

2016 WAEC Past Questions

Question 1

Which of the following sources of energy contributes to green-house effect?

Options

- A) Natural gas
- B) Nuclear
- C) Wind
- D) Solar

The correct answer is A.

Question 2

A consequence of global warming is

Options

- A) Air pollution
- B) Flooding
- C) Increased humidity
- D) Water pollution

The correct answer is A.

Question 3

Which of the following metals is common to both brass and bronze?

Options

- A) Aluminium
- B) Copper
- C) Lead
- D) Iron

The correct answer is B.

Question 4

The alkanol obtained from the production of soap is

Options

- A) Dihydric Alkanol
- B) Tertiary Alkanol
- C) Trihydric Alkanol
- D) Monohydric Alkanol

The correct answer is C.

Question 5

When a compound **X** is heated with concentrated tetraoxosulphate(VI)acid, it produces an alkene. **X** ia an

Options

- A) Alkane
- B) Alkanol
- C) Alkanoate

D) Alkyne

The correct answer is B.

Question 6

Ripening of fruits is hastened by using

Options

- A) Ethanol
- B) Ethane
- C) Ethene
- D) Ethyne

The correct answer is C.

Question 7

Which of the following compounds is/are secondary alkanols?

- i) $\text{CH}_3\text{CH}(\text{CH}_2)\text{OH}$
- ii) $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
- iii) $\text{CH}_3\text{C}(\text{OH})(\text{CH}_2)\text{CH}_3$

Options

- A) I only
- B) II only
- C) I and III only
- D) II and III only

The correct answer is B.

Question 8

Consider the following reaction equation:



The volume of oxygen at s.t.p that will be required to burn 14g of ethene is

[C H = 28; Molar volume of gas at s.t.p = 22.4dm³

Options

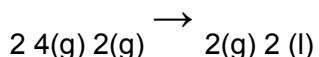
A) 64.2dm³

B) 33.6dm³

3 3 3

3 2 3

3 3 3



2 4 3

3 3 3

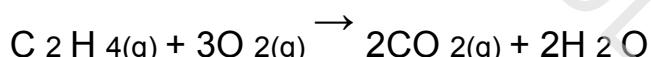
C) 11.2dm³

D) 3.73dm³

3

The correct answer is B.

Explanation:



(l) 1 28g mole of ethene required required 3 x 3 22.4dm³ moles of O₂

O₂

14g will require

$$14 \times 3 \times 22.4 \text{ dm}^3$$

3

$$= 33.6 \text{ dm}^3$$

3

Question 9

Which of the following substances is a non-electrolyte?

Options

A) H₂SO₄

B) CH₃COOH

C) C₆H₁₂O

D) NH₄Cl

The correct answer is C.

Question 10

The oxidation number of sulphur is +4 in

Options

A) Na₂S₂O

B) H₂SO₃

C) H₂SO₄

4

3

The correct answer is B.

From 2015 WAEC Past Questions

Question 1

Which of the following products of biotechnology can be used as a fuel in place of petrol?

Options

A) Butane

B) Ethanol

C) Ethene

D) Propanol

The correct answer is A.

Question 2

Which of the following metals is the strongest reducing agent?

Options

A) Sodium

B) Silver

C) Potassium

D) Copper

The correct answer is C.

Question 3

The complete
hydrogenation of
benzene gives

Options

A) Cyclohexene

B) Cyclohexane

C) Hexene

D) Hexane

The correct answer is B.

Question 4

A compound has an empirical formula CH_2O and molecular mass of 90. [H = 1.00, C = 12.0, O = 16.0]

Options

A) C₄H₁₀O₂

B) C₃H₁₀O₂

C) C₃H₆O₃

D) C₂H₂O₄

The correct answer is C.

Explanation:

$$(CH_2O)_n = 90; (12 + (1 \times 2) + 16)n = 90$$

$$(12 + 2 + 16)n = 90; 30n = 90; n =$$

90

30

9030

; n = 3



Question 5

Which of the following reactions would take place when concentrated sodium hydroxide solution is

added to palm oil?

Options

A) Esterification

B) Neutralization

C) Polymerization

D) Saponification

The correct answer is D.

Question 6

Starch could be
converted to glucose by

the process of

Options

A) Condensation

B) Dehydration

C) Fermentation

D) Hydrolysis

The correct answer is D.

Question 7

Which of the following compounds is the least

soluble in water?

Options

A) CaCl_2

B) CaSO_4

C) NaCl

D) Na_2SO_4

The correct answer is B.

Question 8

A substance which
dissolves readily in

organic solvent would

Options

- A) Be a covalent compound
- B) Have strong electrostatic forces of attraction
- C) have a high melting point
- D) Conduct electricity in molten state

The correct answer is A.

Question 9

A change in the
temperature of a
saturated solution
disturbs the equilibrium

between the

Options

- A) Undissolved solute and the solvent
- B) Dissolved solute and the solvent
- C) Dissolved solute and the undissolved solute
- D) Dissolved solute and the solution

The correct answer is C.

Question 10

Which of the following statements about an electrochemical cell is correct? Oxidation

occurs

Options

- A) At the anode
- B) At the cathode
- C) Through the salt bridge
- D) In the aqueous solution

The correct answer is A.

THE WEST AFRICAN EXAMINATIONS COUNCIL
West African Senior School Certificate Examination

November 2011

CHEMISTRY 2

3 hours

Do not open this booklet until you are told to do so. While you are waiting, write your name and index number in the spaces provided at the top right-hand corner of this booklet and thereafter, read the following instructions carefully. 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

OBJECTIVE TEST

[50 marks]

1 hour

1. Use HB pencil throughout.
2. If you have got a blank answer sheet, complete the top section 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 'WASSCE', '2011 NOV.', 'CHEMISTRY' and '2' respectively.
 - (c) In the box marked Index Number, write your index 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 Paper Code, write the digits 505213 in the spaces on the left-hand side. Shade the corresponding numbered spaces in the same way as for your index 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 Index Number, Paper Code and Sex, reshade each of the shaded spaces.
4. An example is given below. This is for a male candidate, whose name is Chukwuma Adekunle CIROMA, whose index number is 5251102068 and who is offering Chemistry 2.

THE WEST AFRICAN EXAMINATIONS COUNCIL

PRINT IN BLOCK LETTERS

Name: CIROMA CHUKWUMA ADEKUNLE Examination: WASSCE Year: 2011 NOV.

Surname

Other Names

Subject: CHEMISTRY

Paper: 2

INDEX NUMBER	
5	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
2	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
5	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
1	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
1	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
0	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
2	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
0	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
6	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
8	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:

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0	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
5	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
2	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
1	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
3	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:

SEX	
Indicate your sex by shading the space marked M (for Male) or F (for Female) in this box: M <input type="checkbox"/> F <input type="checkbox"/>	

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.

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 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 elements reacts with water?

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

The correct answer is Sodium, which is lettered C and therefore answer space C 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. The smallest particle of a substance that can exist on its own and still retains the chemical properties of that substance is
 - A. a radical.
 - B. an ion.
 - C. a molecule.
 - D. a compound.

2. Consider two atoms represented as $^{16}_8\text{X}$ and $^{17}_8\text{Y}$. The difference between the atoms is in the
 - A. number of protons.
 - B. number of neutrons.
 - C. number of protons and electrons.
 - D. electron structure.

3. The number of electrons present in $^{31}_{15}\text{P}^{3-}$ ion is
 - A. 3.
 - B. 15.
 - C. 18.
 - D. 31.

4. Which of the following ions is monoatomic?
 - A. Mg^{2+}
 - B. OH^-
 - C. CN^-
 - D. NH_4^+

5. The correct electron configuration of an element $_{20}\text{W}$ is
 - A. $1s^2 2s^2 3s^2 2p^6 3p^6 4s^2$.
 - B. $1s^2 2s^2 3s^2 2p^6 4s^2 3p^6$.
 - C. $1s^2 2s^2 2p^6 3s^2 3p^8 4s^0$.
 - D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$.

6. Which of the following sets of elements has the same outermost electron configuration?

- I. H, He, Be.
 - II. H, Li, Be.
 - III. H, Li, Na.
 - IV. He, Ne, Ar.
- A. I
 - B. II
 - C. III
 - D. IV

7. What is the relative atomic mass of hydrogen which contains 99.30% of ${}_1^1\text{H}$ atoms and 0.70% ${}_1^2\text{H}$ atoms?

- A. 1.017
- B. 1.99
- C. 50.35
- D. 199.70

8. Which of the following periodic properties decreases down the group?

- A. *Atomic radius*
- B. *Electron affinity*
- C. *Electronegativity*
- D. *Ionic radius*

9. One of the **main** characteristic properties of transition metals is their ability to

- A. ionize readily by electron loss.
- B. form basic oxides.
- C. react with water.
- D. exhibit variable oxidation states.

10. The high melting points of ionic compounds are due to

- A. the presence of electrostatic forces of attraction.
- B. their ability to dissolve in water.
- C. their ability to exist as solids.
- D. their ability to conduct electricity in the molten state.

11. Which of the following molecules has the **strongest** covalent bond?

- A. H_2
- B. Cl_2
- C. O_2
- D. N_2

12. Which of the following molecules is non-linear?

- A. CO_2
- B. F_2
- C. H_2O
- D. HCl

13. Naphthalene crystals are held together by
- hydrogen bonds.
 - van der Waal's forces.
 - dispersion forces.
 - electrovalent bonds.
14. A metal Z forms two chlorides, ZCl_2 and ZCl_3 . What type of bond exists between Z and chlorine?
- Covalent
 - Dative
 - Ionic
 - Metallic
15. Which of the following bonds are broken when ethanol boils?
- Hydrogen bonds
 - Ionic bonds
 - Covalent bonds
- I only
 - II only
 - I and II only
 - II and III only
16. Which of the following equations represents a reaction that is **not feasible**?
- $Cl_{2(g)} + 2NaBr_{(aq)} \longrightarrow 2NaCl_{(aq)} + Br_{2(g)}$
 - $Cl_{2(g)} + 2KI_{(aq)} \longrightarrow 2KCl_{(aq)} + I_{2(g)}$
 - $Cl_{2(g)} + 2NaF_{(aq)} \longrightarrow 2NaCl_{(aq)} + F_{2(g)}$
 - $Cl_{2(g)} + 2KBr_{(aq)} \longrightarrow 2KCl_{(aq)} + Br_{2(g)}$
17. One mole of a compound $M(OH)_2$ has a mass of 58 g. What is the relative atomic mass of M?
- [H = 1.00, O = 16.0]
- 24
 - 58
 - 92
 - 94
18. Nitrogen combines with oxygen to form two different oxides in which 1.0 g nitrogen combines with 1.142 g of oxygen and 1.714 g of oxygen respectively. This observation illustrates the law of
- constant composition.
 - conservation of mass.
 - chemical combination.
 - multiple proportion.
19. If 60 cm^3 of a gas is heated from 27°C to 77°C, what is the new volume of the gas at constant pressure?
- 21 cm^3
 - 51 cm^3
 - 70 cm^3
 - 171 cm^3

20. The pressure of a gas is due to the
- absence of attractive forces between molecules.
 - constant random motion of molecules.
 - collisions between the molecules and the walls of the container.
 - collision between the molecules.
21. Liquids with strong intermolecular forces have
- small number of molecules escaping into gaseous state.
 - low boiling points.
 - large number of molecules escaping into gaseous state.
 - high vapour pressures.
22. The collision between gas molecules is perfectly elastic because
- cohesive forces between the molecules are negligible.
 - there is no loss of energy during collision.
 - they are highly compressible.
 - they move randomly in straight lines.
23. The similarity between combustion and neutralization reactions is that they are
- endothermic.
 - exothermic.
 - oxidation processes.
 - reduction processes.
24. When an ionic solid dissolves in water, the water molecules split the crystals into free ions. The energy required for this process is
- kinetic energy.
 - potential energy.
 - hydration energy.
 - lattice energy.
25. The reaction of ammonia with excess air in the presence of heated platinum catalyst would yield
- water and nitrogen (II) oxide.
 - water and nitrogen (IV) oxide.
 - water vapour and nitrogen.
 - water vapour and ammonium ion.
26. Which of the following chemical equations illustrates behaviour of an acid?
- $\text{X}_2\text{O}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow 2\text{X}_{(aq)}^+ + 2\text{OH}_{(aq)}^-$
 - $\text{HX}_{(aq)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{H}_3\text{O}_{(aq)}^+ + \text{X}_{(aq)}^-$
 - $\text{HX}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{HX}_{(aq)} + \text{H}_2\text{O}_{(l)}$
 - $\text{X}_{(s)} + 2\text{H}_2\text{O}_{(l)} \longrightarrow \text{X}_{(aq)}^+ + 2\text{OH}_{(aq)}^- + \text{H}_2(g)$

27. Which of the following acids is a **weak acid**?
- H_3PO_4
 - HClO_4
 - H_2SO_4
 - HNO_3
28. When an alkali is warmed with ammonium trioxonitrate (V), the gas liberated is
- NO .
 - NO_2 .
 - N_2O .
 - NH_3 .
29. Which of the following compounds would **not** dissociate completely in water?
- H_2CO_3
 - H_2SO_4
 - HNO_3
 - HCl
30. Consider the process represented by the following chemical equation.
- $$2\text{NaCl}_{(s)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{Na}^+_{(aq)} + \text{Cl}^-_{(aq)} + \text{NaCl}_{(s)}$$
- The equation represents
- saturated solution.
 - unsaturated solution.
 - solute dissolving in a solvent.
 - fully dissociated solute.
31. Which of the following salts would **not** be recovered from its solution by heating to dryness?
- Na_2CO_3
 - NH_4NO_3
 - K_2SO_4
 - NaCl
32. The colour of methyl orange in a solution of potassium hydroxide is
- yellow.
 - orange.
 - pink.
 - colourless.
33. Which of the following factors would **not** affect the rate of a chemical reaction?
- Addition of a catalyst
 - Density of the reactants
 - Change in temperature of the reaction system
 - Physical states of reactants

34. Which of the following quantities represents 965C of electricity?

$$[1F = 96500C]$$

- A. 96500 moles of electrons
- B. 965 moles of electrons
- C. 1·0 mole of electrons
- D. 0·01 mole of electrons

35. During the electrolysis of $\text{CuSO}_4(aq)$ using carbon electrodes, the substance produced at the anode is

- A. $\text{Cu}_{(s)}$
- B. $\text{SO}_{4(g)}$
- C. $\text{O}_{2(g)}$
- D. $\text{H}_2\text{O}_{(l)}$

36. Which of the following processes does **not** involve redox reaction?

- A. Rusting of iron
- B. Combustion of fuels
- C. Decomposition of limestone
- D. Bleaching action of dye

37. Which of the following substances is **not** a reducing agent?

- A. NH_3
- B. KI
- C. H_2O_2
- D. CaI_2

38. When methane combines with **excess** chlorine gas in the presence of ultra-violet radiation, the product formed is

- A. tetrachloromethane.
- B. trichloromethane.
- C. dichloromethane.
- D. chloromethane.

39. The IUPAC name of the compound $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{OH}$ is

- A. propan-2-ol.
- B. propan-1, 2-diol.
- C. propan-2, 3-diol.
- D. propan-3-ol.

40. Which of the following reactions would benzene **readily** undergo?

- A. Polymerization
- B. Addition
- C. Substitution
- D. Hydrolysis

41. A hydrocarbon contains 25% hydrogen. Its empirical formula would be
 [C = 12, H = 1·00]
- CH₄
 - CH₃
 - CH₂
 - CH
42. A hydrocarbon X was bubbled into an alkaline solution of KMnO₄ and the solution changed from purple to green. X would likely be an
- alkene.
 - alkane.
 - alkanol.
 - alkanone.
43. Which of the following formulae **cannot** be used to represent primary alkanols?
- C_nH_{2n+1} OH
 - C_nH_{2n+2} O
 - RR'CHOH
 - ROH
44. Which of the following pairs of metals constitute soft solder?
- Lead and copper
 - Sodium and lead
 - Sodium and copper
 - Lead and tin
45. The compound that could be used to remove impurities from haematite in the blast furnace is
- CaCO₃.
 - CaSiO₃.
 - NaOH.
 - H₂SO₄.
46. Which of the following compounds is used in the manufacture of photographic films?
- Aluminium chloride
 - Silver chloride
 - Zinc chloride
 - Iron (II) chloride
47. A factor which is **not** usually considered when siting an industry is nearness to
- source of power.
 - source of raw materials.
 - market.
 - residential area.

48. Which of the following methods can be used to separate a mixture of petrol and liquid paraffin?
- A. Fractional distillation
 - B. Filtration
 - C. Chromatography
 - D. Evaporation
49. Pollution of rivers by domestic waste causes
- A. an increased level of sediments.
 - B. increased presence of heavy metals.
 - C. reduced level of dissolved oxygen.
 - D. scarcity of nutrients in water.
50. Which of the following polymers is thermoplastic?
- A. Perspex
 - B. Cellulose
 - C. Bakelite
 - D. Proteins

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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

[100 marks]

Answer four questions in all: three questions from Section I and one question from either Section II or Section III.

All questions carry equal marks.

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

SECTION I**FOR ALL CANDIDATES**

Answer three questions from this section.

1. (a) What is a *transition element*? [2 marks]
 - (b) Iron can be represented as $_{26}\text{Fe}$.
 - (i) Write the electron configuration for iron.
 - (ii) Explain briefly why iron exhibits:
 - I. paramagnetism;
 - II. variable oxidation.
 - (iii) Mention two by-products in the extraction of iron in the blast furnace.
 - (iv) Write an equation to illustrate the formation of each of the by-products in 1(b)(iii).
- [10 marks]
- (c) List the elements present in each of the following alloys:
 - (i) steel;
 - (ii) bronze;
 - (iii) brass;
 - (iv) soft solder.
- [4 marks]
- (d) Outline how a pure dry sample of silver chloride could be obtained from aqueous solutions of sodium chloride and silver trioxonitrate (V). [5 marks]
 - (e) If 2.40 g of carbon is burnt completely in air, calculate the volume of carbon (IV) oxide produced at s.t.p.
- [$C = 12.0$. Molar volume, $V_m = 22.4 \text{ dm}^3 \text{ mol}^{-1}$] [4 marks]

2. (a) Consider the following list of elements:
nitrogen, fluorine, aluminium and potassium.
Which of the elements
 - (i) forms diatomic molecule with a triple bond?
 - (ii) is the most reactive electropositive element?
 - (iii) forms amphoteric oxide?
 - (iv) is the most reactive non-metal?

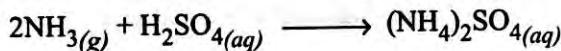
[4 marks]

- (b) (i) State what would be observed if chlorine gas is passed into an aqueous solution of:
- iron (II) chloride;
 - potassium bromide.
- (ii) Give the names of the products in 2(b)(i)I and 2(b)(i)II.
- (iii) Write an ionic equation to represent each of 2(b)(i)I and 2(b)(i)II.
- (iv) Suggest the type of reaction in each of 2(b)(i)I and 2(b)(i)II.

[13 marks]

- (c) State two differences between *conductors* and *electrolytes*. [2 marks]

- (d) Consider the reaction represented by the following chemical equation:



Determine the mass of ammonium tetraoxosulphate (VI) that would be produced from 85 g of ammonia.

[H = 1·00, N = 14·0, O = 16·0, S = 32·0]

[6 marks]

3. (a) (i) What is the shape of
- s-orbital*;
 - p-orbital*?
- (ii) Which ion has the following composition?
0 – electron, 2 – protons and 2 – neutrons. [3 marks]

- (b) The following table shows the melting and boiling points of oxides of the elements X, Y and Z.

Oxides	Melting point/K	Boiling point/K
X ₂ O	1403	2223
Y ₂ O	273	373
Z ₂ O	49	128

- (i) What type of bond binds X, Y and Z respectively to oxygen in their oxides?
- (ii) Explain briefly how the bond in Z₂O is formed?
- (iii) What type of forces hold the molecules of
- Y₂O,
 - Z₂O respectively?

[8 marks]

- (c) The following equation illustrates homogeneous equilibrium established when hydrogen and carbon (IV) oxide react:



- (i) Why is this reaction regarded as homogeneous?
- (ii) Explain briefly the effect of an increase in pressure on the:
 - I. equilibrium position;
 - II. reaction rate.
- (iii) State three features of an equilibrium reaction.

[8 marks]

- (d) A compound Q contains 29.1% sodium, 40.5% sulphur and 30.4% oxygen. Determine the:

- (i) empirical formula;
- (ii) molecular formula of Q if its relative molar mass is 158.
[O = 16.0, Na = 23.0, S = 32.0]

[6 marks]

4. (a) (i) What is meant by *saponification*?
 (ii) List the raw materials needed for the manufacture of soap.
 (iii) Name the main by-product obtained from the manufacture of soap.

[5 marks]

- (b) What type of reaction is represented by each of the following equations?

- (i) $\text{C}_3\text{H}_8 + \text{Cl}_2 \longrightarrow \text{C}_3\text{H}_7\text{Cl} + \text{HCl}$
- (ii) $n(\text{CH}_2=\text{CH}_2) \longrightarrow -(\text{CH}_2-\text{CH}_2)_n-$
- (iii) $\text{C}_{16}\text{H}_{34} \longrightarrow 3\text{C}_2\text{H}_4 + \text{C}_{10}\text{H}_{22}$
- (iv) $\text{C}_2\text{H}_4 + \text{H}_2 \longrightarrow \text{C}_2\text{H}_6$
- (v) $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{SO}_4 \longrightarrow \text{C}_2\text{H}_5\text{HSO}_4 + \text{H}_2\text{O}$

[5 marks]

- (c) An organic compound U produces effervescence when reacted with sodium metal liberating gas V.

U produces a sweet fruity smelling liquid when warmed with colourless liquid W in the presence of a catalyst.

W reacts with sodium hydrogen trioxocarbonate (IV) solution to produce gas G.

- (i) Write the functional group present in U and W.
- (ii) Identify gases V and G.
- (iii) Name the type of reaction between:
 - I. U and sodium metal;
 - II. U and W.
- (iv) Name the catalyst used in the reaction between U and W.

- (v) If the molar mass of W is 74 g mol^{-1} , deduce the:
- molecular formula;
 - structural formula of the compound.
- [H = 1·00; C = 12·0, O = 16·0] [12 marks]
- (d) Explain briefly why the reaction between magnesium and 1.0 mol dm^{-3} ethanoic acid would be slower than the reaction between magnesium and 1.0 mol dm^{-3} hydrochloric acid. [3 marks]

SECTION II

FOR CANDIDATES IN GHANA ONLY

Answer one question from this section.

No marks will be awarded for answering questions not peculiar to your own country.

5. (a) (i) What is *fermentation*?
(ii) Write an equation for the fermentation of glucose.
(iii) What substance must be added to glucose solution to make it ferment?
(iv) Complete and balance the following chemical equations:
- I. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow[\text{heat}]{\text{H}_2\text{SO}_4}$ [9 marks]
II. $\text{CH}_3\text{COOH} + \text{CH}_3\text{OH} \longrightarrow$
- (b) Explain why ethanol is completely miscible with water? [3 marks]
- (c) (i) What is *biotechnology*?
(ii) Distinguish between *fine chemicals* and *heavy chemicals*.
(iii) Mention the major raw material used in the large scale production of each of the following products:
I. cement;
II. tyre. [6 marks]
- (d) (i) List three chemical properties of acids.
(ii) Give two large scale uses of H_2SO_4 .
(iii) Write a chemical equation for the action of heat on each of the following compounds:
I. AgNO_3 ;
II. $\text{Pb}(\text{NO}_3)_2$. [7 marks]
6. (a) (i) Define *hybridization*.
(ii) Explain briefly how sp^3 hybrid orbitals are formed. [5 marks]
- (b) Consider the equilibrium reaction represented by the following equation:
 $2\text{SO}_{2(g)} + \text{O}_{2(g)} \longrightarrow 2\text{SO}_{3(g)}$; $\Delta H = -x \text{ kJ mol}^{-1}$.
- (i) Write an expression for the equilibrium constant K_p .
(ii) Sketch the energy profile diagram for the forward reaction indicating the position of
I. reactants and products;
II. activated complex;
III. enthalpy change;
IV. activation energy. [7 marks]

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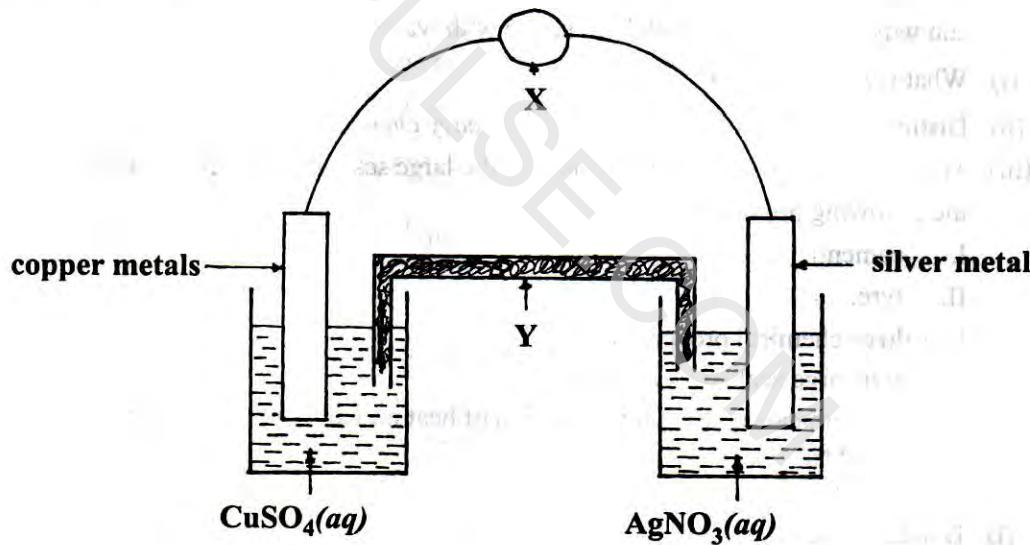
- (c) (i) Calculate the pH of a solution containing $4.0 \times 10^{-5} \text{ mol dm}^{-3}$ hydrogen ion.
(ii) Indicate whether the solution is acidic or basic. Give a reason for your answer. [5 marks]
- (d) Give three differences between the solubilities of solids in liquids and gases in liquids. [3 marks]
- (e) Calculate the volume occupied by 0.125 moles of oxygen at 27°C and pressure of $2.02 \times 10^5 \text{ Nm}^{-2}$.
[standard pressure = $1.01 \times 10^5 \text{ Nm}^{-2}$; 1 mole of gas occupies 22.4 dm^3 at s.t.p.] [5 marks]

SECTION III FOR CANDIDATES IN NIGERIA, SIERRA LEONE AND THE GAMBIA.

Answer one question only from this section.

No marks will be awarded for answering questions not peculiar to your own country.

7. (a) (i) Distinguish between a *primary cell* and a *secondary cell*.
(ii) Give one example of each cell in 7(a)(i). [4 marks]
- (b) Consider the following set-up.



The standard electrode potential for copper and silver are:

$$E^\theta \text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$$

$$E^\theta \text{Ag}^+/\text{Ag} = +0.80 \text{ V}$$

- (i) Name the reference against which other electrode potentials are measured.
(ii) Which instrument should be at position X?
(iii) What is Y? State its function.
(iv) Calculate the e.m.f. of the cell. [7 marks]

- (c) Explain briefly why electrolysis of an aqueous solution of sodium chloride does not produce sodium at the cathode.

[3 marks]

- (d) (i) What is meant by *nuclear fission*?
(ii) How could electrical energy be generated by nuclear fission?

[5 marks]

- (e) Turpentine was burnt in chlorine gas resulting in the formation of the products as illustrated below:



Calculate the mass of turpentine that would completely burn in 21.3 g of chlorine.

[H = 1.00; C = 12.0; Cl = 35.5]

[6 marks]

8. (a) Describe briefly how each of the following aqueous solutions could be identified in the laboratory:

- (i) ammonium trioxocarbonate (IV);
(ii) ammonium chloride.

[6 marks]

- (b) Arrange the following compounds in order of increasing boiling point and give reasons for your answer:

CS_2 , NaF and CO_2 .

[5 marks]

- (c) List two gases each that are:

- (i) acidic;
(ii) highly soluble in water;
(iii) oxidized by acidified $\text{KMnO}_4(aq)$.

[6 marks]

- (d) In a tabular form, compare the elements silicon and sulphur under the following properties:

- (i) metallic character;
(ii) physical state;
(iii) conduction of electricity.

[3 marks]

- (e) A cuboid piece of sodium metal measures $3\text{ cm} \times 4\text{ cm} \times 10\text{ cm}$. If the density of sodium is 0.971 g cm^{-3} , calculate the number of atoms in the sodium metal.

[Na = 23; Avogadro constant = $6.02 \times 10^{23}\text{ mol}^{-1}$].

[5 marks]

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 CHIDEREA NKIRUKA Examination: WASSCE Year: 2000 NOV.
Surname Other Names

Subject: CHEMISTRY

Paper: 2

IDENTIFICATION NUMBER	
5	c0:c1:c2:c3:c4:c6:c7:c8:c9:
2	c0:c1:c3:c4:c5:c6:c7:c8:c9:
5	c0:c1:c2:c3:c4:c6:c7:c8:c9:
1	c0:c2:c3:c4:c5:c6:c7:c8:c9:
1	c0:c2:c3:c4:c5:c6:c7:c8:c9:
0	c0:c2:c3:c4:c5:c6:c7:c8:c9:
2	c0:c1:c3:c4:c5:c6:c7:c8:c9:
0	c0:c2:c3:c4:c5:c6:c7:c8:c9:
6	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:
8	c0:c1:c2:c3:c4:c5:c6:c7:c8:c9:

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

SUBJECT CODE	
5	c0:c1:c2:c3:c4:c6:c7:c8:c9:
0	c1:c2:c3:c4:c5:c6:c7:c8:c9:
5	c0:c1:c2:c3:c4:c6:c7:c8:c9:
2	c0:c1:c3:c4:c5:c6:c7:c8:c9:
1	c0:c2:c3:c4:c5:c6:c7:c8:c9:
3	c0:c1:c2:c4:c5:c6:c7:c8:c9:

SEX	
Indicate your sex by shading the space marked M (for Male) or F (for Female) in this box: M <input type="checkbox"/> F <input checked="" type="checkbox"/>	

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 $\begin{smallmatrix} 40 \\ 20 \end{smallmatrix} Y$, 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 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
- XY.
 - XY_2 .
 - X_2Y .
 - XY_3 .
6. "Electrons will occupy equivalent orbitals singly, as far as possible, with the same spin" is a statement of
- Hund's rule.
 - Pauli Exclusion Principle.
 - Periodic law.
 - Aufbau Principle.
7. M is a group II element. Which of the following represents the ionization of its chloride?
- $M_2Cl \longrightarrow 2M^+ + Cl^-$
 - $MCl \longrightarrow M^{2+} + Cl^-$
 - $MCl_2 \longrightarrow M^{2+} + 2Cl^-$
 - $M(Cl)_2 \longrightarrow M^{2+} + Cl_2$
8. Which of the following forms a coordinate covalent bond with H^+ ?
- CO_2
 - O_2
 - H_2O
 - N_2
9. How many electrons are present in the $2p$ orbital of an element represented as $^{19}_9X$?
- 10
 - 7
 - 6
 - 5
10. The emission of a beta particle from the nucleus of $^{226}_{88}Ra$ will produce
- $^{226}_{89}Ac$.
 - $^{222}_{86}Rn$.
 - $^{222}_{87}Fr$.
 - $^{230}_{90}Th$.

- 11.** Which of the following represents correctly the rearrangement of particles during double decomposition reaction?
- PQ + RS \longrightarrow PS + QR
 - PQ + RS \longrightarrow PR + SQ
 - PQ + RS \longrightarrow PR + QS
 - 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?
- Pressure exerted by the gases
 - Frequency of collision of their molecules
 - Number of molecules present
 - 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; SO₂ = 64]
- 5.7 seconds
 - 8.0 seconds
 - 11.3 seconds
 - 16.0 seconds
- 14.** The number of hydroxonium ions produced by one molecule of an acid in aqueous solution is known as its
- basicity.
 - acid strength.
 - pH.
 - concentration.
- 15.** Consider the following equation:
- $$2\text{Na} + 2\text{H}_2\text{O} \longrightarrow 2\text{NaOH} + \text{H}_2$$
- Calculate the mass of sodium required to produce 0.40 g of sodium hydroxide.
- [H = 1, O = 16, Na = 23]
- 0.23 g
 - 0.46 g
 - 2.3 g
 - 4.6 g

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

- A. $2\text{NH}_4\text{OH} + \text{H}_2\text{S} \longrightarrow (\text{NH}_4)_2\text{S} + 2\text{H}_2\text{O}$
- B. $\text{H}_2\text{SO}_4 + \text{H}_2\text{S} \longrightarrow \text{SO}_2 + 2\text{H}_2\text{O} + \text{S}$
- C. $2\text{FeCl}_3 + \text{H}_2\text{S} \longrightarrow 2\text{FeCl}_2 + 2\text{HCl} + \text{S}$
- D. $\text{Pb}(\text{NO}_3)_2 + \text{H}_2\text{S} \longrightarrow \text{PbS} + 2\text{HNO}_3$

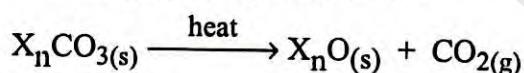
17. Hydrogen is evolved when dilute hydrochloric acid reacts with

- 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.



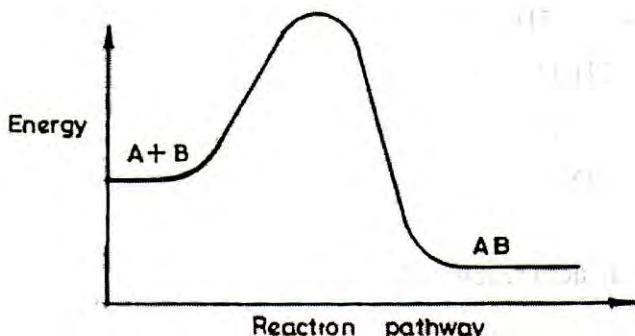
The reaction will not occur when X is

- A. Cu.
- B. Na.
- C. Mg.
- D. Zn.

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

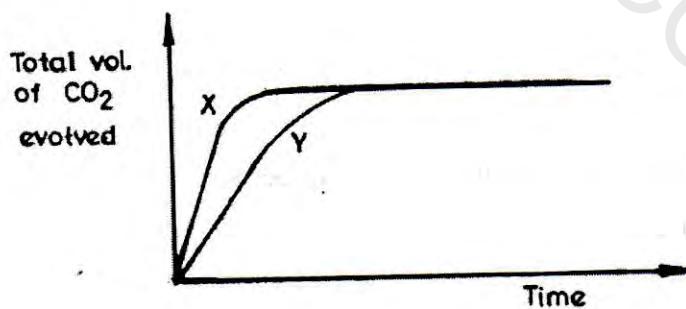
- A. It contains more OH^- than H_3O^+ .
- B. Its pOH value will be 10.
- C. It is more acidic than a solution of pH 2.
- D. Its hydrogen ion concentration is $4.0 \times 10^{-1} \text{ mol dm}^{-3}$.

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



The reaction between A and B

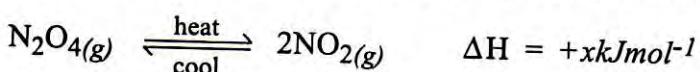
- A. occurs irreversibly.
 - B. is endothermic.
 - C. is at equilibrium.
 - D. is exothermic.
22. The presence of catalyst in a reaction mixture alters the
- A. heat of reaction.
 - B. yield of products.
 - C. equilibrium position.
 - D. reaction pathway.
23. The rate curves below represent the reaction 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.



What happens when the temperature is reduced at equilibrium ?

25. An oxidizing agent can be defined as

- 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.

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



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. $\text{K}_{(s)} \longrightarrow \text{K}^+_{(aq)}$
- B. $\text{Mg}_{(s)} \longrightarrow \text{Mg}^{2+}_{(aq)}$
- C. $\text{Fe}^{2+}_{(aq)} \longrightarrow \text{Fe}^{3+}_{(aq)}$
- D. $\text{Cu}^{2+}_{(aq)} \longrightarrow \text{Cu}_{(s)}$

30. What is the oxidation number of boron in $\text{Na}_2\text{B}_4\text{O}_7$?

- 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 alcanoic 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 alcanoic acid.

34. The empirical formula of a compound is $\text{C}_5\text{H}_7\text{N}$. If its relative molecular mass is 162, what is its molecular formula ?

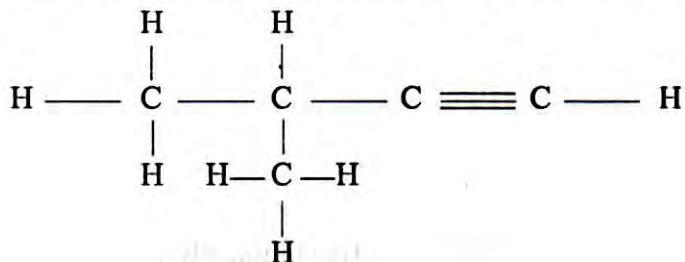
[H = 1, C = 12, N = 14]

- A. $\text{C}_5\text{H}_7\text{N}_2$
- B. $\text{C}_7\text{H}_9\text{N}_2$
- C. $\text{C}_{10}\text{H}_{14}\text{N}_2$
- D. $\text{C}_{24}\text{H}_2\text{N}_{28}$

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

- A. $\text{CH}_3\text{CH}_2\text{CH}_3$
- B. CH_3COCH_3
- C. $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
- D. $\text{CH}_3\text{CH}_2\text{CHO}$

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. $\text{C}_n\text{H}_{2n+2}$.
- D. $\text{C}_n\text{H}_{2n-2}$.

39. Which of the following compounds will react together to give $\text{CH}_3(\text{CH}_2)_2\text{COOCH}_3$?
- A. Methane and propanoic acid
 - B. Methanol and butanoic acid
 - C. Propane and ethanoic acid
 - D. Butanol and methanoic acid

40. $\text{C}_{12}\text{H}_{26}$ and $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ are both covalent. $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ is soluble in water while $\text{C}_{12}\text{H}_{26}$ is insoluble. This is because $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- A. has a higher molar mass.
 - B. can be hydrolyzed.
 - C. forms hydrogen bonds with the solvent.
 - D. contains stronger van der Waals' forces.

41. The tensile strength of natural rubber is increased by heating it with
- carbon black.
 - sulphur.
 - nickel catalyst.
 - hydrogen.
42. How many moles of oxygen are required to burn one mole of C_4H_8 completely ?
- 2
 - 4
 - 6
 - 8
43. Which of the following solutions react without producing a precipitate ?
- $BaCl_{2(aq)}$ and $H_2SO_{4(aq)}$
 - $HCl_{(aq)}$ and $KNO_{3(aq)}$
 - $ZnCl_{2(aq)}$ and $AgNO_{3(aq)}$
 - $CuCl_{2(aq)}$ and $NaOH_{(aq)}$
44. The use of silver salts in photography is based on the process of
- oxidation of silver to silver halide.
 - reduction of silver ions to silver.
 - double decomposition to form silver halide.
 - 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
- fermentation.
 - distillation.
 - filtration.
 - electrolysis.
46. In the extraction of iron in the blast furnace, the role of limestone is to
- decompose the iron ore.
 - remove the silicate impurities.
 - convert iron (III) to iron (II) compounds.
 - oxidize red hot coke to carbon (IV) oxide.

47. Which of the following methods is most suitable for preventing the rusting of petroleum pipelines ?
- Painting
 - Greasing
 - Electroplating with tin
 - Cathodic protection with magnesium
48. Soldering wire is an alloy of tin and
- Al.
 - Pb.
 - Fe.
 - Cu.
49. Which of the following pollutants is associated with genetic mutation ?
- Carbon (II) oxide
 - Radioactive fallout
 - Biodegradable waste
 - Sulphur (IV) oxide
50. Effects of water pollution include the following except
- depletion of dissolved oxygen.
 - depletion of heavy metal ions.
 - ecological changes.
 - increased turbidity.

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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 5.00g required 50.0 cm^3 of 2.00 $mol\ dm^{-3}$ HCl to react completely according to the equation below:



- (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 $1s^2 2s^2 2p^6$, 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]

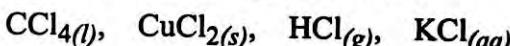
- (b) (i) Explain why isotopes have different mass numbers but are chemically alike.
(ii) Calculate the relative atomic mass of an element R given that the relative abundance of ^{63}R and ^{65}R are 68% and 32% respectively.

[5 marks]

- (c) (i) List two uses of chlorine.
(ii) Give the balanced half equations for the following reaction:



- (iii) Given the following substances:

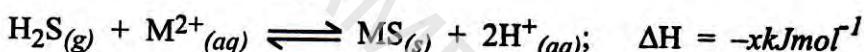


State which of them

- 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



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

- (i) Increase in temperature;
- (ii) Addition of solution of $\text{M}(\text{NO}_3)_2$;
- (iii) Addition of acidified $\text{KMnO}_4(aq)$.

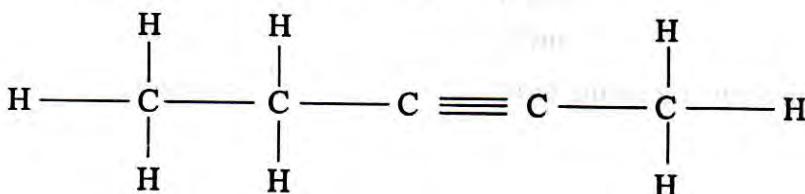
[6 marks]

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

- (i) $\text{C}_n\text{H}_{2n+2}$
- (ii) $\text{C}_n\text{H}_{2n+1}\text{COOH}$
- (iii) $\text{C}_n\text{H}_{2n+1}\text{CHO}$

[6 marks]

- (b) (i) Give one test for unsaturation.
(ii) Consider the following compound:



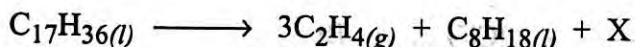
- I. Write its IUPAC name.
- II. State the product of its complete hydrogenation.
- III. Why does it not give a precipitate with ammoniacal AgNO_3 whereas some homologues do?

[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 alcanoic acid.

[6 marks]

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



- (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 $\text{C}_{17}\text{H}_{36}$ in the reaction.

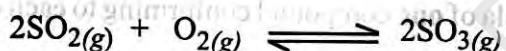
[1 mole of a gas occupies 22.4 dm^3 at s.t.p.]

[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.



[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]

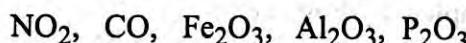
SECTION II

*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?



- (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 4.00g of oxygen.

[$O = 16.0$; Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$]

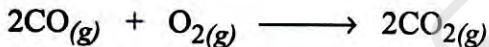
[9 marks]

- (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 ?



[6 marks]

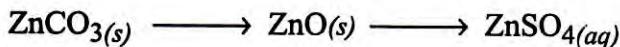
6. (a) (i) State Gay-Lussac's law of combining volumes.
(ii) The following reaction occurred when 100 cm^3 of carbon (II) oxide was burnt in 70 cm^3 of oxygen:



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:



- (iii) State how each of the following can be obtained from $\text{ZnSO}_{4(aq)}$.
I. $\text{ZnSO}_{4(s)}$
II. $\text{ZnCO}_{3(s)}$

[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) $\text{Na}_2\text{CO}_{3(aq)}$ 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]

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