MARKER CODE

Student Personal Identification Number

Pacific Senior Secondary Certificate

CHEMISTRY

2012

QUESTION and ANSWER BOOKLET

Time allowed: Three hours

1. This Examination Paper consists of TWO sections. **ANSWER ALL QUESTIONS**.

		MARKS	TIME
SECTION A	Multiple choice questions	40	36 minutes
SECTION B	Q21: Atomic Structure and Bonding	22	20 minutes
	Q22: Quantitative Chemistry	25	23 minutes
	Q23: Organic Chemistry	21	18 minutes
	Q24: More Organic Chemistry	25	23 minutes
	Q25: Inorganic Chemistry	21	18 minutes
	Q26: Oxidation and Reduction	22	20 minutes
	Q27: Principles of Physical Chemistry	24	22 minutes
TOTAL		**200**	**180 minutes**

2. Write your **Student Personal Identification Number (SPIN)** on the top right hand corner of this page and at the top of the **fold-out flap** on the last page.
3. Write all answers to the Multiple Choice questions on the answer sheet on the **FOLD-OUT FLAP** on the last page.
4. In SECTION B, write the answers to the questions in the spaces provided in this booklet.

A copy of the **Periodic Table of the Elements – Sheet No. 3/2** is provided.
NOTE: The symbol M is used for molar mass.
For example, M(Na) = 23 g mol^{-1} and M(CO2) = 44 g mol^{-1}

Check that this booklet contains pages 2-33 in the correct order and none of these pages is blank. Page 34 has been left blank deliberately.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL MARKS 200

SECTION A [40 MARKS]

Answer ALL the questions in this section. Write the letters of the best answers in the boxes on the fold-out flap provided on the back flap of this booklet. Each question is worth 2 marks.

1. The atoms of chlorine which have an atomic number of 17 and a mass number of 35 have the composition denoted by which row of the following table?

	No. of protons	No. of electrons	No. of neutrons
A.	17	17	18
B.	17	17	17
C.	35	35	18
D.	35	18	17

2. Which of the electron configurations (main energy levels) listed below would belong to a halogen atom (Group 7) in its ground state?

   A. 2, 8
   B. 2,8,1
   C. 2,8,7
   D. 2,8,8

3. Carbon atoms in graphite are arranged in layers in a two dimensional structure where the layers are held together by which type of forces?

   A. Electrostatic forces
   B. Vanderwaal forces
   C. Metallic forces
   D. Magnetic forces

4. Which solution has a pH of 1?

   A. 0.1mol L^{-1} H_2SO_4
   B. 0.1mol L^{-1} HCl
   C. 0.5 mol L^{-1} H_2SO_4
   D. 0.001mol L^{-1} HCl

5. In which compound do the molecules have a trigonal pyramidal shape?

   A. Water
   B. Methane
   C. Ammonia
   D. Carbon dioxide

6. The equation for the burning of ethanol is

$$C_2H_5OH_{(l)} + 3\,O_{2\,(g)} \longrightarrow 2\,CO_{2\,(g)} + 3H_2O_{(g)} \quad \triangle H = -1370 kJ\ mol^{-1}$$

Use this information: M(C) = 12g/mol M (H) = 1g/mol M (O) = 16g/mol to calculate the enthalpy change, ΔH when 2.3 g of ethanol is burnt.

A. - 68.5 kJ
B. - 685 kJ
C. + 685 kJ
D. + 68.5 kJ

7. The relative molecular mass of sulfur trioxide, SO_3 is 80. How many molecules of SO_3 are there in 0.8 kilograms of sulfur trioxide?

A. 6.02×10^{22}
B. 6.02×10^{23}
C. 6.02×10^{24}
D. 6.02×10^{25}

Use this information to answer Question 8.
M (H) = 1g/molM (C) = 12g/mol M (O) = 16g/mol M (S) = 32g/mol

8. The amount of carbon in 116g of butane (C_4H_{10}) is

A. 2.
B. 4.
C. 8.
D. 14.

9. Which statement about the physical properties of ionic substances is correct?

A. They form non-polar liquids when molten.
B. They generally have high melting points.
C. They are good conductors of electricity.
D. They are generally brittle in texture.

10. A colourless solution formed a white precipitate when sodium hydroxide solution was added to it. The precipitate was soluble when sodium hydroxide was added to it in excess.
The colourless solution most likely contained

A. carbonate ions.
B. zinc ions.
C. chloride ions.
D. nitrate ions.

11. An ionic chloride, belonging to the second short period, is a white solid and is insoluble in carbon tetrachloride. This chloride is most probably

    A. NaCl
    B. $MgCl_2$
    C. $AlCl_3$
    D. $SiCl_4$

12. Which of the following elements will react explosively with water to form a basic solution?

    A. Sodium
    B. Fluorine
    C. Magnesium
    D. Phosphorous

13. If 20 mL of a 0.1 mol L^{-1} solution of ethanoic acid is diluted with distilled water to reach the 200mL mark in a standard flask, the new concentration in mol L^{-1} is

    A. 0.001
    B. 0.01
    C. 0.100
    D. 0.205

From the key list below, select the compound that best fits the properties given in Questions 14 and 15.

KEY LIST			
A. Iodine	**B. Beryllium chloride**	**C. Carbon tetrachloride**	**D. Copper**

14. A coloured solid which has the weakest forces between the particles and melts to give a dark red liquid.

15. A liquid at room temperature of 25^0 C in which non-polar substances can dissolve.

16. The reaction that takes place between methane and chlorine to form methyl chloride and hydrogen chloride is called

    A. addition.
    B. cracking.
    C. hydrolysis.
    D. substitution.

17. The family of organic compounds that can show geometric isomerism are the

    A. Alcohols.
    B. Alkanes.
    C. Alkenes.
    D. Esters.

18. When butane is bubbled through bromine water in a test tube

    A. the clear solution slowly goes brown.
    B. the brown solution slowly clears.
    C. the brown solution slowly goes green.
    D. the solution remains brown.

19. Which of the following statements about **oxidation and reduction reactions** is correct?

    A. One substance is reduced and oxidized at the same time.
    B. One substance is oxidized and another is reduced.
    C. Both substances are oxidized.
    D. Both substances are reduced.

20. The fastest reaction between coral ($CaCO_{3\,(s)}$) and hydrochloric acid ($HCl_{(aq)}$) would take place between

    A. large lumps of coral and 0.1 mol L^{-1} HCl
    B. small lumps of coral and 0.2 mol L^{-1} HCl
    C. powdered coral and 0.2 mol L^{-1} HCl
    D. powdered coral and 0.1mol L^{-1} HCl

SECTION B [160 marks]

Answer ALL seven questions (21 – 27) in the spaces provided.

If you are unable to calculate a value in one question which you will need for your calculations in a later question, select an appropriate value and use it where needed.

QUESTION 21: ATOMIC STRUCTURES AND BONDING (22 MARKS)

A. 1. Write the electron configuration for the following using s, p, d, f notations.

K _____

K^+ _____

Ca _____

(3 marks)

2. The term **Atomic Radius** refers to the distance between the nucleus and the electrons in a valence shell of an atom.

(a) Explain why atomic radii tend to decrease from left to right across the Period.

_____

_____

_____

(1 mark)

(b) Arrange the following atoms from the largest atomic radius to the smallest and explain.

Mg Cl Si Ca

_____

_____

_____

_____

(2 marks)

(c) Account for the fact that the atomic radius for Mg2+ is smaller than its parent atom Mg.

_____

_____

_____

(1 mark)

3. Use the table below to answer parts (a), (b) and (c).

Atomic No.	11	12	13	14	15	16	17	18
Element	Na	Mg	Al	Si	P	S	Cl	Ar
Atomic Radius nanometre (10^{-9})	0.154	0.136	0.118	0.111	0.106	0.102	0.099	0.098
Electronegativity	0.9	1.2	1.5	1.8	2.1	2.5	3.0	-

(a) i. Give TWO trends that can be determined from the table above.

(2 marks)

ii. Give an explanation for the electronegativity trend described in your answer above.

(1 mark)

(b) i. Using the electronegativity difference in a Si -Cl bond, explain how a polar covalent bond is formed.

(1 mark)

ii. Explain why silicon tetrachloride ($SiCl_4$) is a non-polar molecule when it contains polar bonds.

(1 mark)

(c) Predict the bond types in the following substances and give a reason for your choice.

H_2S _____

Reason _____

_____

_____

_____

(2 marks)

Cl_2 _____

Reason _____

_____

_____

_____

(2 marks)

B. 1. Complete Table B by filling in the blanks with the appropriate items from the lists provided in Table A.

Table A

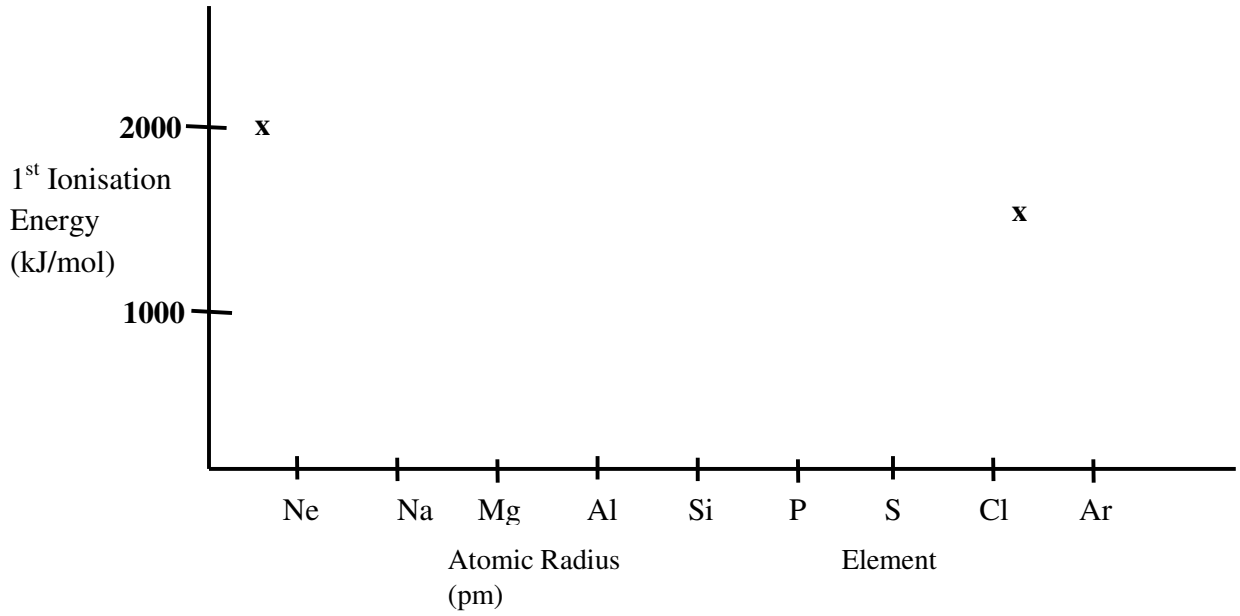
List for Column A	List for Column B	List for Column C
potassium iodide	Good conductor of electricity	Mobile ions and electrons
copper	Conductor of electricity only in molten state	Ions are fixed in their lattice until energy is gained
diamond	Extremely hard and non-conductor of electricity	Molecules are compactly packed
sulphur	Slightly conductor of electricity	Atoms are packed in a three-dimensional network.

Table B

Column A	Column B	Column C
Compound/Substance	Property	Reason for that Property
(i)	Good conductor of electricity	Mobile ions and electrons
Diamond	Extremely hard and non-conductor of electricity	(ii)
(iii)	Conductor of electricity only in molten state	(iv)

(4 marks)

2. Sketch and complete the graph below to show the general trend in ionization energies across a period of the periodic table.



(2 marks)

QUESTION 22: QUANTITATIVE CHEMISTRY (25 MARKS)

A. 1. The reaction between aluminum and hydrochloric acid is represented by the equation shown below.

$$2Al_{(s)} + 6HCl(s) \longrightarrow 2ACl_{3(s)} + 3H_{2\,(g)}$$

(i) How many moles of hydrogen would be obtained if 2.7g of aluminium reacts with excess hydrochloric acid?

(1 mark)

(ii) The reaction between the acid and aluminium is slow in the beginning and then gets faster. Give an explanation for this observation.

(1 mark)

2. In a titration, 20ml of potassium hydroxide solution of unknown concentration was placed in a conical flask to which an indicator had been added. The sample was titrated with 0.23 mol L^{-1} sulphuric acid. The end point was reached when 17 ml of the acid had been added.

The equation for the reaction is:

$$2KOH_{(aq)} + H_2SO_{4\,(aq)} \longrightarrow K_2SO_{4\,(aq)} + 2H_2O_{(l)}$$

(i) What piece of equipment would you use to transfer the 0.23 mol L^{-1} sulphuric acid?

(1 mark)

(ii) Briefly describe the cleaning procedure of the apparatus in (i) above.

(1 mark)

(iii) Calculate the amount of sulphuric acid used.

(1 mark)

(iv) Calculate the amount of potassium hydroxide needed to react with that amount of sulphuric acid.

(1 mark)

(v) Calculate the concentration of the potassium hydroxide solution.

(1 mark)

(vi) If 30 mL of this potassium hydroxide solution is diluted to 300 mL what is the concentration of the diluted solution?

(1 mark)

(vii) In an acid base titration, usually towards the end of titration, distilled water is used to wash chemicals on the inside of the conical flask down into the mixture. The titration is then continued.
Explain if the added water will affect the end- point of the titration and give a reason for your answer.

(1 mark)

3. (a) A student carried out an experiment to find the water of crystallization in hydrated magnesium sulphate. She recorded the data as follows:

Mass of crucible and lid	-	24.35g
Mass of crucible, lid and $MgSO_4$ before heating	-	27.35g
Mass of crucible, lid and $MgSO_4$ after heating	-	26.25g

(i) Calculate the mass of the hydrate.

(1 mark)

(ii) Calculate the mass of the anhydrous salt.

(1 mark)

(iii) Calculate the mass of water driven off.

(1 mark)

(iv) Find the percentage of water of crystallization.

(1 mark)

(v) Using your answers in parts (i) to (iv) above, show how the formula of the hydrate is worked out.

M (Mg) = 24.5g/mol M (S) = 32 g/mol M (O) = 16 g/mol M (H) = 1g/mol

(3 marks)

(b) In the same experiment the student is provided with a crucible and lid, a source of heat, a chemical balance, and some crystals of magnesium sulphate.

(i) Describe in order, the steps she would take to determine the percentage of water of crystallization in the crystals. Include any **precautions** she would take in each step.

(5 marks)

(ii) Analysis of an organic compound shows that it contained 80% Carbon and 20% Hydrogen by weight.
Calculate the empirical formula for the hydrocarbon. M (C) = 12 g/mol M (H) = 1 g/mol.

(2 marks)

(iii) Calculate the molecular formula of the hydrocarbon if its relative molecular mass is 60.

(2 marks)

QUESTION 23: ORGANIC CHEMISTRY (21 MARKS)

A. 1. Name the following organic compounds:

$CH_3\ CH_2\ CH\ (CH_3)\ CH_2\ CH_3$ _____

$CH_3\ CH\ Br\ CH\ Br\ CH_3$ _____

$CH_3\ CH\ CH_2$ _____

$CH_3\ CH_2\ CH_2\ CH_2\ OH$ _____

$CH_3\ CH\ (OH)\ CH_3$ _____

$CH_3\ CH_2\ CHO$ _____

(6 marks)

2. Explain the following terms and give examples. Molecular formulas with their Structures and Names are to be included.

(i) Structural isomers

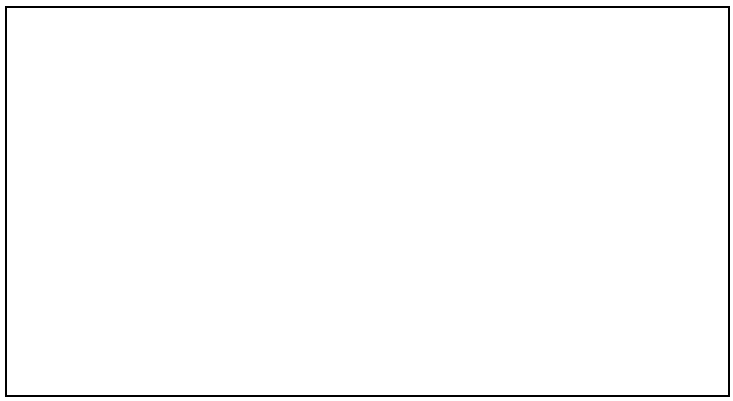
_____

_____

_____

_____

Example:



(2 marks)

(ii) Unsaturated hydrocarbon

Example:

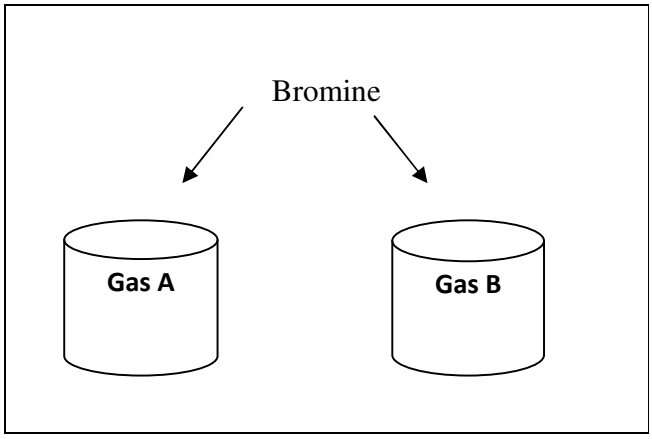
(2 marks)

(iii) Tertiary Alcohol

Example:

(1 mark)

3. Mele was given two gas cylinders labelled **Gas A** and **Gas B** and a supply of bromine solution to identify them after carrying out a simple test. She was given a hint that both gases have two carbons in their chemical structure but were different in their degree of saturation and unsaturation.



(i) Gas A is saturated and Gas B is unsaturated. Name the two gases.

Gas A:_____ (1 mark)

Gas B: _____ (1 mark)

(ii) A sample of each gas in turn was bubbled through separate solutions of bromine.

Describe the result of each test.

Gas A:

_____

_____

(1 mark)

Gas B:

_____

_____

(1 mark)

(iii) Write the equation for the reaction which occurred with Gas B.

_____

(2 marks)

4. Propan-1- ol is warmed with methanoic acid to which a few drops of concentrated sulphuric acid have been added.

(a) (i) Complete the chemical equation for the above reaction.

$CH_3CH_2CH_2OH$ + [I] ⟶ [II] + H_2O

I: _____

II: _____

(2 marks)

(ii) To what group of organic compounds does the product belong?

_____

(1 mark)

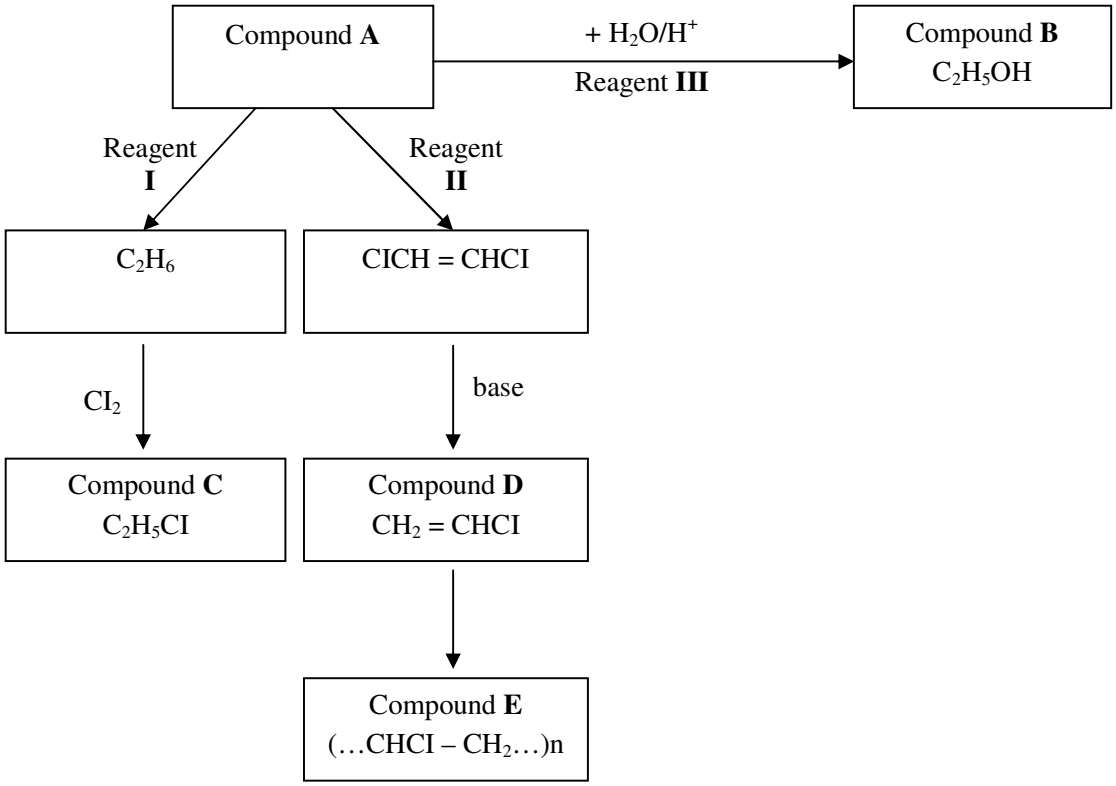
(iii) Why is it necessary to add concentrated sulphuric acid?

_____

(1 mark)

QUESTION 24 MORE ORGANIC CHEMISTRY (25 MARKS)

A. 1. The diagram shows a series of reactions involving organic compounds.
Use the reaction sequence to answer the questions that follow.



The correct names for **Compound A** to **Compound E** are:

Compound A: _____

Compound B: _____

Compound C: _____

Compound D: _____

Compound E: _____

(5 marks)

2. Compound D is a monomer.

(i) Complete the following equation showing how the polymer is formed from its monomers.

$CH_2 = CHCl + CH_2 = CH\,Cl + CH_2 = CHCl \longrightarrow$ [ ]

(1 mark)

(ii) Name the Reagents **I** and **II**.

Reagent **I**: _____

(1 mark)

Reagent **II**: _____

(1 mark)

(iii) Give ONE use of Compound E: _____

(1 mark)

B. Soap making involves the alkaline hydrolysis of triesters of glycerol.

(i) Complete the following hydrolysis. (General names can be given).

$CH_2\,OOC(CH_2)_{16}\,CH_3$

$CHOOC(CH_2)_{16}\,CH_3$ + [ ] $\longrightarrow$ [ ] +

$CH_2\,OOC(CH_2)_{16}\,CH_3$

Triesters of glycerol (I) (II) (III)

(3 marks)

(ii) Give correct names for the missing labels in the box.

Name I _____

Name II _____

Name III _____

(3 marks)

C. Use the key list below to answer questions (i) – (iii).

Key List

CH_3CH_2OH	CH_3COOH	C_3H_6	$CH_3COH(CH_3)CH_3$
$CH_3CHOHCH_3$	CH_3CHO	CH_3COCH_3	C_4H_{10} C_3H_4

(i) Select the compound which is a secondary alcohol.

_____ (1 mark)

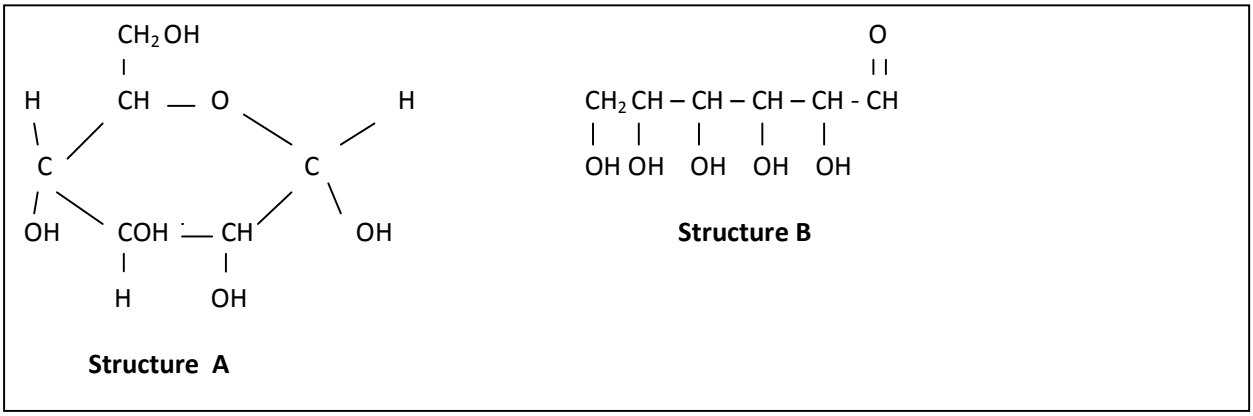
(ii) Select the compound that will be formed if Compound (i) is oxidized.

_____ (1 mark)

(iii) Which compound will give a positive result in a Silver Mirror test?

_____ (1 mark)

D. 1. Glucose is the building unit for carbohydrates and it exists in two forms, cyclic form and an open chain form as shown in the diagrams below.



(i) In the diagram, identify and circle the aldehyde group of atoms. (1 mark)

(ii) Which of the Glucose structures will give a positive test when reacted with Fehling's solution?

_____ (1 mark)

(iii) The aldehyde positive test with Fehling's solution forms a brick red precipitate.

Name the precipitate: _____ (1 mark)

(iv) Give the molecular formula for Glucose.

_____ (1 mark)

2. (i) Draw the structural formula of ethanoic acid , circle the functional group and label it X.

(2 marks)

(ii) Explain the term **functional group**.

_____

_____

(1 mark)

QUESTION 25: INORGANIC CHEMISTRY (21 MARKS)

A. 1. The following table summarises the reactions of a number of pairs of solutions. Several spaces are filled with descriptions of what happens when the solutions are mixed.

Reacting solution	**Sodium Chloride**	**Sodium sulphate**	**Sodium Carbonate**
Silver nitrate	A white precipitate of silver chloride forms which darkens	**I**	A white precipitate of silver carbonate forms
Barium Chloride	No reaction	**II**	A white precipitate of barium carbonate forms
Copper chloride	No reaction	No reaction	**III**

Write down the observations occurring at I, II and III.

I: _____

(1 mark)

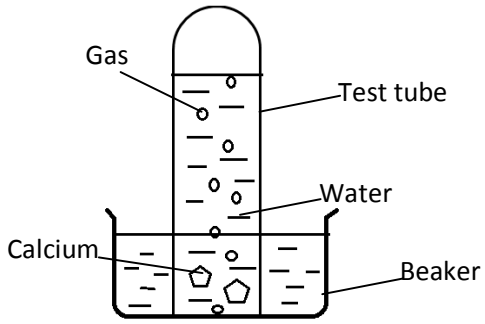
II: _____

(1 mark)

III: _____

(1 mark)

2. A student used the following set-up to investigate the reaction of calcium with water.



(i) Name the gas produced in the reaction.

_____

(1 mark)

(ii) How would the student know when the test tube is full of the gas?

_____

(1 mark)

(iii) Some phenolphthalein was placed in the water. Give ONE observation the student would have made as the calcium reacts with water.

_____

(1 mark)

(iv) Write a balanced equation for the reaction of calcium with water.

_____

(2 marks)

B. 1. The table below shows some oxides from the second row of the Periodic Table. Use the table to answer the questions that follow.

Oxides	Na_2O	Al_2O_3	SiO_2	SO_2
Type of Solid	Giant ionic	Giant ionic	**I**	Molecular
Nature of Oxides	basic	**II**	acidic	acidic

(i) Write the appropriate information for items I and II.

I _____ (1 mark)

II _____ (1 mark)

(ii) Explain with the use of chemical equations why sodium oxide is basic and sulfur dioxide is acidic.

_____

_____

_____

_____

_____

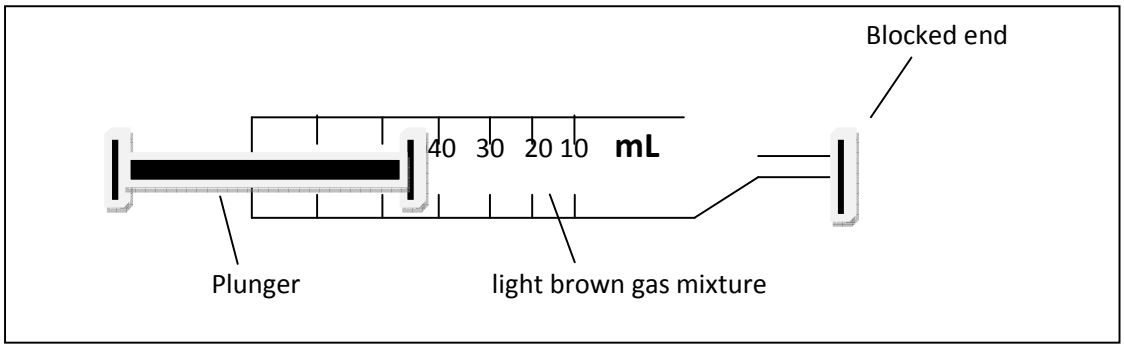
(2 marks)

2. The equilibrium between two gases is represented in the equation below.

$2\ AB_{2\,(g)} \rightleftharpoons A_2B_4 \qquad \triangle H = -\ 120 kJmol^{-1}$

(dark brown) (colourless)

Some of the equilibrium mixture is put into a gas syringe as shown in the diagram below.



(i) Explain what H = -120kJ mol^{-1} means.

_____

_____

(1 mark)

(ii) State giving reasons the effect of the following on the equilibrium amount of A_2B_4 if:

the plunger was pushed into the 30mL mark while the temperature was kept constant.

_____

_____

(1 mark)

the syringe is placed in ice cold water while the plunger is kept at a constant position.

_____

_____

(1 mark)

(iii) What colour change would be observed if the temperature is increased slightly while the volume is kept constant? Give a reason for your answer.

_____

_____

(1 mark)

C. 1. Use the information in the table below to answer questions (i) and (ii)

ACID	CONCENTRATION	PH
Hydrochloric Acid	0.01 $molL^{-1}$	2
Ethanoic Acid	0.01 $molL^{-1}$	5

(i) What does a PH scale measure?

_____

(1 mark)

(ii) Give an explanation for the difference in the pH values of the two acids even though their concentrations are the same.

_____

_____

_____

_____

(2 marks)

2. A solution was prepared by dissolving 3.65g of HCl in 200mL of water.

Given : M (Cl) = 35.5 g mol^{-1} M(H) = 1 g mol^{-1}

(i) Calculate its concentration in $molL^{-1}$.

_____

_____

_____

(1 mark)

(ii) Calculate the pH of the solution.

_____

_____

_____

_____

(1 mark)

QUESTION 26: OXIDATION AND REDUCTION (22 MARKS)

A. 1. In an experiment a student added a piece of copper turning to 5mL concentrated nitric acid in a test- tube.

(i) Give TWO observations that the student would make.

_____

_____

(2 marks)

The skeletal equation for the reaction is given below.

$$\mathbf{Cu + HNO_3 \longrightarrow Cu^{2+} + NO_2}$$

(ii) Name the oxidant and reductant in the reaction.

Oxidant: _____

Reductant: _____

(2 marks)

(iii) Give the two ion- electron half equations for the reaction above.

Reduction: _____

Oxidation: _____

(2 marks)

(iv) Balance the oxidation ion – electron half equation.

_____

(1 mark)

B. 1. Write a balanced ion – electron half equation for each of the following reactions.

(i) $Cl^{-1} \longrightarrow Cl_2$

_____ (1 mark)

(ii) $MnO_4^{-1} \longrightarrow Mn^{2+}$

_____ (1 mark)

(iii) Combine your answers from (i) and (ii) into a fully balanced oxidation reduction equation.

_____

_____

(2 marks)

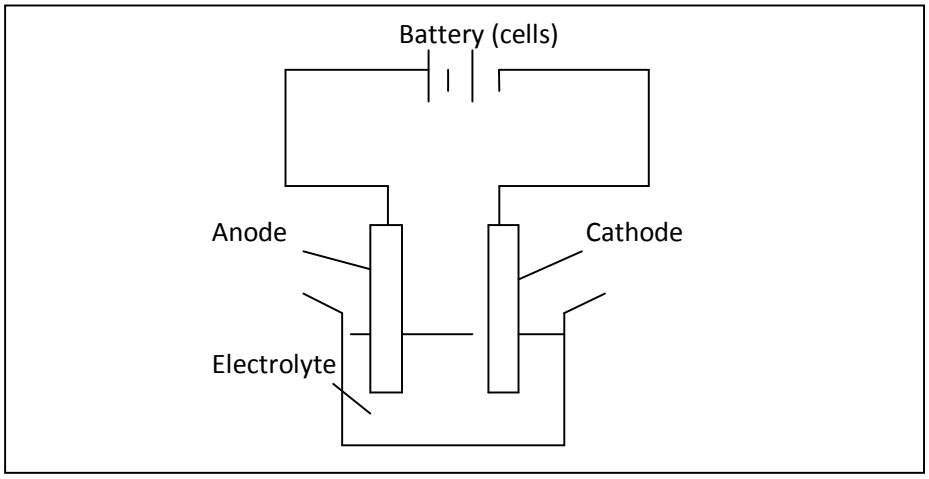
2. Place the following manganese compounds in order of increasing oxidation number for manganese.

$KMnO_4$ K_2MnO_4 MnO_2 Mn_2O_3

_____

(1 mark)

3. The diagram below shows the electrolysis of molten sodium chloride.



(i) Name the electrolyte used in the electrolysis experiment.

_____

(1 mark)

(ii) State why the gas produced at the anode turns moist blue litmus red.

_____

(1 mark)

(iii) Write the balanced ion-electron half equation to show the formation of the gas at the anode.

_____

(1 mark)

(iv) Write the **half equation** that could occur in the cathode.

_____

(1 mark)

(v) State ONE important application of electrolysis of molten sodium chloride.

_____

(1 mark)

(vi) Positive ions are attracted to the cathode. Is it oxidation or reduction that occurs in the cathode? Give a reason for your answer.

_____

(1 mark)

4. For the redox reactions shown in the table, fill in the observation made and the name of the product associated with the observation you have stated.

Reaction	Observation	Name of product
A piece of steel wool placed in copper sulphate solution.	Steel wool is covered with a reddish brown deposit.	I
Sulphur dioxide gas is bubbled through potassium permanganate solution	II	Manganese ion
A piece of zinc metal is placed in a test tube of dilute hydrochloric acid.	III	Hydrogen gas
An iron nail left outside the window for two months	Rust forms on the nail	IV

I: _____

(1 mark)

II: _____

(1 mark)

III: _____

(1 mark)

IV: _____

(1 mark)

QUESTION 27 PRINCIPLES OF PHYSICAL CHEMISTRY (24 MARKS)

A. 1. The following table contains data which could be used to decide the most suitable conditions for the production of ammonia by the Haber process.

Data Table

Temperature ^{0}C	**Percentage of ammonia in the equilibrium mixture**				
	10 atm	**50 atm**	**100 atm**	**300 atm**	**1000 atm**
200	51	74	82	90	98
300	15	39	52	71	93
400	4	15	25	47	80
500	1	6	11	26	57
600	0.5	2	5	14	13

1 atmosphere pressure unit (atm) = 101.3 kPa

The equation for the process is: $N_{2(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$

Use the information given in the Data Table to answer questions (i) – (v).

(i) Is the synthesis of ammonia exothermic or endothermic?

_____

(1 mark)

(ii) With reference to the data, explain your answer in question (i) above.

_____

_____

_____

(2 marks)

(iii) What happens to the percentage yield of ammonia if the pressure is increased at a constant temperature?

_____

(1 mark)

(iv) At what temperature and pressure is the greatest percentage of ammonia present in the equilibrium mixture?

_____

(1 mark)

(v) In the industrial process a temperature of 4000 – 5000 C and a pressure of 200 atmospheres are used. Explain why these conditions are used rather than the one you gave in (iv) above.

(1 mark)

(vi) The Haber process uses a surface catalyst. Name the catalyst used in the process.

(1 mark)

2. Using the Kinetic Theory of gases explain why the pressure of a gas decreases if its temperature is lowered at a constant volume.

(2 marks)

3. When ammonia is dissolved in water the following dynamic equilibrium is established.

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

(i) Explain briefly what is meant by the term **dynamic equilibrium**.

(1 mark)

(ii) State what pH change takes place when ammonia dissolves in water.

(1 mark)

(iii) Explain your answer to question (ii) above.

(1 mark)

4. Combustion of sulfur dioxide gas is shown by the equation given below.

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \qquad \Delta H = -198kJ\ mol^{-1}$

Giving brief reasons, state the effect of the following changes on the equilibrium amount (number of moles) of sulfur trioxide in a closed container.

(i) The addition of oxygen

_____

_____

_____

(2 marks)

(ii) The removal of sulfur trioxide

_____

_____

_____

(2 marks)

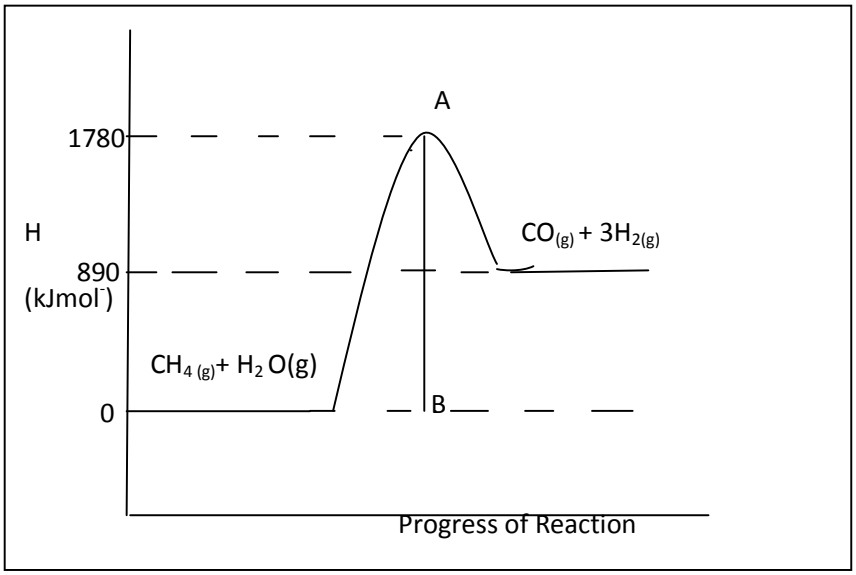
(iii) Increasing the temperature

_____

_____

(2 marks)

B. Enthalpy diagram for the reaction between methane and water is shown in the diagram below.



(i) Represent the information from the above diagram as a balanced equation. Include the enthalpy change term ($\triangle H$) with the appropriate sign.

_____

(2 marks)

(ii) What does AB represent in the above diagram?

_____

(1 mark)

(iii) Is the above enthalpy diagram for exothermic or endothermic?

_____

(1 mark)

(iv) From the diagram, estimate the activation energy for the reaction.

_____

(1 mark)

C. John wishes to measure heat change for the above reaction. What is the best instrument to use in the school laboratory?

_____

(1 mark)

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Student Personal Identification Number

SECTION A
ANSWER SHEET

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SECTION B
(Marker Only)

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TOTAL

	SECTION A		SECTION B		
Number Correct x 2	40	+	160	=	200