important when siting a chemical industry is
- availability of storage facilities.
 - nearness to other industrial establishment.
 - favourable climate conditions.
 - nearness to raw materials.
18. The boiling point of pentane is higher than that of propane because
- carbon-carbon single bonds are stronger than carbon-hydrogen bonds.
 - the intermolecular forces in pentane are stronger than those of propane.
 - pentane has more covalent bonds to break.
 - pentane does not burn easily as propane.
19. Which of the following solids would **not** decompose on heating?
- Potassium trioxocarbonate(IV)
 - Ammonium chloride
 - Lead(II) trioxonitrate(V)
 - Sodium hydrogen trioxocarbonate(IV)
20. The following molecules have double covalent bonds between two atoms **except**
- oxygen.
 - carbon(IV) oxide.
 - water.
 - ethene.
21. The type of isomerism exhibited by *cis* and *trans* isomers is
- positional.
 - functional
 - optical.
 - geometrical.

22. Which of the following compounds has the **lowest** boiling point?
- A. CH_3COOH
 - B. $\text{C}_2\text{H}_5\text{OH}$
 - C. C_4H_{10}
 - D. H_2O
23. An alkanol containing 60 % carbon by mass would have a molecular formula [H = 1.0, C = 12.0, O = 16.0]
- A. $\text{C}_3\text{H}_7\text{OH}$.
 - B. $\text{C}_4\text{H}_9\text{OH}$.
 - C. $\text{C}_2\text{H}_5\text{OH}$.
 - D. CH_3OH .
24. Which of the following compounds would release hydrogen when reacted with sodium metal?
- I. CH_3COOH
 - II. $\text{CH}_3\text{CH}_2\text{OH}$
 - III. $\text{CH}_3\text{COOCH}_3$
- A. I only
 - B. II and III only
 - C. I and III only
 - D. I and II only
25. Which of the following substances is **not** a reducing agent?
- A. H_2
 - B. O_2
 - C. CO
 - D. C
26. Which of the following statements is **correct** for a reaction at equilibrium?
- A. The rates of the forward and backward reactions are equal.
 - B. All reactions cease to occur.
 - C. The reaction has gone to completion.
 - D. The amount of product equals the amount of reactants.
27. Which of the following reactions are **always** exothermic?
- I. Neutralization
 - II. Decomposition
 - III. Combustion
- A. I, II and III
 - B. II and III only
 - C. I and II only
 - D. I and III only

28. Which of the following standard conditions is **not correct** about energy changes?
- Standard temperature is 298 K
 - ΔH^\ominus at 298 K is the activation energy
 - Standard pressure is 1 atm
 - Concentration of solution must be 1 mol dm^{-3}
29. If 5.0 cm^3 of $0.200 \text{ mol dm}^{-3} \text{ Na}_2\text{CO}_3$ was diluted to 250 cm^3 solution, what would be the concentration of the resulting solution?
- $0.200 \text{ mol dm}^{-3}$
 - $0.020 \text{ mol dm}^{-3}$
 - $0.004 \text{ mol dm}^{-3}$
 - $0.400 \text{ mol dm}^{-3}$
30. The initial volume and pressure of a given mass of gas is V and $3P$. What is its pressure if its volume is increased to $2V$ at constant temperature?
- $\frac{3}{2}P$
 - $\frac{2}{3}P$
 - $2P$
 - $3P$
31. What volume of oxygen at s.t.p. is required to burn completely 7.5 dm^3 of methane according to the following equation?
- $$\text{CH}_{4(g)} + 2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(g)}$$
- 30.00 dm^3
 - 15.00 dm^3
 - 7.50 dm^3
 - 3.75 dm^3
32. When 250 cm^3 of a saturated solution of CuSO_4 at 30°C was evaporated to dryness, 5.0 g of the salt was obtained. What is the solubility of the salt at 30°C ?
[$\text{CuSO}_4 = 160$]
- 0.031
 - 0.640
 - 1.560
 - 0.125
33. The bond between NH_3 and H^+ in NH_4^+ is
- covalent.
 - hydrogen.
 - dative.
 - electrovalent.

34. Which of the following oxides has a giant covalent structure?
- SiO_2
 - P_4O_{10}
 - Na_2O
 - Al_2O_3
35. Which of the following hydroxides is **not** readily soluble in water?
- KOH
 - NaOH
 - Ca(OH)_2
 - NH_4OH
36. Which of the following statements about the solubility of a salt is **correct**?
- A salt whose solubility increases with temperature would not crystallize easily on cooling.
 - Crystallization would be efficient in separating out a salt whose solubility increases considerably with temperature.
 - A salt whose solubility is independent of temperature would normally crystallize out on cooling.
 - Solubility of a solid does not affect its crystallization.
37. How many moles of H_2SO_4 are there in 50 cm^3 of $0.108 \text{ mol dm}^{-3}$ solution of the acid?
- 5.4×10^{-2}
 - 5.4×10^{-3}
 - 5.4×10^{-1}
 - 5.4×10
38. If 20 cm^3 of sodium hydroxide was neutralized by 20 cm^3 of 0.01 mol dm^{-3} tetraoxosulphate(VI) acid, what is the concentration of the solution?
- 0.150
 - 0.100
 - 0.010
 - 0.020
39. *Electrons always occupy the lowest empty energy level* is a statement of
- Pauli Exclusion Principle.
 - Periodic law.
 - Aufbau Principle.
 - Hund's rule.
40. Which of the following metals does **not** react with water to produce hydrogen?
- Zinc
 - Sodium
 - Lithium
 - Potassium
41. Which of the following arrangements of elements is in **decreasing** order of electronegativity?
- Na, Mg, Al, Si, P
 - Na, Al, Mg, P, Si
 - P, Si, Al, Mg, Na
 - P, Mg, Na, Si, Al

42. The metallic bond in magnesium is stronger than that in calcium because magnesium has a
- larger atomic size.
 - greater number of valence electrons.
 - lower melting point.
 - smaller atomic size.
43. Consider the reaction represented by the following equation:
- $$\text{AgNO}_{3(\text{aq})} + \text{NaCl}_{(\text{aq})} \rightarrow \text{AgCl}_{(\text{s})} + \text{NaNO}_{3(\text{aq})}$$
- The steps that could be taken to obtain pure dry sample of $\text{AgCl}_{(\text{s})}$ from the mixture include
- filtering, washing and drying.
 - filtering and evaporation to dryness.
 - heating to saturation and drying.
 - crystallizing and allowing to cool.
44. How many electrons does ${}_{15}^{31}\text{P}^{3-}$ contain?
- 12
 - 15
 - 18
 - 16
45. The atomic number of an atom would be equal to its mass number if it
- does not contain neutrons.
 - has a totally filled valence shell.
 - has a high charge to mass ratio.
 - exhibits isotopy.
46. Which of the following processes is not exhibited by atoms in order to attain more stable electron configuration?
- Losing electrons
 - Sharing electrons
 - Gaining of electrons
 - Hybridization of orbitals
47. Which of the following quantities is a molar quantity?
- Mass concentration
 - Molarity
 - Molality
 - Molar Mass
48. Dilution factor is the
- number of times the volume of the concentrated solution is diluted to give the dilute solution.
 - amount of distilled water that is added to the concentrated solution to dilute it.
 - quantity of distilled water added to 1 dm^3 of the concentrated solution to give the dilute solution.
 - act of diluting the concentrated solution to obtain the dilute solution.

49. Calcium chloride is an ionic compound. Which of the following statements account for its ionic character?
- I. Calcium has high ionization energy.
 - II. Calcium has low ionization energy.
 - III. Chlorine has high electron affinity.
 - IV. Chlorine has high ionization energy.
- A. I, II, III and IV
 - B. II, III and IV only
 - C. I, II and IV only
 - D. I and II only
50. An example of a biodegradable pollutant is
- A. hydrogen sulphide.
 - B. carbon(II) oxide.
 - C. plastic.
 - D. sewage.

END OF PAPER

SC5053/C
WASSCE 2020
CHEMISTRY 3
Practical
ALTERNATIVE C
2 hours

C

THE WEST AFRICAN EXAMINATIONS COUNCIL

West African Senior School Certificate Examination
for School Candidates

SC 2020

CHEMISTRY 3

2 hours

PRACTICAL

ALTERNATIVE C

[50 marks]

Write your name and index number in ink in the spaces provided above.

*On the front page of your answer booklet record your **index number**, your **serial number**, and the **number and letter** of every substance supplied to you. These substances should all bear your **serial number**; if this is not so, inform the Supervisor immediately.*

*Answer **all** the questions in ink.*

Answer **all** questions.

All your burette readings (initial and final) as well as the volume of your pipette must be recorded but **no** account of experimental procedure is required. All calculations **must** be done in your answer booklet.

1. **G** is $0.045 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$.

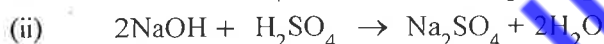
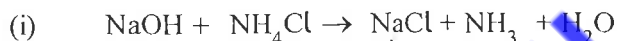
H was prepared by dissolving a sample of NH_4Cl in excess of $0.092 \text{ mol dm}^{-3} \text{ NaOH}$ solution.

(a) Put **G** into the burette and titrate it against 20.0 cm^3 or 25.0 cm^3 portions of **H** using methyl orange as indicator.

Repeat the titration to obtain **concordant** titre values.

Tabulate your results and calculate the average volume of **G** used.

The equations for the reactions are:



(b) From your results and the information provided, calculate the:

- (i) concentration of NaOH in **H** in mol dm^{-3} ;
- (ii) amount of NaOH that reacted with NH_4Cl ;
- (iii) amount of NH_4Cl added;
- (iv) mass of NH_4Cl added;
- (v) volume of NH_3 evolved.

[H = 1.0; N = 14.0; O = 16.0; Na = 23.0; Cl = 35.5; $V_m = 22.4 \text{ dm}^3$]

[23 marks]

Credit will be given for strict adherence to the instructions, for observations precisely recorded and for accurate inferences. All tests, observations and inferences **must** be clearly entered in your answer booklet, in **ink** at the time they are made.

2. **J** is a mixture of **two** salts. Carry out the following exercises on **J**.

Record your observations and identify any gas(es) evolved.

State the conclusions you draw from the result of **each** test.

(a) Put all of **J** into a boiling tube and add about 10 cm^3 of distilled water. Stir the mixture thoroughly and filter. Keep both the filtrate and the residue.

- (b) (i) To about 2 cm^3 portion of the filtrate, add $\text{NH}_3(\text{aq})$ in drops and then in excess.
- (ii) To another 2 cm^3 portion of the filtrate, add $\text{BaCl}_2(\text{aq})$ and then add dilute HCl.

- (c) Divide the residue into **two** portions.
- Heat the first portion strongly in a boiling tube.
 - Add dilute HCl to the second portion in a test tube.
- [19 marks]

3. (a) Give **one** example of **each** of the following substances:
- a gas that turns damp red litmus paper blue;
 - a compound of calcium used to neutralize soil acidity.
 - a gas other than oxygen that can relight a glowing splint.
- [3 marks]

- (b) State what would be observed, when
- sodium hydroxide pellets are exposed to the atmosphere for sometime.
 - ethene is passed through bromine water.
- [3 marks]

- (c) Explain **briefly** why when carbon(IV) oxide is bubbled through lime water, it turns milky, but the milkiness disappears when the gas is bubbled for a long time.
- [2 marks]

END OF PAPER