DEPARTMENT OF EDUCATION

UPPER SECONDARY SCHOOL CERTIFICATE EXAMINATIONS

CHEMISTRY

Tuesday

21 October 2014

Time allowed:

2 hours and 30 minutes

(8:00am – 10:30 am)

NO EXTRA TIME

(NO OTHER TIME)

Candidates are advised to fully utilize the allocated time

INSTRUCTIONS TO CANDIDATES

To be read by the external invigilator to all candidates

1. The **subject code** for **Chemistry** is **6.**
2. There are **15 printed** pages in the question booklet and **10 printed** pages in the answer booklet. There are two parts in this paper. Answer all questions.

   Part A : Multiple Choice Questions - 30 marks

   This section will be electronically marked.

   All answers to the Multiple Choice Part MUST be answered on the ELECTRONIC ANSWER SHEET provided.

   Carefully following the instructions, fill in your Candidate Information and Subject Information.

   Part B: Short Answer Questions - 70 marks

   Write down your name, your school name and your 10-digit candidate number on the Part B Answer Sheet provided.

3. You are required to write the correct answer in the space provided.
4. Answers written on the question paper will not be marked. Write answers neatly in spaces as allocated on the answer sheet. Answer **ALL** questions.
5. Answer all questions on the answer sheet. Answers on any other paper including rough work paper and the question paper **will not be marked**
6. ALL working must be shown step by step to get full marks. Students may lose marks for writing down final answers only.
7. Enough spaces have been allocated for answers to every question. Questions must be answered in spaces as allocated. Answers all over the answer booklet may not be marked.
8. Correctional Fluid is not allowed on the answer sheet. Where you have made an error, cross out all the working and start on a new line.

PENALTY FOR CHEATING OR ASSISTING TO CHEAT IN NATIONAL EXAMINATIONS IS NON-CERTIFICATION.

C

DO NOT TURN OVER THE PAGE

AND DO NOT WRITE

UNTIL YOU ARE TOLD TO START.

PART A: MULTIPLE CHOICE (QUESTIONS 1 to 30) 30 MARKS

Answer each question by shading in with HB pencil, the circle directly under the correct alternative A, B, C or D.

If you make a mistake, rub it out completely using an eraser rubber and shade the correct answer on the ELECTRONIC ANSWER SHEET.

QUESTION 1

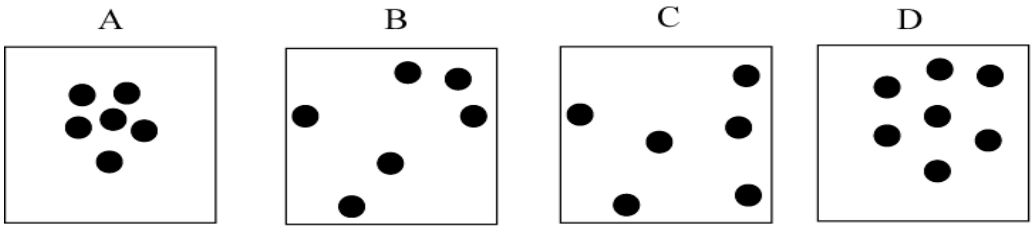
At a constant temperature and pressure, which of the following gases will diffuse the fastest?

A. Chlorine B. Fluorine C. Oxygen D. Neon

QUESTION 2

The following diagrams (A, B, C and D) show four (4) samples of the same amount of a gas each in an identical enclosed space.

Which of these samples is under the greatest pressure?



QUESTION 3

Impure water contains impurities.

Compared with pure water, what differences would be observed in the melting point and boiling point of impure water?

A. Higher melting point and boiling point

B. Higher melting point and lower boiling point.

C. Lower melting point and higher boiling point.

D. Lower melting point and boiling point.

QUESTION 4

Rubidium comes below Lithium in Group I of the periodic table.

Compared with Lithium, Rubidium would

A. be more reactive. B. be less reactive.

C. have a higher boiling point. D. have a higher melting point.

QUESTION 5

Which of the following does **NOT** have the same number of electrons as the chloride ion (Cl^-)?

A. Ar B. S^{2-} C. K^+ D. Na^+

QUESTION 6

Which of the following pairs of elements would be unlikely to form a compound of formula XY?

A. Zinc and Oxygen
B. Magnesium and Chlorine
C. Nickel and Sulphur
D. Hydrogen and Potassium

QUESTION 7

Hydrochloric acid and Sodium Hydroxide react as follows:

$$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(\ell)}$$

This reaction is an example of a

A. synthesis or combination reaction.
B. combustion reaction.
C. neutralisation reaction.
D. precipitation reaction.

QUESTION 8

Which of the following reactions would you expect to take place?

A. $Zn^{2+}_{(aq)} + Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} + Zn_{(s)}$

B. $Pb^{2+}_{(aq)} + Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + Pb_{(s)}$

C. $Mg^{2+}_{(aq)} + Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + Mg_{(s)}$

D. $Fe^{2+}_{(aq)} + Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + Fe_{(s)}$

QUESTION 9

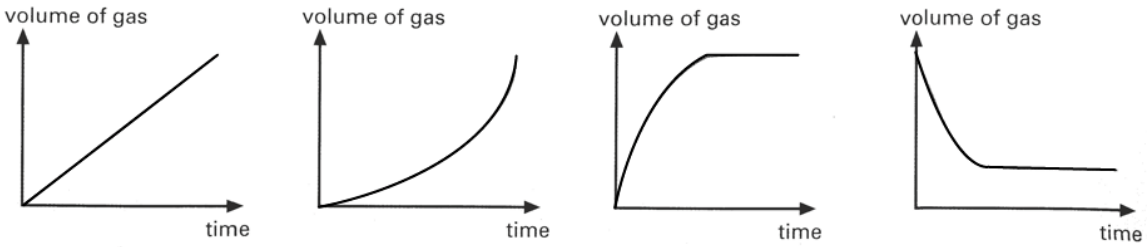
The enthalpy of a substance is the total energy

A. surrounding the substance.
B. stored in a substance.
C. released by a substance.
D. absorbed by a substance.

QUESTION 10

The total volume of hydrogen gas produced during the reaction between sulphuric acid and magnesium solid is plotted against time.

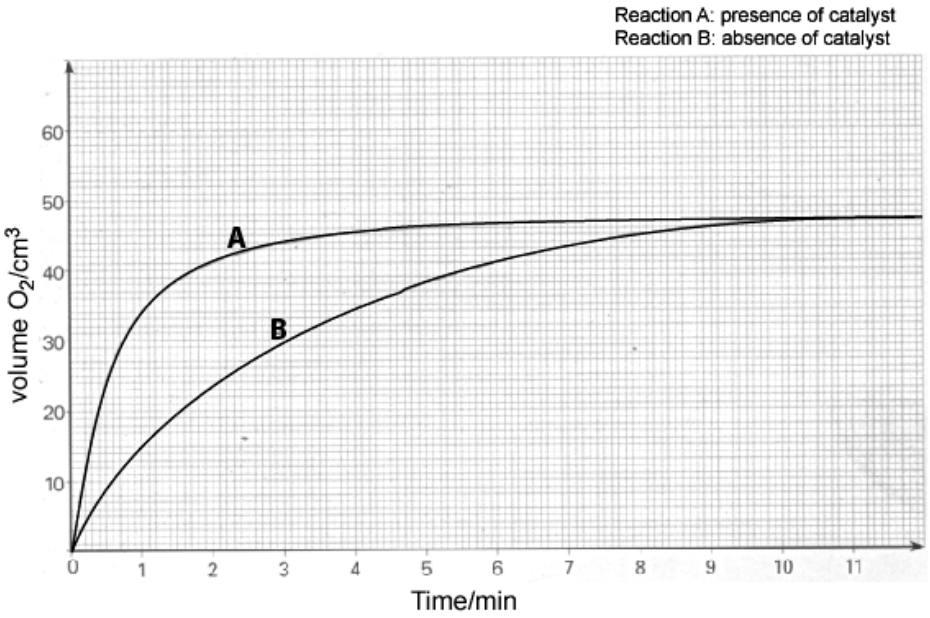
Which of the following graphs would be obtained?



A. B. C. D.

QUESTION 11

The graph below shows the volume of oxygen gas produced by the decomposition of hydrogen peroxide with a catalyst (A) and without a catalyst (B).



Which of the following statements about the reaction is **NOT** correct?

A. Reaction A stops at 10 minutes after the start of the experiment.

B. The catalyzed reaction produces oxygen at a faster rate.

C. The total volume of the oxygen produced by both reactions is the same.

D. The uncatalyzed reaction stops later than the catalyzed reaction.

QUESTION 12

Which of the following is **NOT** true about factors increasing the rate of reaction?

A. Lower surface area increases the rate of reaction.

B. The higher the concentration, the faster the reaction.

C. Increasing the temperature by 10°C approximately doubles the rate of reaction.

D. A catalyst lowers the activation energy and increases the rate of reaction.

QUESTION 13

Which of the following lists show the correct order of the reactivity of the metals, from the least reactive to the most reactive?

A. Calcium, Sodium, Iron, Magnesium, Zinc.

B. Iron, Zinc, Magnesium, Calcium, Sodium.

C. Zinc, Iron, Magnesium, Calcium, Sodium.

D. Sodium, Calcium, Magnesium, Iron, Zinc.

QUESTION 14

Metal X displaces metal Y from an aqueous solution of its salt. Metal Z reacts with cold water to liberate hydrogen, but metal X reacts only with steam on heating.

What could be metals X, Y and Z?

	X	Y	Z
A.	Sodium	Lead	Copper
B.	Copper	Zinc	Calcium
C.	Potassium	Lead	Magnesium
D.	Iron	Copper	Calcium

QUESTION 15

Why do farmers add ammonium nitrate to the soil?

A. To reduce the acidity of the soil.

B. To kill soil bacteria which are harmful to the crops.

C. To increase the oxygen content of the soil.

D. To increase the nitrogen content of the soil.

QUESTION 16

The percentage composition of an oxygen atom in an oxygen molecule, O_2, is

A. 100% B. 10% C. 50% D. 5%

QUESTION 17

How many moles are there in 54 grams of water?

A. 3.0 B. 6.0 C. 3.2 D. 1.0

QUESTION 18

What is the molar concentration of 25g of Copper(II) sulphate pentahydrate ($CuSO_4 \cdot 5H_2O$) in 1 Litre?

A. 1.0 moles/L B. 0.1 moles/L C. 0.01 moles/L D. 0.001 moles/L

QUESTION 19

The formula for sulphuric acid is

A. H_2SO_3 B. HSO_4 C. H_4SO_2 D. H_2SO_4

QUESTION 20

The pH of a 0.1M KOH solution is

A. 0.1 B. 1.0 C. 13.0 D. 14.0

QUESTION 21

Which of the following acids would most likely show a vigorous reaction with magnesium solid?

A. Ethanoic acid
B. Hydrochloric acid
C. Citric acid
D. Carbonic acid

QUESTION 22

Which of the following materials will **NOT** conduct electricity?

A. Graphite
B. Molten $KCl_{(\ell)}$
C. KCl in solution
D. Solid $KCl_{(s)}$

QUESTION 23

During the reaction of molten potassium bromide (KBr) the electrolytic process at the cathode is

A. reduction and gain of electrons.
B. oxidation and loss of electrons.
C. reduction and loss of electrons.
D. oxidation and gain of electrons.

QUESTION 24

An object is to be plated with copper.

What is the most suitable material for the anode and electrolyte?

	ANODE	**ELECTROLYTE**
A.	Carbon	Aqueous copper(II) sulphate
B.	Copper	Dilute sulphuric acid
C.	Copper	Molten copper(II) sulphate
D.	Copper	Aqueous copper(II) nitrate

QUESTION 25

Which of the following hydrocarbons is **NOT** an aliphatic compound?

A. Benzene B. Ethene C. Methane D. Propene

QUESTION 26

The general formula for alkynes is C_nH_{2n-2}.

How many hydrogen atoms would you find bonded to carbon atoms in butyne?

A. 4 B. 6 C. 8 D. 10

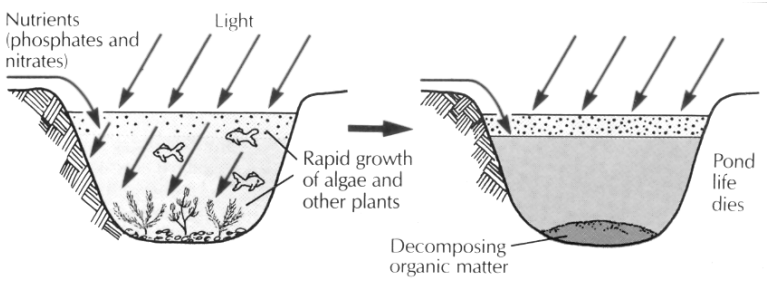
QUESTION 27

Soap is formed by the reaction between a fatty acid and an

A. alcohol. B. aldehyde. C. alkaline base. D. alkane.

QUESTION 28

Study the diagram below that shows the process of eutrophication.



The reason why pond life dies is because of a lack of

A. phosphates and nitrates.
B. plants and animals.
C. carbon dioxide and light.
D. oxygen and light.

For Question 29 and 30 refer to the following statements relating to plastics.

I. All plastics produce toxic gases when burned.
II. All plastics are durable.
III. All plastics are biodegradable.
IV. All plastics can be recycled.

QUESTION 29

Which two statements contradict each other?

A. I and II B. I and IV C. II and III D. III and IV

QUESTION 30

Which of the statements is **TRUE** and describes an advantage of all plastics?

A. I B. II C. III D. IV

PART B: SHORT ANSWERS (QUESTIONS 31 to 40) 70 MARKS

For each Question, work out the answers for each question and write the answer in the space provided on the ANSWER BOOKLET.

QUESTION 31

a) All substances can be classified into three (3) groups: mixtures, compounds and elements.

For each substance below, state whether it is a mixture, compound or element.

i. Metal alloy (1)

ii. Lime (1)

iii. Diamond (1)

iv. Air (1)

b) The gas laws define three (3) main quantities that can be used to describe gas behavior. These are Pressure, Temperature and Volume.

According to Charles' law, which of these quantities is/are:

i. fixed? (1)

ii. variable? (1)

c) The table below shows the solubility of an ionic compound X in water at different temperatures.

Solubility of X (g/100g of water)	5	21	47	72	110
Temperature (*°C*)	0	10	20	30	40

What mass of water is needed to make a saturated solution with 25g of solute at 20^{o}C? (1)

QUESTION 32

a) Chlorine can form covalent bonds and ionic bonds. Draw "dot and cross" diagrams to show bonding in:

i. Chlorine gas (1)

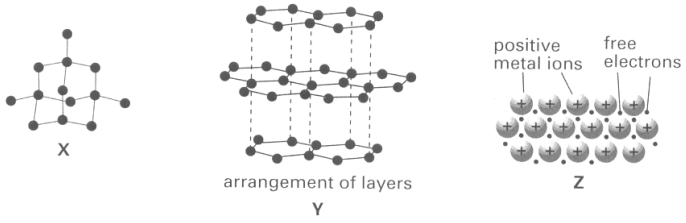
ii. Sodium chloride (1)

b) Which of the elements in the pairs of elements below is more ***electronegative***?

i. Calcium and bromine (1)

ii. Sulphur and oxygen (1)

c) The diagrams below represent the bonding structures of three substances X, Y and Z.



Name the substances.

i. Substance X (1)

ii. Substance Y (1)

iii. Substance Z (1)

QUESTION 33

a) When solid iron(III) oxide is added to hydrochloric acid, the following reaction takes place:

$$\text{Iron(III) oxide} + \text{Hydrochloric acid} \rightarrow \text{Iron(III) chloride} + \text{water}$$

i. What type of chemical reaction is this? (1)

ii. Write the balanced chemical equation for this reaction. (2)

iii. Write the balanced net ionic equation for this reaction. (1)

b) The following chemical equation shows the combustion of 1 mole of heptane (C_7H_{16}).

$$C_7H_{16} + XO_2 \rightarrow YCO_2 + ZH_2O$$

Find the values of the coefficients X, Y and Z so that the chemical equation is balanced. (3)

QUESTION 34

a) What is the function of a catalyst? (2)

b) Copper(II) oxide catalyses the decomposition of hydrogen peroxide. 0.5g of the oxide was added to a flask containing 100mL of hydrogen peroxide solution. A gas was released. It was collected and its volume noted every 10 seconds. The table below shows the results.

Time (sec)	0	10	20	30	40	50	60	70	80	90
Volume (cm^3)	0	18	30	40	48	53	57	58	58	58

i. Write a balanced equation for the decomposition of hydrogen peroxide. (2)

ii. Name the gas that is formed. (1)

iii. What are the chemicals present in the flask after 90 seconds? (1)

iv. What mass of Copper(II) oxide would be left in the flask at the end of the reaction? (1)

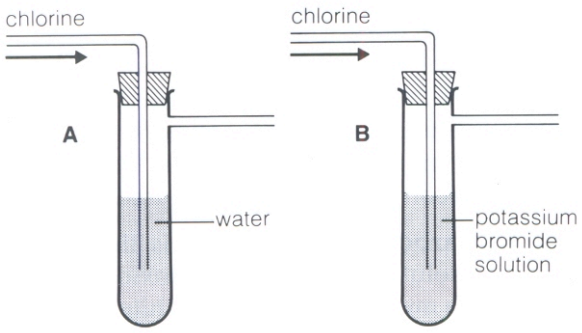
QUESTION 35

a) Name the industrial process that produces;

i. Sulphuric acid from sulphur. (1)

ii. Ammonia from nitrogen and hydrogen gases. (1)

b) Chlorine gas is passed through two solutions as shown below.



i. Name the substance formed in tube A. (1)

ii. Write a balanced chemical equation for the reaction in tube B. (2)

c) Silver is a metal that is often used to make jewellery.

List any two of the metallic properties of silver that allows it to be used for jewellery. (2)

QUESTION 36

a) How many grams are there in:

i. 2 moles of magnesium atoms? (1)

ii. 2 moles of phosphorus molecules, P_4? (2)

b) What is the percentage of oxygen in Calcium nitrate dihydrate, $Ca(NO_3)_2 \cdot 2H_2O$? (2)

c) What is the molar concentration of 10g of Calcium nitrate dihydrate prepared in a 500mL solution? (2)

QUESTION 37

a) Complete the table below by filling in the blanks with the colour change for each indicator. (3)

Indicator	***Colour in strong acid***	***Colour in strong alkali***
Litmus		
Phenolphthalein		
Methyl orange		

b) Name the starting materials (metal + acid) to make magnesium nitrate. (2)

c) In the table below, state the name of the gas produced by the reactions. (2)

Reaction	***Name of gas the produced***
Hydrochloric acid + Calcium carbonate	
Magnesium + Sulphuric acid	

QUESTION 38

a) During electrolysis, to which electrode do

i. the positive ions of the electrolyte move? _____ (1)

ii. the negative ions of the electrolyte move? _____ (1)

b) Do the ions gain or lose electrons at the

i. Cathode _____ (1)

ii. Anode _____ (1)

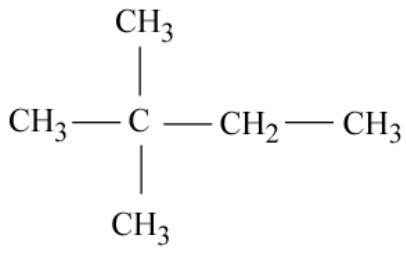
c) Complete the table below to predict the products formed at each electrode from the given electrolyte. Assume that *inert electrodes* are used and the *solutions are concentrated*. (3)

Electrolyte	***Product at the Cathode***	***Product at the Anode***
Molten potassium chloride		
Molten calcium bromide		
Aqueous sodium chloride		

QUESTION 39

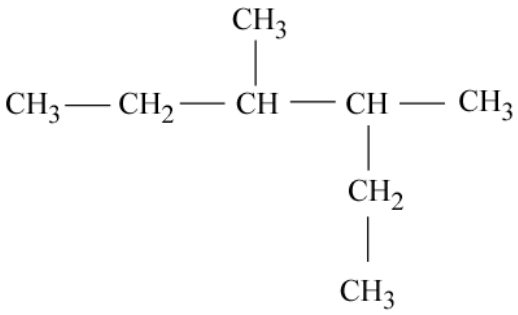
a) State the correct IUPAC names for the following hydrocarbons.

i.



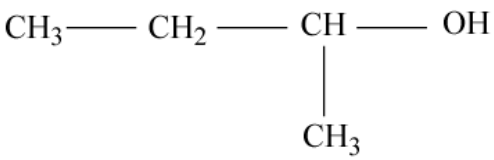
(1)

ii.



(2)

iii.



(1)

b) Draw the structural formula for the following.

i. 2-methyl-3-ethylpentane (1)

ii. 2, 4, 5-trimethylheptane (2)

QUESTION 40

Copper(II) oxide (CuO) ore can be treated with sulphuric acid in the process of "leaching" to chemically extract copper from the ore.

a) Write the equation for the chemical leaching. (2)

b) If copper metal is required it can be obtained by reacting "scrap iron" (Fe).

Write the reaction equation for this process. (2)

c) Another process for the recovery of copper is by electrolysis using a reactive copper anode.

For a solution of $CuSO_{4\,(aq)}$, the reaction at the anode and cathode are;

i. Anode (1)

ii. Cathode (1)

d) Fermentation of sugar can be carried out giving glucose as a product. Glucose has the formula $C_6H_{12}O_6$. In the next fermentation step, glucose can be converted to ethanol.

Complete the following equation for the formation of ethanol from glucose. (1)

$$C_6H_{12}O_6 \xrightarrow{zymase} \_\_\_\_\_ + 2CO_2$$

END OF EXAMINATION

CHEMISTRY - 2014

PART B – ANSWER BOOKLET

Write your name, province and school codes and your candidate number correctly and clearly in the space provided below.

Year		Province		School			Candidate No		
1	*4*								

Candidate Name: _____

School Name: _____

ANSWERS WRITTEN ON THE QUESTION PAPER OR ANY OTHER PAPER WILL NOT BE MARKED.

WRITE ANSWERS NEATLY IN THE SPACES PROVIDED IN THIS ANSWER BOOKLET.

****

FOR MARKERS USE ONLY

	Score	Markers' Initials	
		Marker 1	Marker 2
PART B			
QUESTION 31			
QUESTION 32			
QUESTION 33			
QUESTION 34			
QUESTION 35			
QUESTION 36			
QUESTION 37			
QUESTION 38			
QUESTION 39			
QUESTION 40			
FINAL TOTAL	/ **70**		

START YOUR WORK ON THE NEXT PAGE

PART B: ANSWER BOOKLET

Write your answer in the space provided below. Your answers must be clear and precise.

Question 31	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) i. Metal alloy _____	1		
ii. Lime _____	1		
iii. Diamond _____	1		
iv. Air _____	1		
b) i. _____	1		
ii. _____	1		
c) Answer: _____	1		
For Markers Use Only ***Q31 Total***			

Question 32	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) i.	1		
a) ii.	1		
b) i. _____	1		
ii. _____	1		
c) i. _____	1		
ii. _____	1		
iii. _____	1		
For Markers Use Only ***Q32 Total***			

Question 33	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) i. _____	1		
ii. _____	2		
iii. _____	1		
b) X = _____	1		
Y = _____	1		
Z = _____	1		
For Markers Use Only ***Q33 Total***			

Question 34	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) _____ _____ _____ _____	2		
b) i._____	2		
ii._____	1		
iii._____	1		
iv._____	1		
For Markers Use Only ***Q34 Total***			

Question 35	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) i. _____ ii. _____	1 1		
b) i. _____ ii. _____	1 2		
c) i._____ ii._____	1 1		
For Markers Use Only ***Q35 Total***			

Question 36	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) i. Answer: _____	1		
a) ii. Answer: _____	2		
b) Answer: _____	2		
c) Answer: _____	2		
For Markers Use Only ***Q36 Total***			

Question 37

	Marks per Qs.	Marker 1	Marker 2

a)

Indicator	*Colour in strong acid*	*Colour in strong alkali*	
Litmus			1
Phenolphthalein			1
Methyl orange			1

b) Metal _____ 1

Acid _____ 1

c)

Reaction	*Name of the gas produced*	
Hydrochloric acid + Calcium carbonate		1
Magnesium + Sulphuric acid		1

For Markers Use Only ***Q37 Total***

Question 38	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) i. _____ ii. _____	1 1		
b) i. Cathode _____ ii. Anode _____	1 1		
c)			

Electrolyte	*Product at the cathode*	*Product at the anode*	
Molten potassium chloride			1 1
Molten calcium bromide			1
Aqueous sodium chloride			

For Markers Use Only ***Q38 Total***			

Question 39	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) i. _____ ii. _____ iii. _____	1 2 1		
b) i.	1		
b) ii.	2		
For Markers Use Only ***Q39 Total***			

Question 40	**Marks per Qs.**	**Marker 1**	**Marker 2**
a) _____	2		
b) _____	2		
c) i. Anode _____ ii. Cathode _____	2		
d) $C_6H_{12}O_6 \xrightarrow{zymase}$ _____ $+ 2CO_2$	1		
For Markers Use Only ***Q40 Total***			

CHEMISTRY DATA SHEET

1 mole of any element contains 6.02×10^{23} molecules

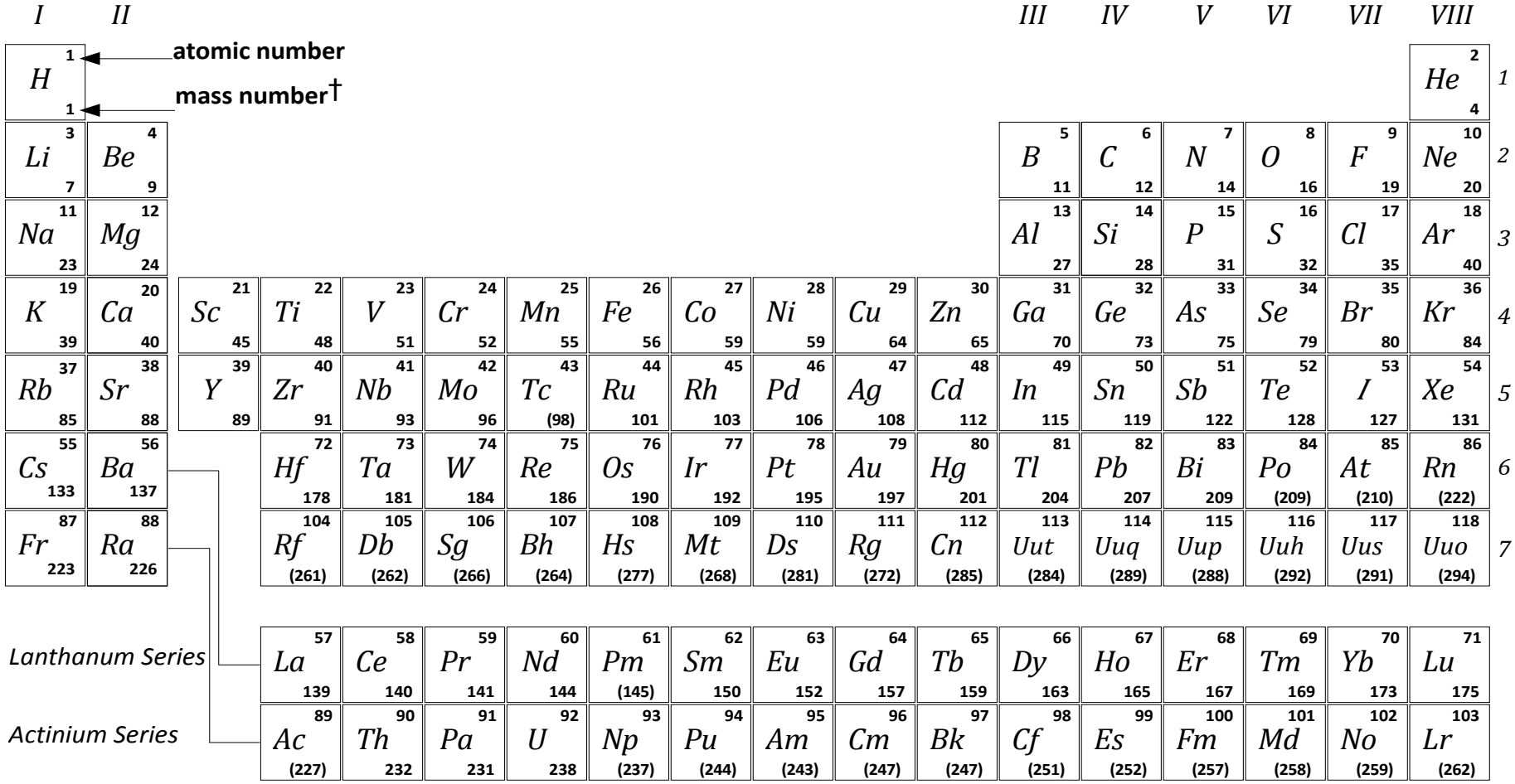
FORMULAE OF COMMON IONS	
Positive	**Negative**
Ag^{+}	Br^{-}
Al^{3+}	Cl^{-}
Ca^{2+}	CO_3^{2-}
Cu^{2+}	HCO_3^{-}
Fe^{2+}	HSO_4^{-}
Fe^{3+}	I^{-}
H^{+}	NO_3^{-}
K^{+}	O^{2-}
Li^{+}	OH^{-}
Mg^{2+}	S^{2-}
Na^{+}	SO_3^{2-}
NH_4^{+}	SO_4^{2-}
Pb^{2+}	PO_4^{3-}
Zn^{2+}	HPO_4^{3-}
Ba^{2+}	H_2PO^4

REACTIVITY SERIES	
Elements	**Reactivity**
Potassium	*Most reactive*
Sodium	
Lithium	
Calcium	
Magnesium	
Aluminium	
(Carbon)	
Zinc	
Iron	*Decrease in Reactivity*
Tin	
Lead	
(Hydrogen)	
Copper	
Silver	
Gold	
Platinum	*Least reactive*

SOLUBILITY OF SALTS AND HYDROXIDES IN COLD WATER

Soluble	Insoluble
All sodium, potassium and ammonium salts	
All nitrates	
Most bromides, chlorides & iodides	Bromides, chlorides & iodides of silver & lead*
Most sulphates	Sulphates of barium, calcium & lead*
Carbonates & hydroxides of sodium, potassium & ammonium	Most other carbonates & hydroxides
Calcium hydroxide is only slightly soluble	*lead salts are more soluble in hot water

Chemistry Data Sheet
The Periodic Table of Elements



† mass number relates to the commonest isotope.
For all calculations assume relative atomic mass = mass number, except for CHLORINE.
For chlorine, relative atomic mass = 35.5