P5052 Nov.
W.A.S.S.C.E. 2000
CHEMISTRY 2 **2**
3 hours

Name:.....

Identification Number:.....

THE WEST AFRICAN EXAMINATIONS COUNCIL

West African Senior School Certificate Examination

November 2000 CHEMISTRY 2 3 hours

Do **not** *open this booklet until you are told to do so. While you are waiting, read the following instructions carefully. Write your* **Name** *and* **Identification Number** *in the spaces provided at the top right-hand corner of this booklet. This paper consists of* **two** *parts,* A *and* B. *Answer* Part A *on your Objective Test answer sheet and* Part B *in your answer booklet.* Part A *will last for 1 hour after which the answer sheet will be collected. Do* **not** *start* Part B *until you are told to do so.* Part B *will last for 2 hours.*

PART A 1 hour

OBJECTIVE TEST

[50 marks]

1. Use **HB** pencil throughout.
2. If you have got a blank answer sheet, complete the top section of it as follows:
   (a) In the space marked *Name,* write in capital letters your **surname** followed by your **other names.**
   (b) In the spaces marked *Examination, Year, Subject* and *Paper,* write **'W.A.S.S.C.E.', '2000 NOVEMBER,' 'CHEMISTRY'** and **'2'**, respectively.
   (c) In the box marked *Identification Number,* write down your **Identification number** vertically in the spaces on the left-hand side. There are numbered spaces in line with each digit. Shade carefully the space with the same number as each digit.
   (d) In the box marked *Subject Code,* write down the digits **505213** in the spaces on the left-hand side. Shade the corresponding numbered spaces in the same way as for your identification number.
   (e) In the box marked *Sex,* shade the space marked ***M*** if you are **male**, or ***F*** if you are **female**.
3. If you have got a pre-printed answer sheet, check that the details are correctly printed, as described in **2** above. In the boxes marked *Identification Number, Subject Code* and *Sex,* **reshade** each of the shaded spaces.
4. An example is given below. This is for a **female** candidate, whose **name** is Chidera Nkiruka OBI, whose **Identification number** is **5251102068,** and who is offering **Chemistry 2.**

THE WEST AFRICAN EXAMINATIONS COUNCIL

PRINT IN BLOCK LETTERS

Name: OBI (Surname) CHIDERA NKIRUKA (Other Names) Examination: WASSCE Year: 2000 NOV.

Subject: CHEMISTRY Paper: 2

IDENTIFICATION NUMBER
5
2
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8

SUBJECT CODE
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3

SEX

Indicate your sex by shading the space marked M (for Male) or F (for Female) in this box: M / F

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

INSTRUCTIONS TO CANDIDATES

1. Use grade HB pencil throughout.
2. Answer each question by choosing one letter and shading it like this: [A] [B] [C] [■]
3. Erase completely any answers 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.

Answer **all** *the 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 pairs of substances would react when mixed?

A. Ethanol and water
B. Ink and water
C. Palm wine and water
D. Sodium and water

The correct answer is sodium and water, *which is lettered* D, *and therefore answer space* D *would be shaded.*

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

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

Do all rough work on this question paper.

Now answer the following questions:

1. If an atom of an element is represented as $^{40}_{20}\mathbf{Y}$, this shows that it has

A. 40 neutrons.
B. mass number 20.
C. 20 protons.
D. atomic number 40.

2. When metals react, they usually do so by

A. gaining electrons.
B. sharing electrons.
C. donating electron pair.
D. losing electrons.

3. If the mass number of **X** is 24 and $\mathbf{X}^{2+}$ contains 10 electrons, the nucleus of **X** will consist of

A. 8 protons and 16 neutrons.
B. 10 protons and 14 neutrons.
C. 10 protons and 12 neutrons.
D. 12 protons and 12 neutrons.

4. The atom and ion of chlorine have the same

A. number of protons.
B. electronic configuration.
C. chemical properties.
D. electrical charge.

5. Element **X** has 2 electrons in its outer shell while element **Y** has 6. The compound formed by **X** and **Y** has the formula

A. XY.
B. XY_2.
C. X_2Y.
D. XY_3.

6. "Electrons will occupy equivalent orbitals singly, as far as possible, with the same spin" is a statement of

A. Hund's rule.
B. Pauli Exclusion Principle.
C. Periodic law.
D. Aufbau Principle.

7. **M** is a group II element. Which of the following represents the ionization of its chloride ?

A. $M_2Cl \longrightarrow 2M^+ + Cl^-$
B. $MCl \longrightarrow M^{2+} + Cl^-$
C. $MCl_2 \longrightarrow M^{2+} + 2Cl^-$
D. $M(Cl)_2 \longrightarrow M^{2+} + Cl_2$

8. Which of the following forms a coordinate covalent bond with H^+ ?

A. CO_2
B. O_2
C. H_2O
D. N_2

9. How many electrons are present in the **2p** orbital of an element represented as $^{19}_{9}X$?

A. 10
B. 7
C. 6
D. 5

10. The emission of a beta particle from the nucleus of $^{226}_{88}Ra$ will produce

A. $^{226}_{89}Ac$.
B. $^{222}_{86}Rn$.
C. $^{222}_{87}Fr$.
D. $^{230}_{90}Th$.

11. Which of the following represents correctly the rearrangement of particles during double decomposition reaction ?

A. $PQ + RS \longrightarrow PS + QR$

B. $PQ + RS \longrightarrow PR + SQ$

C. $PQ + RS \longrightarrow PR + QS$

D. $PQ + RS \longrightarrow PS + RQ$

12. Two corked vessels of different capacities contain 0.01 mole each of gases **X** and **Y**, maintained at the same temperature. Which of the following will be the same for **X** and **Y** ?

A. Pressure exerted by the gases

B. Frequency of collision of their molecules

C. Number of molecules present

D. Molar mass of the gases

13. A given volume of oxygen diffuses through a porous plug in 8.0 *seconds*. How long will it take the same volume of sulphur (IV) oxide to diffuse through under the same conditions ?

[O = 16; SO_2 = 64]

A. 5.7 *seconds*

B. 8.0 *seconds*

C. 11.3 *seconds*

D. 16.0 *seconds*

14. The number of hydroxonium ions produced by one molecule of an acid in aqueous solution is known as its

A. basicity.

B. acid strength.

C. pH.

D. concentration.

15. Consider the following equation:

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Calculate the mass of sodium required to produce 0.40 *g* of sodium hydroxide.

[H = 1, O = 16, Na = 23]

A. 0.23 *g*

B. 0.46 *g*

C. 2.3 *g*

D. 4.6 *g*

16. In which of the following reactions is hydrogen sulphide behaving as an acid?

A. $2NH_4OH + H_2S \longrightarrow (NH_4)_2S + 2H_2O$

B. $H_2SO_4 + H_2S \longrightarrow SO_2 + 2H_2O + S$

C. $2FeCl_3 + H_2S \longrightarrow 2FeCl_2 + 2HCl + S$

D. $Pb(NO_3)_2 + H_2S \longrightarrow PbS + 2HNO_3$

17. Hydrogen is evolved when dilute hydrochloric acid reacts with

A. Ca^{2+}.

B. Mg^{2+}.

C. Fe.

D. Cu.

18. Which of the following properties distinguishes concentrated H_2SO_4 from concentrated HNO_3 ?

A. Ability to conduct electricity on dilution

B. Ability to liberate CO_2 from CO_3^{2-}

C. Reaction as an oxidizing agent

D. Dehydration of compounds

19. Consider the general equation below.

$$X_nCO_{3(s)} \xrightarrow{\text{heat}} X_nO_{(s)} + CO_{2(g)}$$

The reaction will **not** occur when **X** is

A. Cu.

B. Na.

C. Mg.

D. Zn.

20. Which of the following conclusions about a solution of pH 4 is correct ?

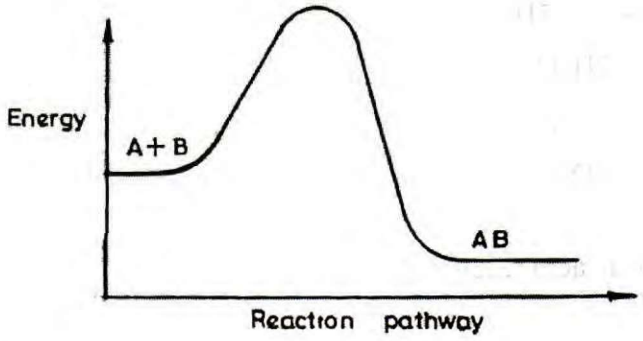
A. It contains more OH^- than H_3O^+.

B. Its pOH value will be 10.

C. It is more acidic than a solution of pH 2.

D. Its hydrogen ion concentration is 4.0×10^{-1} *mol* dm^{-3}.

21. Which of the following can be deduced from the energy profile diagram below ?



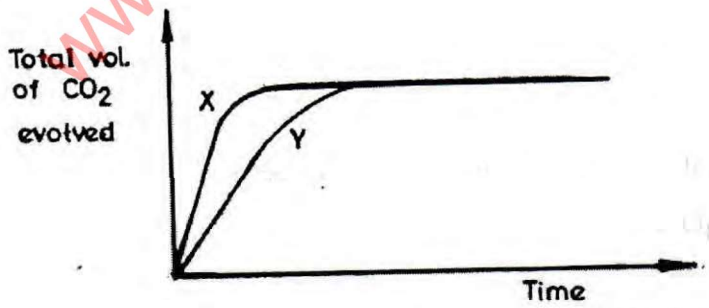
The reaction between A and B

A. occurs irreversibly.
B. is endothermic.
C. is at equilibrium.
D. is exothermic.

22. The presence of catalyst in a reaction mixture alters the

A. heat of reaction.
B. yield of products.
C. equilibrium position.
D. reaction pathway.

23. The rate curves below represent the reaction between a fixed mass of Na_2CO_3 and 0.10 *mol* dm^{-3} solutions of two acids **X** and **Y**.



Which of the following statements about **X** and **Y** is **false** ?

A. The rate of gas production is the same for **X** and **Y**.
B. The total volume of gas evolved is the same for **X** and **Y**.
C. **X** is a stronger acid than **Y**.
D. **X** ionizes more than **Y** in aqueous solution.

24. The reaction represented by the equation below occurred in a sealed glass tube.

$$N_2O_{4(g)} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} 2NO_{2(g)} \qquad \Delta H = +xkJmol^{-1}$$

What happens when the temperature is reduced at equilibrium ?

A. The concentration of N_2O_4 increases.
B. The NO_2 reacts with the N_2O_4.
C. A colourless liquid is obtained.
D. The pressure exerted by the gases increases.

25. An oxidizing agent can be defined as

A. an acceptor of oxygen.
B. a donor of ions.
C. an acceptor of hydrogen.
D. a donor of electrons.

26. What are the values of x and y in the following equation ?

$$2MnO_4^- + xH^+ + yC_2O_4^{2-} \longrightarrow 2Mn^{2+} + 8H_2O + 10CO_2$$

	x	y
A.	8	10
B.	2	4
C.	16	5
D.	10	6

27. Which of the following is a good conductor of electric current ?

A. Mixture of petrol and kerosene
B. Aqueous solution of sugar
C. Mixture of ethanol and water
D. Aqueous solution of table salt

28. Metal **P** will be above metal **Q** in the activity series if **P**

A. has a higher relative atomic mass than **Q**.
B. displaces ions of **Q** from solution.
C. is a better conductor of electricity than **Q**.
D. has a higher melting point than **Q**.

29. Which of the following conversions involves electron gain ?

A. $K_{(s)} \longrightarrow K^+_{(aq)}$
B. $Mg_{(s)} \longrightarrow Mg^{2+}_{(aq)}$
C. $Fe^{2+}_{(aq)} \longrightarrow Fe^{3+}_{(aq)}$
D. $Cu^{2+}_{(aq)} \longrightarrow Cu_{(s)}$

30. What is the oxidation number of boron in $Na_2B_4O_7$?

A. +1
B. +2
C. +3
D. +5

31. Which of the following species undergoes oxidation during the electrolysis of dilute H_2SO_4 ?

A. H^+
B. OH^-
C. H_3O^+
D. SO_4^{2-}

32. C_3H_4 belongs to the same homologous series as

A. C_5H_6.
B. C_5H_8.
C. C_5H_{10}.
D. C_5H_{12}.

33. Alkanes can be prepared by

A. heating the sodium salt of an alkanoic acid with soda lime.
B. treating alkanols with dehydrating agents.
C. reacting a haloalkane with hot alcoholic KOH solution.
D. heating the ammonium salt of the corresponding alkanoic acid.

34. The empirical formula of a compound is C_5H_7N. If its relative molecular mass is 162, what is its molecular formula ?

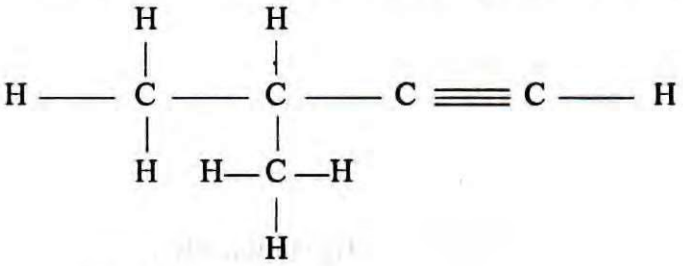
[H = 1, C = 12, N = 14]

A. $C_5H_7N_2$
B. $C_7H_9N_2$
C. $C_{10}H_{14}N_2$
D. $C_{24}H_2N_{28}$

35. Which of the following compounds reacts readily with sodium to liberate hydrogen ?

A. $CH_3CH_2CH_3$
B. CH_3COCH_3
C. $CH_3CH(OH)CH_3$
D. CH_3CH_2CHO

36. What is the IUPAC name of the compound below ?



A. 3-Methylbut-1-yne
B. Pent-2-yne
C. 2-Methylbut-3-yne
D. But-1-yne

37. Vegetable oils are converted into margarine by

A. saponification.
B. esterification.
C. hydrogenation.
D. polymerization.

38. Hydrocarbons which react with ammoniacal copper (I) chloride solution conform to the general molecular formula

A. C_nH_n.
B. C_nH_{2n}.
C. C_nH_{2n+2}.
D. C_nH_{2n-2}.

39. Which of the following compounds will react together to give $CH_3(CH_2)_2COOCH_3$?

A. Methane and propanoic acid
B. Methanol and butanoic acid
C. Propane and ethanoic acid
D. Butanol and methanoic acid

40. $C_{12}H_{26}$ and $C_{12}H_{22}O_{11}$ are both covalent. $C_{12}H_{22}O_{11}$ is soluble in water while $C_{12}H_{26}$ is insoluble. This is because $C_{12}H_{22}O_{11}$

A. has a higher molar mass.
B. can be hydrolyzed.
C. forms hydrogen bonds with the solvent.
D. contains stronger van der Waals' forces.

Turn over

41. The tensile strength of natural rubber is increased by heating it with

A. carbon black.
B. sulphur.
C. nickel catalyst.
D. hydrogen.

42. How many moles of oxygen are required to burn one mole of C_4H_8 completely ?

A. 2
B. 4
C. 6
D. 8

43. Which of the following solutions react without producing a precipitate ?

A. $BaCl_{2(aq)}$ and $H_2SO_{4(aq)}$
B. $HCl_{(aq)}$ and $KNO_{3(aq)}$
C. $ZnCl_{2(aq)}$ and $AgNO_{3(aq)}$
D. $CuCl_{2(aq)}$ and $NaOH_{(aq)}$

44. The use of silver salts in photography is based on the process of

A. oxidation of silver to silver halide.
B. reduction of silver ions to silver.
C. double decomposition to form silver halide.
D. direct combination of silver with halogens.

45. A sample of local gin that turned brown through storage in a rusty metal drum can be purified by

A. fermentation.
B. distillation.
C. filtration.
D. electrolysis.

46. In the extraction of iron in the blast furnace, the role of limestone is to

A. decompose the iron ore.
B. remove the silicate impurities.
C. convert iron (III) to iron (II) compounds.
D. oxidize red hot coke to carbon (IV) oxide.

47. Which of the following methods is most suitable for preventing the rusting of petroleum pipelines ?

A. Painting
B. Greasing
C. Electroplating with tin
D. Cathodic protection with magnesium

48. Soldering wire is an alloy of tin and

A. Al.
B. Pb.
C. Fe.
D. Cu.

49. Which of the following pollutants is associated with genetic mutation ?

A. Carbon (II) oxide
B. Radioactive fallout
C. Biodegradable waste
D. Sulphur (IV) oxide

50. Effects of water pollution include the following **except**

A. depletion of dissolved oxygen.
B. depletion of heavy metal ions.
C. ecological changes.
D. increased turbidity.

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.

PART B

ESSAY

2 hours

Answer **four** *questions in all:* **three** *from* Section I *and* **one** *from* Section II .

All questions carry equal marks.

SECTION I

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

1. *(a)* (i) List **three** characteristic properties of transition metals.

(ii) Which of the following metals belong(s) to the first transition series ? Chromium, Lead, Iron, Magnesium, Aluminium, Manganese.

[6 marks]

(b) Copy and complete the following table:

Alloy	Constituent elements	One major use
Bronze		
Steel		
Duralumin		

[7 marks]

(c) A razor blade of mass 5.00*g* required 50.0 cm^3 of 2.00 *mol* dm^{-3} HCl to react completely according to the equation below:

$$Fe_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_{2(g)}$$

(i) Calculate the mass of iron in the blade.
[Fe = 56.0]

(ii) State **two** ways by which the reaction time can be reduced, assuming the blade retains its form at the start of the reaction.

[7 marks]

(d) A solid sample of a sodium salt **X** does not conduct electric current.

(i) Give the reason for this observation.

(ii) Suggest **two** ways by which **X** can be made to conduct.

(iii) If **X** gave a greenish-yellow gas **Y** on warming with MnO_2 and concentrated H_2SO_4, identify **X** and **Y**.

[5 marks]

2. *(a)* (i) Explain what is meant by *ionization energy* and state how it varies across a period in the Periodic Table.

(ii) If the electronic configuration of an ion Q^{2+} is $Is^2 2s^2 2p^6$, give the:

I. atomic number of **Q**.

II. formula of the chloride of **Q**.

III. reason why **Q** is described as an s-block element.

[6 marks]

(b) (i) Explain why isotopes have different mass numbers but are chemically alike.

(ii) Calculate the relative atomic mass of an element **R** given that the relative abundance of $^{63}_{29}\mathbf{R}$ and $^{65}_{29}\mathbf{R}$ are 68% and 32% respectively.

[5 marks]

(c) (i) List **two** uses of chlorine.

(ii) Give the balanced half equations for the following reaction:

$$Cl_{2(g)} + 2Br^-_{(aq)} \longrightarrow 2Cl^-_{(aq)} + Br_{2(g)}$$

(iii) Given the following substances:

$CCl_{4(l)}$, $CuCl_{2(s)}$, $HCl_{(g)}$, $KCl_{(aq)}$

State which of them

I. has the highest entropy value;
II. contain(s) chloride ions;
III. can be decomposed by an electric current.

[8 marks]

(d) Consider the following equation

$$H_2S_{(g)} + M^{2+}_{(aq)} \rightleftharpoons MS_{(s)} + 2H^+_{(aq)}; \quad \Delta H = -xkJmol^{-1}$$

State and explain the effect of each of the following on the equilibrium position:

(i) Increase in temperature;
(ii) Addition of solution of $M(NO_3)_2$;
(iii) Addition of acidified $KMnO_{4(aq)}$.

[6 marks]

3. (a) Write the name and structural formula of **one** compound conforming to each of the following:

(i) C_nH_{2n+2}

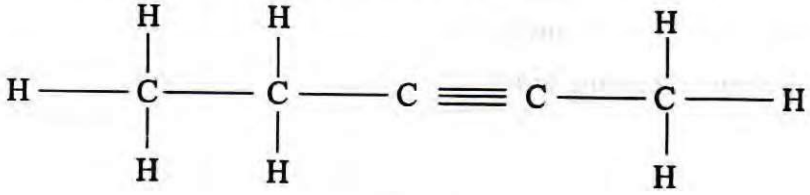
(ii) $C_nH_{2n+1}COOH$

(iii) $C_nH_{2n+1}CHO$

[6 marks]

(b) (i) Give **one** test for unsaturation.

(ii) Consider the following compound:



I. Write its IUPAC name.
II. State the product of its complete hydrogenation.
III. Why does it not give a precipitate with ammoniacal $AgNO_3$ whereas some homologues do?

[6 marks]

(c) (i) Write an equation for the reaction between propanol and sodium.
(ii) State the reaction conditions for the conversion of ethanol to ethylpropanoate.
(iii) Mention **one** reagent that can convert an alkanol to alkanoic acid.

[6 marks]

(d) The equation below represents one of the reactions of alkanes.

$$C_{17}H_{36(l)} \longrightarrow 3C_2H_{4(g)} + C_8H_{18(l)} + X$$

(i) Determine the formula of X and the homologous series to which it belongs.
(ii) What type of reaction does the equation represent?
(iii) Calculate the volume of ethene at *s.t.p.* that would be obtained from 0.100 *mole* of $C_{17}H_{36}$ in the reaction.

[1 *mole* of a gas occupies 22.4 dm^3 at *s.t.p.*]

[7 marks]

4. (a) (i) List **three** characteristic properties of acids.
(ii) Given 0.10 *mol* dm^{-3} solutions of HCl and CH_3COOH, state and explain which of the acid solutions will have the higher electrical conductivity.
(iii) Write **one** equation in each case to illustrate the behaviour of HNO_3 as:
I. a typical acid;
II. an oxidizing agent.

[10 marks]

(b) (i) Draw and label a diagram for the laboratory preparation of sulphur (IV) oxide.
(ii) Mention the catalyst used for the following reaction and explain its effect on the system.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

[9 marks]

(c) In the extraction of aluminium from bauxite, state the
(i) substance used for digesting the ore;
(ii) composition of the mixture electrolysed;
(iii) anode material and give the reason why it has to be changed at intervals.

[6 marks]

SECTION II

Answer **one** *question* **only** *from this section.*

5. (a) What is meant by each of the following terms?
(i) Enthalpy of combustion
(ii) Structural isomers

[4 marks]

(b) (i) What type of oxide is each of the following?

NO_2, CO, Fe_2O_3, Al_2O_3, P_2O_3

(ii) Mention **one** oxide associated with global warming.

[6 marks]

(c) (i) State the main processes involved in the industrial production of oxygen from air.

(ii) Write equations to show the action of heat on each of KNO_3 and $NaHCO_3$.

(iii) Calculate the number of molecules in 4.00*g* of oxygen.

[O = 16.0; *Avogadro constant* = 6.02×10^{23} mol^{-1}]

[9 marks]

(d) (i) List **two** metals that can displace iron (II) ions from solution.

(ii) During the extraction of iron in the blast furnace, oxygen combines with one of the raw materials to form a reducing agent **W**. Identify **W** and the raw material that produces it.

(iii) What property is exhibited in each case when the following changes occur on exposure ?

I. $Fe_{(s)}$ converted to $Fe_2O_3.xH_2O$

II. $FeCl_{3(s)}$ converted to $FeCl_{3(aq)}$

[6 marks]

6. (a) (i) State Gay-Lussac's law of combining volumes.

(ii) The following reaction occurred when 100 cm^3 of carbon (II) oxide was burnt in 70 cm^3 of oxygen:

$$2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}$$

Calculate the total volume of gas mixture in the reaction vessel at the end of the reaction, assuming the temperature and pressure were adjusted to the initial values.

[6 marks]

(b) (i) List **two** uses of H_2SO_4.

(ii) Give equations and reaction conditions for the following conversions:

$$ZnCO_{3(s)} \longrightarrow ZnO_{(s)} \longrightarrow ZnSO_{4(aq)}$$

(iii) State how each of the following can be obtained from $ZnSO_{4(aq)}$.

I. $ZnSO_{4(s)}$

II. $ZnCO_{3(s)}$

[10 marks]

(c) Give the reason for each of the following:

(i) Graphite is soft while diamond, its allotrope, is hard.

(ii) Sodium salts cannot be prepared by double decomposition.

(iii) $Na_2CO_{3(aq)}$ which is a salt solution, turns red litmus blue.

[6 marks]

(d) (i) Mention **two** types of coal.

(ii) Name the process by which benzene is obtained from coal tar.

[3 marks]