DEPARTMENT OF EDUCATION

UPPER SECONDARY SCHOOL CERTIFICATE EXAMINATIONS

CHEMISTRY

Tuesday
27th October 2015

Time allowed:
2 hours and 30 minutes
(8:00am – 10:30 am)

NO EXTRA TIME
(NO OTHER TIME)

Candidates are advised to fully utilise the allocated time

C

INSTRUCTIONS TO CANDIDATES

To be read by the external invigilator to all candidates

1. The subject code for **Chemistry** is **6.**
2. There are **12** printed pages in the question booklet and **7 printed** pages in the answer booklet. The formula sheet is inserted in the middle of the question 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 Section B Answer Sheet Provided.
3. You are required to only write the correct answer in the spaces 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.

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

For each question, choose the best answer and shade in the circle representing the letter of your choice A, B, C or D printed on the electronic answer sheet.

QUESTION 1

If you added salt to pure water, what differences would you observe in the melting point and boiling point of the resulting solution?

A. Lower melting point and higher boiling point.
B. Lower melting point and boiling point.
C. Higher melting point and lower boiling point.
D. Higher melting point and boiling point.

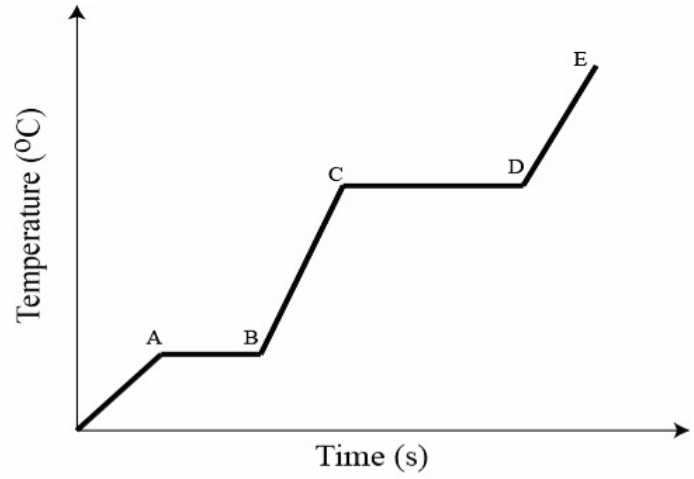
QUESTION 2

Which of the following is NOT TRUE about crystallisation as a separation method?

A. It is used to separate a solid that has been dissolved in a liquid.
B. The solid substance is dissolved in a solvent to create a solution.
C. More solid is dissolved as the solution is heated.
D. The saturated solution is filtered to separate the solid.

QUESTION 3

The graph below shows the heating curve of pure solids and mixtures.



What does the segment AB represent?

A. No more heat is applied to the solid.
B. The latent heat of fusion of the solid.
C. The thermometer stops working.
D. The overall constant temperature of the solid.

QUESTION 4

The correct electronic configurations for the chloride ion (Cl^-) in terms of s and p orbitals is

A. $1s^2\ 2s^2\ 2p^6\ 3s^3\ 3p^6$ B. $1s^2\ 2s^2\ 3s^2\ 2p^6\ 3p^6$ *C*. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ *D*. $1s^2\ 2s^2\ 2p^6\ 3s^1\ 3p^6$

QUESTION 5

Which of the following statements best describes a chemical bond?

A chemical bond

A. consists of special hooks which hold the atoms together.
B. is the result of activities of outermost electrons in atoms.
C. is formed by atoms having the same number of outermost electrons.
D. is formed when two electrons in close proximity attract each other.

QUESTION 6

The bonding in metals is best described as

A. an electrostatic attraction between stationary metal cations and mobile electrons.

B. a weak electrostatic attraction that exists in metals.

C. bonding that is formed when mobile electrons are attracted to positive mobile cations in metals.

D. an electrostatic attraction due to two metal atoms equally sharing two electrons.

QUESTION 7

For the following reaction;

$$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow NaNO_{3(aq)} + AgCl_{(s)}$$

The net completed reaction is indicated by

A. a white precipitate due to $AgCl_{(s)}$.

B. a gas given off due to $AgCl_{(s)}$.

C. heat given off due to $AgCl_{(s).}$

D. increased mass of products due to $AgCl_{(s)}$.

QUESTION 8

Which of the following reactions is a synthesis reaction?

A. $NH_{3(g)} \longrightarrow N_{2(g)} + H_{2(g)}$

B. $CaCO_{3(s)} \xrightarrow{heat} CaO_{(s)} + CO_{2(g)}$

C. $H_{2(g)} + I_{2\,(g)} \longrightarrow 2HI_{(g)}$

D. $2KClO_{3(g)} \xrightarrow{heat} 2KCl_{(s)} + 3O_{2(g)}$

QUESTION 9

The following reaction is an exothermic reaction.

$$Cl_{2(g)} + H_{2(g)} \longrightarrow HCl_{(g)} \qquad \Delta H = -1841J$$

Which of the following statements is TRUE about this reaction?

In this reaction, hydrogen chloride (HCl) will

A. have more energy than the reactants.

B. have equal energy to the reactants.

C. absorb energy from the surroundings.

D. contain less energy than the reactants.

QUESTION 10

Which of the following statements is NOT TRUE about a catalyst?

A. It increases the rate of a chemical reaction.

B. It alters the energy pathway by which the reaction occurs.

C. It loses some of its mass as the reaction is completed successfully.

D. It increases the rate of reaction by lowering the activation energy.

QUESTION 11

Which of the following reactions carried out at the same temperature and pressure would have the highest initial rate?

A. 25mL of 1.0M HCl added to a 1g lump of solid $CaCO_3$.

B. 20mL of 2.0M HCl added to a 1g lump of powdered $CaCO_3$.

C. 20mL of 1.0M HCl added to a 1g lump of powdered $CaCO_3$.

D. 40mL of 0.5M HCl added to a 1g lump of solid $CaCO_3$.

QUESTION 12

Which of the following statements is NOT a property of sulphur?

A. It exists as a brittle solid.

B. It has a low melting point.

C. It has a low boiling point.

D. It can conduct electricity.

QUESTION 13

Certain metals are malleable. This means that such metals

A. can be drawn into wires.

B. are split into fragments when struck with a hammer.

C. can be hammered pressed or drawn into sheets.

D. are good conductors of heat and electricity.

QUESTION 14

If an iron rod is dipped in copper sulphate solution, copper is deposited. Which of the following statements is TRUE about this reaction?

A. Iron is readily oxidised.

B. Copper is the reducing agent.

C. Iron is reduced.

D. Only copper ions remain in solution.

QUESTION 15

According to the following reaction

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

The moles of CO_2 produced when 0.25 moles of O_2 reacts is

A. 0.25 moles B. 0.5 moles C. 1 mole D. 2 moles

QUESTION 16

If 12g of sodium hydroxide is dissolved in 100mL of water, what would be the concentration in mol L^{-1} of the solution?

A. 0.003 mol L^{-1} B. 0.3 mol L^{-1} C. 3.0 mol L^{-1} D. 3.33 mol L^{-1}

QUESTION 17

Compound Z contains 20% by mass of hydrogen and 80% by mass of carbon. The empirical formula of compound Z is

A. CH_2 B. CH_3 C. CH_4 D. C_2H_6

QUESTION 18

The percentage of sodium in sodium hydrogen carbonate is

A. 43.4% B. 0.27% C. 52.6% D. 27.4%

QUESTION 19

Which of the following is NOT TRUE about reactions involving acids?

Acids react with

A. carbonates to produce hydrogen gas.
B. metals to produce hydrogen gas.
C. carbonates to produce carbon dioxide.
D. bases to produce salt and water only.

QUESTION 20

The pH of a 0.01M NaOH solution is

A. 0.01 B. 2.0 C. 11.0 D. 12.0

QUESTION 21

Which of the following statements is TRUE of a galvanic cell?

A. A cell that uses electrical energy to bring about a chemical change.
B. The AA battery used in a portable CD player is an example of a galvanic cell.
C. In a galvanic cell there is no electrolyte.
D. In galvanic cells, electrons flow from cathode to anode.

QUESTION 22

Which of the following statements is TRUE of electrolysis of molten ionic compounds?

A. Anions collect at the negative electrode.
B. Anions are reduced.
C. Cations collect at the positive electrode.
D. Cations are reduced.

QUESTION 23

Which of the following is NOT an alkane?

A. C_2H_6 B. C_4H_{10} C. C_6H_{14} D. C_8H_{16}

QUESTION 24

Propanol is made by the reaction between

A. propane and oxygen.
B. propane and steam.
C. propene and steam.
D. fermentation of carbohydrates.

QUESTION 25

Which of the formulae below represents a ketone?

A. CH_3CH_2OH B. NH_2CONH_2 C. CH_3CH_2COOH D. CH_3COCH_3

QUESTION 26

Persistent Organic Pollutants (POPs) are toxic chemicals that have adverse effects on the environment and human health.

Which of the following POPs was used by the Health Department in PNG in the late 1960s to control the spread of malaria?

A. Dieldrin B. DDT C. Chlorobezene D. Heptachlor

QUESTION 27

Chemistry has been used by Papua New Guineans for centuries. Which of the following was NOT a traditional chemical product in Papua New Guinea?

A. Lime B. Dyes C. Soap D. Medicine

QUESTION 28

Which of the following is TRUE of biodiesel?

A. It has a high sulphur emission.

B. It does not add extra CO_2 greenhouse gas since it is plant-based.

C. It has the same emission as petroleum based diesel.

D. It extends engine life as it is a better lubricant than petroleum diesel.

QUESTION 29

The process of extracting and purifying metals from their ores for commercial use is called extractive metallurgy.

Which of the following processes involves the use of high temperatures?

A. Electrometallurgy B. Leaching C. Hydrometallurgy D. Pyrometallurgy

QUESTION 30

A hydrocarbon with the formula $C_{12}H_{26}$ is cracked. If one of the products is ethene, what is the formula of the other product obtained?

A. C_2H_4 B. $C_{10}H_{22}$ C. C_8H_{16} D. $C_{12}H_{24}$

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

Write your answer to the questions in the spaces provided in your Part B Answer Booklet.

QUESTION 31

a) You pop a balloon of hydrogen gas and a balloon of carbon dioxide gas at the same time in one side of a closed room.

i) Which gas will reach the other side first? (1)

ii) What is the rate of diffusion of carbon dioxide compared to hydrogen? (2)

b) i) State Charles' Law as related to gases. (1)

ii) A fixed amount of a gas at 20°C and constant pressure has volume of 650cm^3. Calculate the volume in cm^3 of the same gas at 0°C. (1)

c) What separation process would be suitable to use to investigate a blue dye to see if it was a single colour? (1)

d) At 40°C the solubility of copper(II) sulphate is 29g/100g of water. At 10°C, the solubility is 17g/100g of water.

If a saturated solution of 174g of copper(II) sulphate at 40°C is cooled to 10°C some of the solute will crystalize out of the solution.

How much of the solute will remain as part of the saturated solution at 10°C? (1)

QUESTION 32

a) Draw dot and cross diagrams of the outer shell of atoms to show the bonding in the following molecules.

i) Carbon disulphide (CS_2) (1)

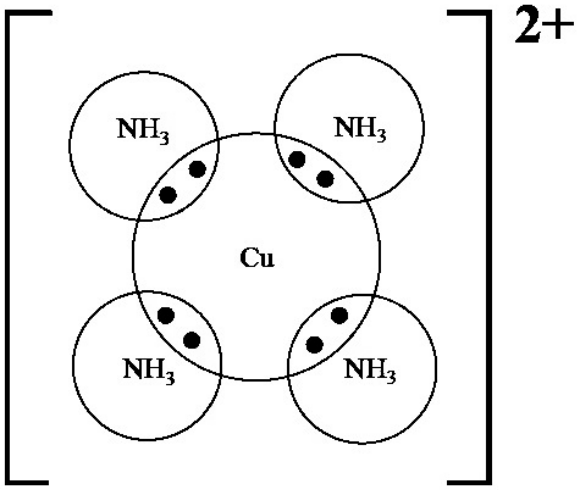
ii) Magnesium sulphide (MgS) (1)

b) The table shows the chlorides of some elements of the third (3rd) period.

Complete the missing information labelled (i), (ii) and (iii). (3)

Element	***Na***	***Mg***	***Al***	***P***
Chloride	NaCl	$MgCl_2$	$AlCl_3$	(i)
Type of bonding	(ii)	Ionic	(iii)	Covalent
Melting point	801°C	712°C	180°C	-91°C

c) The compound formed when four (4) ammonia molecules react with one copper ion is shown below. All electrons used for bonding come from the ammonia molecules.



i) Name the kind of bond between Cu^{2+} and NH_3? (1)

ii) Write the correct formula of the compound. (1)

QUESTION 33

a) State the Law of conservation of matter. (2)

b) Balance the following reactions. (3)

i) $C_2H_{6(l)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(l)}$

ii) $Fe_{(s)} + AgNO_{3(aq)} \rightarrow Fe(NO_3)_{2(aq)} + Ag_{(s)}$

iii) $Mg_{(s)} + CO_{2(g)} \rightarrow MgO_{(s)} + C_{(s)}$

c) Write the balanced and net ionic equation for the following precipitation reaction. (2)

$$Pb(NO_3)_{2(aq)} + KI_{(aq)} \rightarrow PbI_{2(s)} + KNO_{3(aq)}$$

QUESTION 34

a) Suggest a reason for each of the following observations.

i) Zinc powder burns more vigorously than zinc foil. (2)

ii) A car's exhaust pipe will rust faster if the car is used a lot. (2)

b) Manganese dioxide was added to hydrogen peroxide and 20mL of oxygen was produced. The chemical reaction is shown below.

$$2H_2O_{2(l)} \xrightarrow{MnO_{2(s)}} 2H_{2(g)} + O_{2(g)}$$

i) What is the function of manganese dioxide (MnO_2)? (1)

ii) What would be the volume of gas produced when no manganese dioxide is used? (2)

Explain your answer.

QUESTION 35

a) Many metals are more useful when mixed with other elements than when they are pure.

i) What is the name given to mixtures of metals? (1)

ii) Lead (Pb) is one of the two metals that are found in solder. What is the other metal? (1)

b) Ammonia ($NH_{3\,(aq)}$) reacts with acids to form salts. For example ammonia reacts with nitric acid to form ammonium nitrate. Write the balanced chemical equation for this reaction. (2)

c) Farmers use NPK compound fertilizers for nitrogen phosphorus and potassium.

i) Through what plant part do plants obtain the nitrogen, phosphorus and potassium that they need? (1)

ii) Fertilizers containing phosphates and nitrates cause water pollution. Explain how this happens. (2)

QUESTION 36

Study the chemical equation below and answer the questions that follow.

$$Na_2CO_{3(aq)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + CO_{2(g)} + H_2O_{(l)}$$

a) What volume of 0.500mol L^{-1} sulphuric acid is needed to react with 21.2g of Na_2CO_3 (molar mass of Na_2CO_3 = 105.99)? (3)

b) Calculate the moles of CO_2 liberated in the reaction. (2)

c) What would the volume of sulphuric acid be if twice (42.2g) of Na_2CO_3 was used instead? (2)

QUESTION 37

a) The table below shows the colours of two indicators in acidic and alkaline solutions.

Indicator	Colour in Acidic solutions	Colour in Alkaline solutions
X	Red	Blue
Y	Colourless	Red

i) What would be the colour of indicator X in a solution of pH 2.0? (1)

ii) When a few drops of indicator Y are placed in a solution Z, it turns red immediately. What can you deduce about the properties of solution Z? (1)

b) At the endpoint of a titration what would be the colour change of:

i) An alkaline solution titrated with a strong acid using indicator X? (1)

ii) An acidic solution titrated with a strong alkaline solution using indicator Y? (1)

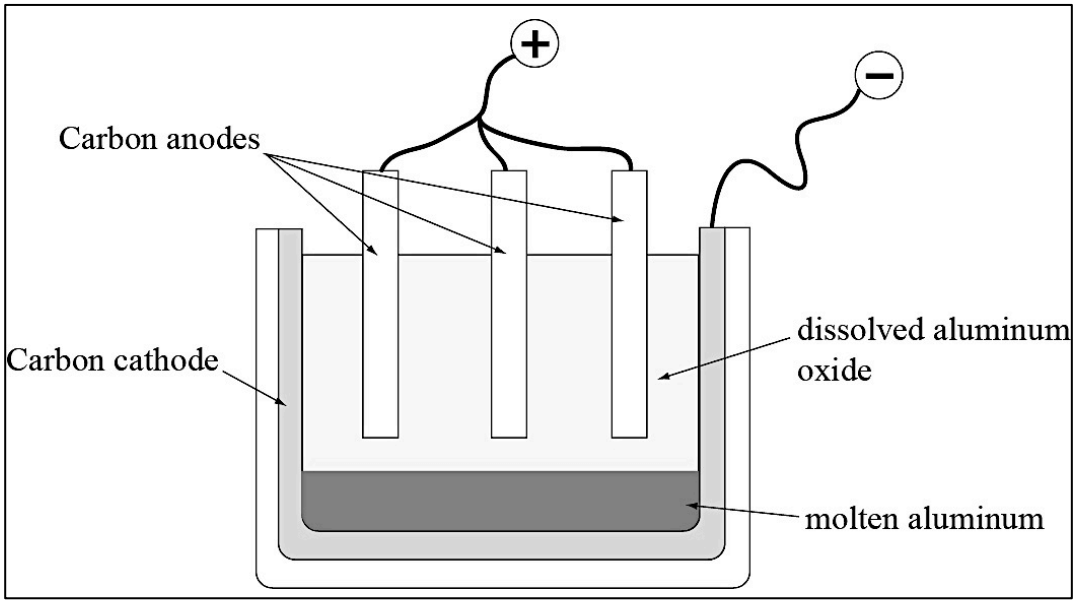
c) Hydrochloric acid is a strong acid while ethanoic acid is a weak acid. An experiment is conducted where each of the acids are reacted with magnesium solid in separate beakers and hydrogen gas is produced.

i) Which of the two acids would be expected to react vigorously with magnesium solid? (1)

ii) If the reaction was vigorous, explain through dissociation of acids why this would be so. (2)

QUESTION 38

a) Aluminium is a metal that has many uses. It is obtained from aluminium oxide by electrolysis. A simplified diagram of the cell used to produce aluminium is shown below.



i) Describe the movement of Al^{3+} ions when an electric current is applied to the cell. (1)

ii) Write a balanced half equation to show the reaction occurring at the cathode and anode. (2)

b) An electrochemical cell is made up of a Zn^{2+}/Zn half cell $(E_0 = -0.76V)$ and an Ag^{+}/Ag half cell. $(E_0 = +0.80V)$. The mass deposited at the silver electrode is 0.50g.

i) Write the balanced equation for the cell reaction. (1)

ii) Calculate the moles of silver used. (1)

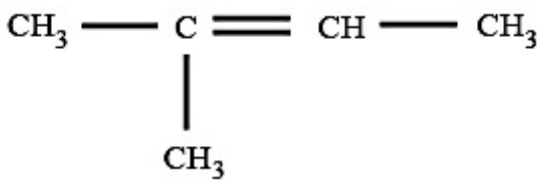
iii) Given that the ratio of moles of zinc to moles of silver is 1:2, calculate the moles of zinc required in the reaction. (1)

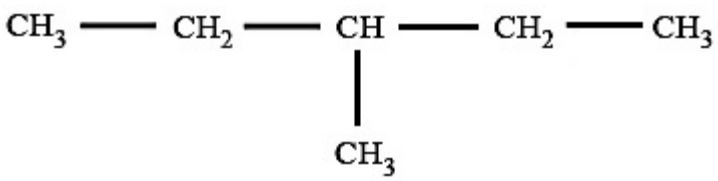
iv) Calculate the mass of zinc required. (1)

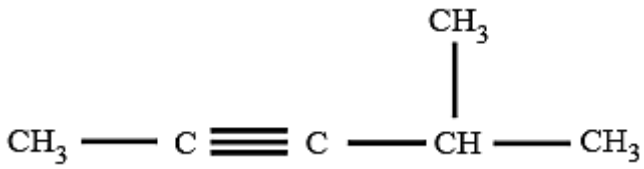
QUESTION 39

a) Write the general formula for an alkene. (1)

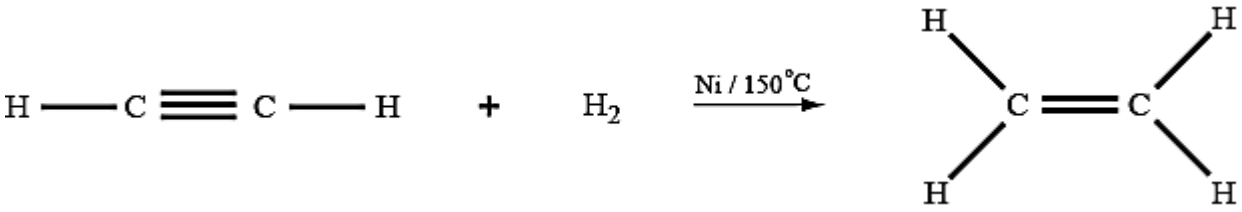
b) Give the names of the following hydrocarbons.

i)  (1)

ii)  (1)

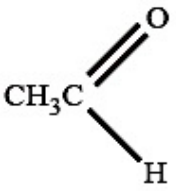
iii)  (1)

c) The reaction between ethyne and hydrogen is shown below.



Name the product of this reaction. (1)

d) The structure of an organic compound is shown below.



i) What grouping does it belong to? (1)

ii) Name the compound. (1)

QUESTION 40

a) Ethanol can be readily manufactured by reacting ethene with steam using phosphoric acid as a catalyst at a temperature of 300°C. This reaction is reversible.

$$CH_2{=}CH_{2(g)} + H_2O_{(g)} \rightleftharpoons CH_3CH_2OH_{(g)} \qquad \Delta H = -45kJ/mol$$

i) How can you tell that this is an exothermic reaction? (1)

ii) Only 5% of the ethane is converted into ethanol. Based on the above equilibrium reaction, suggest two ways in which more ethanol can be manufactured. (2)

b) When minerals containing pyrite are exposed to air and water, a product of this reaction is sulphuric acid (H_2SO_4). This causes lowering of pH in river systems in a phenomenon called "Acid Mine Drainage."

However lime containing compounds such as calcium carbonate can neutralize such acids.

Write a balanced chemical equation for the reaction between calcium carbonate and sulphuric acid. (2)

c) What is meant by the following terms as applied to the oil and gas industries?

i) sour crude (1)

ii) Liquefied Natural Gas (1)

END OF EXAMINATION

CHEMISTRY – 2015

PART B - ANSWER BOOKLET

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

Year		Province		School			Candidate No.		
1	5								

Candidate Name:_____

School Name:_____

Answers written on the QUESTION paper or any other paper will NOT be marked. Write answers in the spaces as provided on this answer booklet.

FOR MARKERS USE ONLY

PART B	**SCORE**	**MARKERS INITIALS**	
		M1	**M2**
QUESTION 31			
QUESTION 32			
QUESTION 33			
QUESTION 34			
QUESTION 35			
QUESTION 36			
QUESTION 37			
QUESTION 38			
QUESTION 39			
QUESTION 40			
FINAL TOTAL			

PART B: Answer Booklet

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

QUESTION 31	
a) i). _____	1
ii).	2
Ans: _____	
b) (i). _____	
_____	1
(ii).	
Ans: _____	1
c) _____	1
d)	
Ans: _____	1
For Markers Use Only **Q31 Total**	

QUESTION 32	
a) i)	1
ii)	1
b) i) _____	1
ii) _____	1
iii) _____	1
c) i) _____	1
ii) _____	1
For Markers Use Only **Q32 Total**	

QUESTION 33	
a) i) _____	2
_____	
b) i) _____	1
ii) _____	1
iii) _____	1
c) Balanced equation _____	1
Net ionic equation _____	1
For Markers Use Only **Q33 Total**	

QUESTION 34	
a) (i) _____	2
_____	
(ii) _____	2
_____	
b) (i) _____	1
(ii) _____	2
_____	
For Markers Use Only **Q34 Total**	

QUESTION 35	
a) i) _____	1
ii) _____	1
b) _____	2
c) i) _____	1
ii) _____	2
_____	
For Markers Use Only **Q35 Total**	

QUESTION 36	
a)	
	3
Ans: _____	
b)	
	2
Ans: _____	
c)	
	2
Ans: _____	
For Markers Use Only **Q36 Total**	

QUESTION 37	
a) i) _____	1
ii) _____	1
b) i) _____	1
ii) _____	1
c) i) _____	1
ii) _____	2
For Markers Use Only **Q37 Total**	

QUESTION 38	
a) i) _____	1
_____	
ii) _____	2
b) i) _____	1
ii)	
Ans: _____	1
iii)	
Ans: _____	1
iv)	
Ans: _____	1
For Markers Use Only **Q38 Total**	

QUESTION 39	
a) _____	1
b) i) _____	1
ii) _____	1
iii) _____	1
c) _____	1
d) i) _____	1
ii) _____	1
For Markers Use Only **Q39 Total**	

QUESTION 40	
a) i) _____	1
_____	
ii) 1. _____	1
_____	
2. _____	1
_____	
b) _____	2
c) i) _____	
_____	1
ii) _____	
_____	1
For Markers Use Only **Q40 Total**	

CHEMISTRY DATA SHEET

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

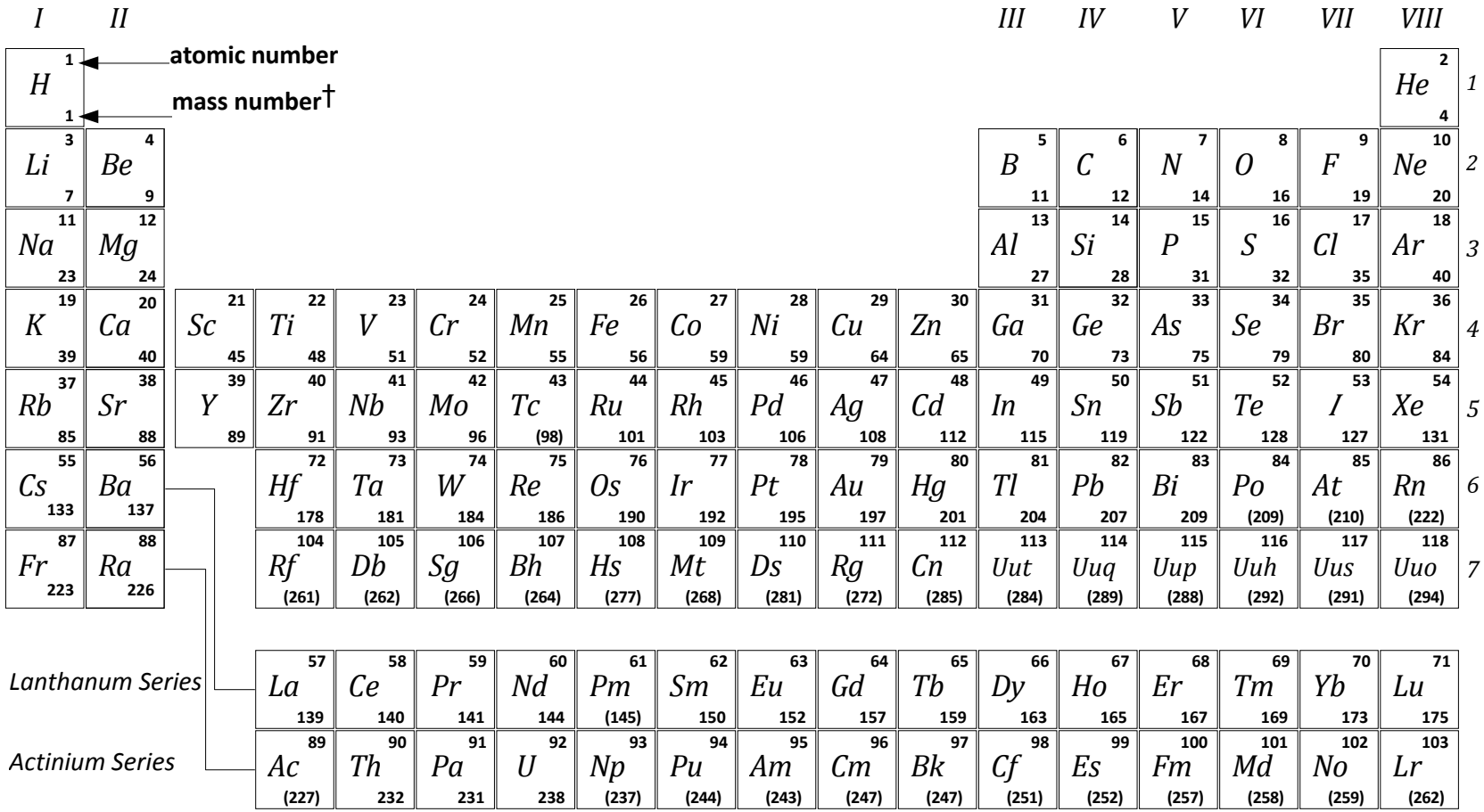
FORMULAE OF COMMON IONS	
Positive	**Negative**
Ag^{+}	Br^{-}
Al^{3+}	Cl^{-}
Ca^{2+}	CO_3^{2-}
Cu^{2+}	HCO_3^{-}
Fe^{2+}	HSO_4^{-}
Fe^{3+}	I^{-}
H^{+}	NO_3^{-}
K^{+}	O^{2-}
Li^{+}	OH^{-}
Mg^{2+}	S^{2-}
Na^{+}	SO_3^{2-}
NH_4^{+}	SO_4^{2-}
Pb^{2+}	PO_4^{3-}
Zn^{2+}	HPO_4^{3-}
Ba^{2+}	H_2PO^4

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