DEPARTMENT OF EDUCATION

UPPER SECONDARY SCHOOL CERTIFICATE EXAMINATIONS

CHEMISTRY

Tuesday

23 October 2012

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

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 **8** printed pages in the answer booklet, **1** page data sheet and a **1** page Electronic Answer Sheet for Part A Multiple Choice.
3. There are two sections in this paper. Answer all questions.

   Section A: Multiple Choice (Questions 1 – 30) 30 marks

   This section will be electronically marked.

   All answers to the Multiple Choice Section MUST be answered on this Answer Sheet.

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

   Section B: Short Answer (Questions 31 – 40) 70 marks

   Write down your name, your school name and complete your 10 digit candidate number on the Section B Answer Sheet Provided.
4. You are required to only write the correct answer in the spaces provided.
5. Calculators may be used.
6. Answers written on the question paper will not be marked. Write answers neatly in spaces as allocated on the answer sheet. Answer **ALL** questions.
7. Answer all questions on the answer sheet. Answers on any other paper including rough work paper and the question paper **will not be marked.**
8. Answers to questions that involve calculations must have the workings shown step by step to get full marks. Students may lose marks for writing down final answers only.
9. 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.
10. 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.
11. Graphical Calculators are NOT permitted.

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.

SECTION A: MULTIPLE CHOICE (QUESTIONS 1 TO 30) 30 MARKS

Choose A, B, C or D from the alternatives given and shade in your answer on the Electronic Answer Sheet using HB pencil. If you make a mistake, rub it out completely using an eraser and shade the correct answer on the answer sheet.

QUESTION 1

The most serious disadvantage in applying the theory of ionic bonding is that ionic bonding does not explain

A. the attraction between Group 1 metals and the halogens.

B. the bonding between group II and the halogens.

C. bonding in metal salts.

D. bonding that takes place between two metals or two non-metals.

QUESTION 2

Which one of the following equations correctly represents a displacement reaction?

A. $ZnCO_{3(s)} \longrightarrow ZnO_{(s)} + CO_{2(g)}$

B. $2KCl_{(s)} \longrightarrow 2KCl_{(l)} + Cl_{2(g)}$

C. $2Mg_{(s)} + O_{2(g)} \longrightarrow 2MgO_{(s)}$

D. $Zn_{(s)} + CuSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$

QUESTION 3

The concentration of 100 mL solution of sodium hydroxide is 0.4 mol/L.

How many grams of sodium hydroxide are dissolved in this solution?

A. 0.4 g B. 0.8 g C. 1.6 g D. 3.2 g

QUESTION 4

Which of the options below is true about soaps?

A. They can be used effectively in hard water.

B. They have a strong cleansing action.

C. They are biodegradable and therefore cause less pollution.

D. They are made from products of petroleum industry.

QUESTION 5

The number of moles of oxygen atoms in 1 mole of anhydrous calcium acetate [$Ca(CH_3COO)_2$] is

A. 2 B. 4 C. 16 D. 32

QUESTION 6

Miscible liquids can be separated using _____ based on their _____.

Which of the options below would correctly fill in the blanks?

A. paper chromatography, differences in solubilities

B. separating funnel, inability to mix well with each other

C. centrifugation, differences in particle size

D. fractional distillation, differences in boiling points

QUESTION 7

Which of the following substances is most acidic?

A. Aspirin B. Seawater C. Pure water D. Chlorine bleach

QUESTION 8

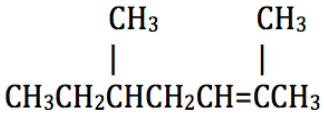
Which option below is true about an exothermic reaction?

A. Temperature of the surrounding drops B. Change in enthalpy (ΔH)>0

C. Change in enthalpy (ΔH)<0 D. Energy is absorbed

QUESTION 9

Below is the structural formula of a compound.



The name of the compound is

A. 2,5-dimethyl-2-heptene. B. 3,6-dimethyl-5-heptene.

C. 3,6-dimethyl-6-heptene. D. 2,5-dimethyl-3-heptene.

QUESTION 10

Which one of the following statements is NOT true about metals?

Metals are

A. good conductors of heat.
B. soluble in fossil fuels.
C. opaque to light.
D. malleable and ductile.

QUESTION 11

A Galvanic Cell is an electrochemical cell

A. which consumes electricity.
B. in which oxidation occurs at cathode.
C. in which reduction occurs at anode.
D. in which anode is negative.

QUESTION 12

Graphite and diamond are made of solid carbon. However, their properties are vastly different.

The reason for their difference is, carbon

A. can form double and triple bonds.
B. behaves as a metal and a non-metal.
C. has two isotopes.
D. atoms can be arranged in more than one type of lattice.

QUESTION 13

How many atoms are present in 591 grams of gold?

A. 3.01×10^{23} B. 5.91×10^{23} C. 6.02×10^{23} D. 18.06×10^{23}

QUESTION 14

20 grams of zinc reacts with hydrochloric acid as given in the following equation.

$$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$$

What is the mass of zinc chloride produced to the nearest gram?

A. 21 g B. 42 g C. 65 g D. 84 g

QUESTION 15

Which of the following is true about synthetic detergents?

A. They cannot be used effectively in hard water.

B. They are not made from by-products of petroleum industry.

C. They do not have a strong cleaning action.

D. They are not biodegradable and cause more pollution.

QUESTION 16

Solvent extraction can be used to _____

A. remove salt from iodine.

B. obtain sodium chloride from seawater.

C. obtain petrol from crude oil.

D. remove liquid from a suspension.

QUESTION 17

Carboxylic acids react with alcohols to give esters and water. For example,

$$\underset{\text{Ethanoic acid}}{CH_3COOH_{(aq)}} + \underset{\text{Ethanol}}{C_2H_5OH_{(aq)}} \longrightarrow \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_{5(aq)}} + \underset{\text{Water}}{H_2O_{(l)}}$$

If an unknown carboxylic acid reacted with methanol to give methylbutanoate, what would be the name of the carboxylic acid used?

A. Butanoic acid

B. Methanoic acid

C. Butanoate acid

D. Methyl butanoic acid

QUESTION 18

Which of the following ingredients is NOT used in the production of beer?

A. Hops B. Vegetable oils C. Yeast D. Malt

QUESTION 19

The most correct definition of a chemical bond is the

A. connection between two atoms that have the same valence electrons.

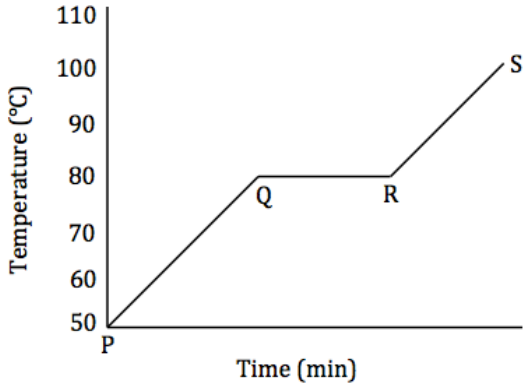
B. attraction between two atoms that have the same charges.

C. connection between two atoms via imaginary hooks.

D. attractive effect between two atoms caused by activities of two electrons in the atoms.

QUESTION 20

Below is a heating curve of a solid.



Which of the following options below is NOT true about the different stages on the graph?

A. The kinetic energy of the particles at position P increases.

B. High vibrations cause attractive forces in the solid lattice to break at position Q.

C. The beginning of the liquid stage at position R.

D. Greater vibrations cause particles to leave the liquid stage to become gaseous at position S.

QUESTION 21

25 mL of 0.1 M NaOH solution (in the flask) was titrated against 0.075 M HCl solution (in the burette). 33.33 mL of HCl was needed to reach the end point.

If H_2SO_4 solution of 0.075 M was used instead of HCl, how much of H_2SO_4 would be needed to reach the end point?

A. 8.33 mL B. 16.16 mL C. 33.33 mL D. 66.66 mL

QUESTION 22

In order to light the matches, the matchsticks are struck against the side of a matchbox because

A. the reaction is exothermic and it requires less activation energy.

B. the reaction is endothermic and it requires more activation energy.

C. a catalyst is needed to lower the activation energy.

D. not enough molecules in the matchsticks have the required activation energy.

QUESTION 23

The most serious flaw or disadvantage in the theory of covalent bonding is that the theory

A. does not apply to bonding between non-metals.

B. does not explain bonding in hydrocarbons (carbon-hydrogen bonding).

C. does not explain why two negatively charged electrons could stay together to form a bond.

D. cannot be used for multiple carbon bonding.

QUESTION 24

Which of the following is NOT a stage in the extraction of gold?

A. Reforming B. Flotation C. Refining D. Mineral Processing

QUESTION 25

Which of the following occurs during the electrolysis of dilute NaCl?

A. Oxygen is evolved at the anode.
B. Chlorine is evolved at the cathode.
C. Chlorine is evolved at the anode.
D. Sodium ions gain electrons.

QUESTION 26

An aqueous solution contains 1.74 grams of potassium sulphate. Its concentration is 0.1 mol/L.

What is the volume of this solution in millilitres (mL)?

A. 50 mL B. 100 mL C. 174 mL D. 200 mL

QUESTION 27

Which of the following is NOT a step in the production of beer?

A. Milling and malting B. Wort boiling C. Mashing D. Smelting

QUESTION 28

An example of a homologous series would be

A. $CH_3Cl, CH_3Br, CH_3I, CH_3F$
B. $CH_3Cl, CH_2Cl_2, CHCl_3, CCl_4$
C. $C_2H_4, C_3H_6, C_4H_8, C_5H_{10}$
D. $CHO_2, CH_2O, CH_2O_2, C_2H_2O$

QUESTION 29

Which of the following compounds is unstable when heated?

A. Sodium hydroxide
B. Barium nitrate
C. Potassium sulphate
D. Sodium carbonate

QUESTION 30

Which of the following statements is NOT true about acid rain?

A. It decreases corrosion of metals.
B. It harms aquatic life in rivers and lakes.
C. It dissolves buildings made of marble.
D. It makes drinking water unpalatable.

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

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

QUESTION 31

A. Name four of the factors affecting reaction rates. (4 marks)

B. The following reaction is at equilibrium.

What would happen if:

(i) More N_2O_4 is added to the system? (1 mark)

(ii) More NO_2 is added to the system? (1 mark)

(iii) NO_2 is removed from the system? (1 mark)

QUESTION 32

A. The volume of a gas at 1000 mm pressure and at 40°C is 480 mL.

What volume does the gas occupy at standard temperature and pressure (STP)? (2 marks)

B. The solubility of a compound at 60°C is 48.5 g in 100 mL of water and 42.0 g at 40°C.

Calculate the amount that would crystallize or remain as solid if a 50 mL of saturated solution of this compound at 60°C is cooled to 40°C. (2 marks)

C. At the top of Mt. Wilhem (4509 m above sea level), the partial pressure of oxygen is very low. As a result, the solubility of oxygen in water near the summit is much lower than that at sea level. Assuming the temperature near Lake Piunde is around 5°C and partial pressure of oxygen is 0.12 atm.

Calculate the solubility of oxygen in that lake in grams/L. Henry's law constant for oxygen at 5°C = 1.3×10^{-3} mol/L atm. (3 marks)

QUESTION 33

A. The empirical formula of vitamin C is $C_3H_4O_3$. Its molar mass is 180g/mol.

What is the molecular formula of vitamin C? (2 marks)

B. 63.0 grams of sodium fluoride was dissolved in water so that the final volume was 250.0 mL.

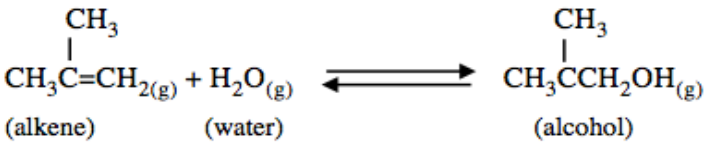
What is the molarity of this solution? (2 marks)

C. Bicarbonate of soda (sodium hydrogen carbonate) is used in many commercial preparations.

Find the percentage mass of sodium, carbon and oxygen in sodium hydrogen carbonate. (3 marks)

QUESTION 34

A. An alcohol was produced by reacting an alkene with steam at a high temperature as shown below. The reaction is reversible and the formation of the alcohol is exothermic.



(i) What is the name of the alcohol produced? (1 mark)

(ii) State whether the alcohol is a primary, secondary or tertiary alcohol. (1 mark)

(iii) Write the name of the alkene used. (1 mark)

(iv) Is the alkene a saturated hydrocarbon or an unsaturated hydrocarbon? (1 mark)

B. Draw the structural formulae for the following compounds. (3 marks)

(i) 2-methyl-2-butanol (ii) 2,2-dimethyl-3-heptene (iii) 4-methylpent-1-yne

QUESTION 35

A. Draw outer electron shell diagrams to represent the bonding in the following substances. (3 marks)

(i) Magnesium metal atoms (ii) Methane, CH_4 (iii) Sodium chloride, NaCl

B. What happens when you heat an ionic compound excessively? (1 mark)

C. Diamond and graphites are 'allotropes' of carbon.

(i) Explain what the term 'allotropes' mean. (1 mark)

(ii) Explain why graphite is soft and used for the 'lead' in pencils. (1 mark)

(iii) Explain why diamonds are hard and used in cutting tools. (1 mark)

QUESTION 36

A. Write a balanced equation for the reactions of each of the following: (3 marks)

(i) Aluminium and sulphur (ii) Aluminium and oxygen (iii) Aluminium and iodine

B. In potassium sulphate (K_2SO_4), what is the oxidation number of sulphur? (2 marks)

C. An acid-base reaction between aqueous orthophosphoric acid (H_3PO_4) and aqueous sodium hydroxide (NaOH) is given below.

$$H_3PO_{4(aq)} + NaOH_{(aq)} \longrightarrow Na_3PO_{4(aq)} + H_2O_{(l)}$$

This reaction proceeds in 3 steps before it is completed. Show the first 2 steps. (2 marks)

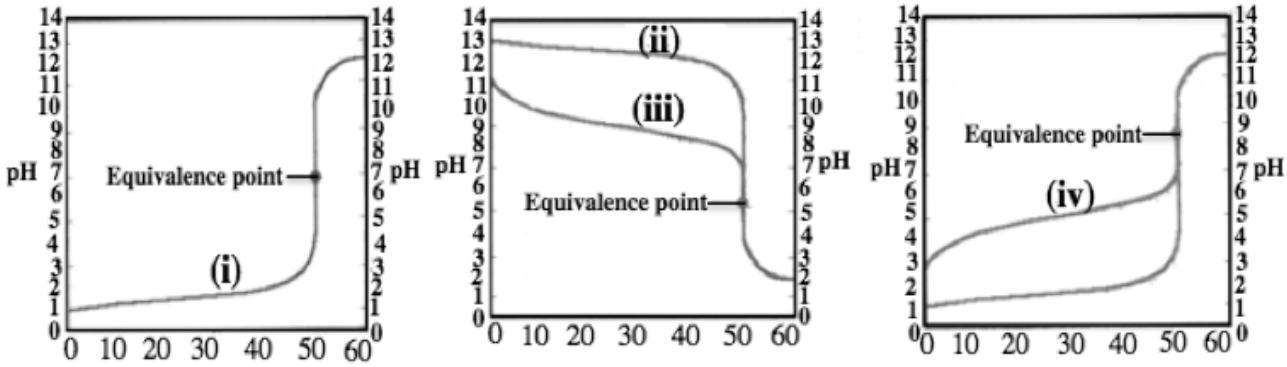
QUESTION 37

A. Titration curves are plotted by monitoring pH (using a pH meter) during titration of an acid or a base (in a flask) against an acid or a base (in a burette).

Choose the most appropriate label from the list below for each of the titration curves labelled (i), (ii), (iii) and (iv). For example, in case of a strong acid in a flask against a weak base in a burette it should be labelled as strong acid versus weak base. (4 marks)

List Of Labels

Strong acid versus strong base; Strong acid versus weak base; Weak acid versus strong base; Weak acid versus weak base; Strong base versus strong acid; Strong base versus weak acid; Weak base versus strong acid; Weak base versus weak acid.



B. What is the pH of a 0.004 M HCl solution? (1 mark)

C. What is the concentration of a solution of HCl of which 25 mL would be needed to neutralize 12.5 mL of 4.0 M NaOH solution? (2 marks)

QUESTION 38

A. The first step in the refining of oil after desalting the crude oil is fractional distillation, which is carried out to separate the components of crude oil.

Name 3 such components separated during petroleum refining. (3 marks)

B. The process used to bring about thermal decomposition of the higher boiling components is called cracking. The concept behind cracking is the thermal decomposition.

What is the aim of cracking? (1 mark)

C. In petroleum refining, what is the operation somewhat opposite to cracking? (1 mark)

D. Name two disadvantages of plastic products. (2 marks)

QUESTION 39

The table below shows some common alloys with their particular properties and the percentage composition of the elements they contain.

ALLOY	PARTICULAR PROPERTIES	CONTAINS	
.....i.....	Resist Corrosion	Iron Chromium Nickel	74% 18% 8%
Brass	Easy to work; Resistant to corrosion	Copper Zinc	60-70% 30-40%
.....ii.....	Harder than brass	Copper Tin	70-90% 10-30%
Solder	Low melting point; Strong	Lead Tin	60% 40%

A. (i) Steel is an alloy of iron and carbon. However, the presence of carbon in steel affects the tendency of steel to corrode. To improve resistance to corrosion, steel is alloyed with chromium and nickel.

What is the new alloy called? (2 marks)

(ii) An alloy of copper and tin is called _____. (1 mark)

B. Brass is an alloy that can be used to produce cheap jewellery or screws & bolts depending on its strength. Cheap jewelleries are made when the alloy is weak and screws & bolts are made when the alloy is strong.

Which element is responsible for the strength of brass? (1 mark)

C. An alloy of 60% lead and 40% tin is called solder and it is used to connect metal wires in electrical and electronic work.

Explain its advantage to this work. (2 marks)

D. Name one alloy not listed nor described above. (1 mark)

QUESTION 40

A. Sodium metal is obtained by the electrolysis of molten sodium chloride.

Write the reactions at the cathode and the anode. (2 marks)

B. Calculate E° (standard cell potential) of the following cell. (2 marks)

$Zn_{(s)} / Zn^{2+}_{(aq)} || Cu^{2+}_{(aq)} / Cu_{(s)}$

Electrode Potentials

$Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn_{(s)} \quad E^\circ = -0.76V$

$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)} \quad E^\circ = +0.34V$

C. 4.0 M copper (II) chloride was electrolysed using carbon electrodes.

(i) Write the cathode reaction. (1 mark)

(ii) Which ions will move to the cathode? (1 mark)

(iii) Which ion is discharged at the cathode? (1 mark)

END OF EXAMINATION

CHEMISTRY — 2012

SECTION B - ANSWER BOOKLET

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

Year		Province		School			Candidate No		
1	2								

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

	Score	Markers Initials	
		M1	**M2**
Section B:			
Question 31			
Question 32			
Question 33			
Question 34			
Question 35			
Question 36			
Question 37			
Question 38			
Question 39			
Question 40			
FINAL TOTAL			

Section B: Answer Booklet

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

QUESTION 31

A	(i)	_____	1
	(ii)	_____	1
	(iii)	_____	1
	(iv)	_____	1
B	(i)	_____	1
	(ii)	_____	1
	(iii)	_____	1
	For Markers Use Only	**Q31 Total**	

QUESTION 32

A

Ans:_____ 2

B

Ans:_____ 2

C

Ans:_____ 3

For Markers Use Only **Q32 Total**

QUESTION 33

A

Ans:_____ 2

B

Ans:_____ 2

C

Ans:_____ 3

For Markers Use Only **Q33 Total**

QUESTION 34

A (i) _____ 1

(ii) _____ 1

(iii) _____ 1

(iv) _____ 1

B (i) 1

(ii) 1

(iii) 1

For Markers Use Only	**Q34 Total**	

QUESTION 35

A (i) 1

(ii) 1

(iii)

1

B

1

C (i)

1

(ii)

1

(iii)

1

For Markers Use Only **Q35 Total**

QUESTION 36

A (i)

1

(ii)

1

(iii)

1

B

Ans:_____ 2

C (i) 1

(ii) 1

For Markers Use Only **Q36 Total**

QUESTION 37

A (i) _____ 1

(ii) _____ 1

(iii) _____ 1

(iv) _____ 1

B

Ans:_____ 1

C

Ans:_____ 2

For Markers Use Only **Q37 Total**

QUESTION 38

A (i) _____ 1

(ii) _____ 1

(iii) _____ 1

B _____ 1

_____

C _____ 1

D (i) _____ 1

(ii) _____ 1

For Markers Use Only **Q38 Total**

QUESTION 39

A (i) _____ _____ 2

(ii) _____ 1

B _____ 1

C _____

_____

_____ 2

D _____ 1

For Markers Use Only **Q39 Total**

QUESTION 40

A (i) Cathode Reaction: _____ 1

(ii) Anode Reaction: _____ 1

B

Ans:_____ 2

C (i) Cathode Reaction: _____ 1

(ii) _____ 1

(iii) _____ 1

For Markers Use Only **Q40 Total**

CHEMISTRY DATA SHEET

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

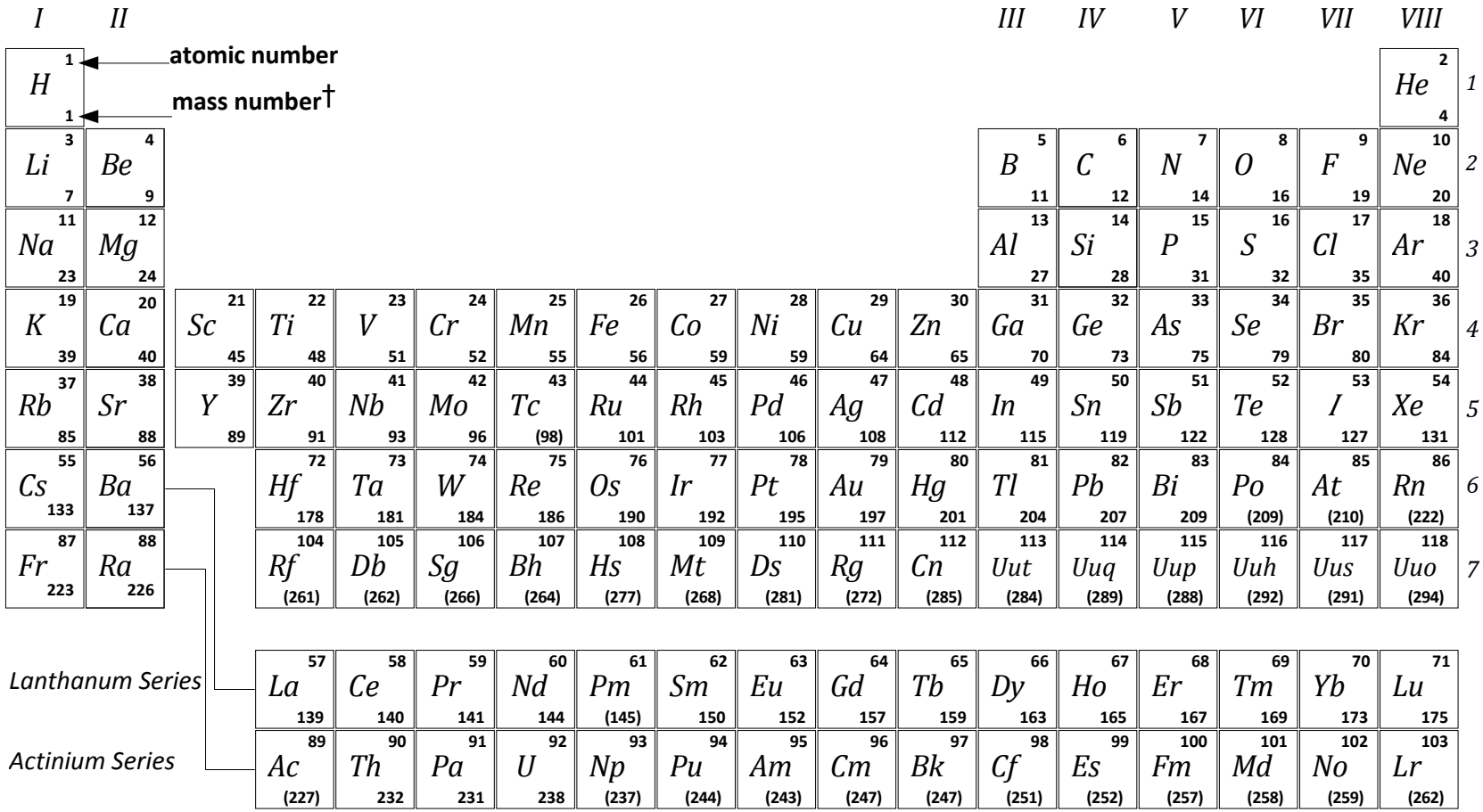
FORMULAE OF COMMON IONS	
Positive	**Negative**
Ag^{+}	Br^{-}
Al^{3+}	Cl^{-}
Ca^{2+}	CO_3^{2-}
Cu^{2+}	HCO_3^{-}
Fe^{2+}	HSO_4^{-}
Fe^{3+}	I^{-}
H^{+}	NO_3^{-}
K^{+}	O^{2-}
Li^{+}	OH^{-}
Mg^{2+}	S^{2-}
Na^{+}	SO_3^{2-}
NH_4^{+}	SO_4^{2-}
Pb^{2+}	PO_4^{3-}
Zn^{2+}	HPO_4^{3-}
Ba^{2+}	H_2PO^4

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