Preparatory Chemistry
EXAMINATION

Reading time: 10 minutes
Writing time: 90 minutes

Your name: _____

Instructions:

1. The student is provided with (**a**) this examination paper; (**b**) answer sheet for Section A; and, (**c**) a data sheet.

2. Answers to Section A should be entered on the separate answer sheet.

3. All answers to Section B questions are to be written on the examination paper.

4. If you run out of room, or need to start your answer again, you may use the back of a page. Clearly indicate where this occurs.

5. Write your answers clearly.

6. You will not be permitted to leave the examination room until the scheduled completion of the exam.

7. Calculators are permitted.

ANSWER SHEET PART A:
        NAME_____

1.	A	B	C	D	**16.**	A	B	C	D
2.	A	B	C	D	**17.**	A	B	C	D
3.	A	B	C	D	**18.**	A	B	C	D
4.	A	B	C	D	**19.**	A	B	C	D
5.	A	B	C	D	**20.**	A	B	C	D
6.	A	B	C	D	**21.**	A	B	C	D
7.	A	B	C	D	**22.**	A	B	C	D
8.	A	B	C	D	**23.**	A	B	C	D
9.	A	B	C	D	**24.**	A	B	C	D
10.	A	B	C	D	**25.**	A	B	C	D
11.	A	B	C	D	**26.**	A	B	C	D
12.	A	B	C	D	**27.**	A	B	C	D
13.	A	B	C	D	**28.**	A	B	C	D
14.	A	B	C	D	**29.**	A	B	C	D
15.	A	B	C	D	**30.**	A	B	C	D

Section A

Questions in Section A are worth one mark each. No penalty is applied for incorrect answers so it is advisable to answer every question. Aim to spend around 30– 40 mins. on this section.

If time permits, check your answers carefully after having completed the paper.

Question 1

Which element is in the group II of the third period of the periodic table?

    (a)   Beryllium
    (b)   Magnesium
    (c)   Carbon
    (d)   Boron

Question 2

Two solutions were mixed and a precipitate formed. A student collected the precipitate by:

    (a)   distillation.
    (b)   filtration
    (c)   evaporation
    (d)   both distillation or filtration

Question 3

A precipitate is best defined as :
    (a)   a white solid formed by the mixing of two solutions..
    (b)   a coloured solid formed by the mixing of two solutions
    (c)   an insoluble solid formed by the mixing of two solutions.
    (d)   a coloured solid that is found in water.

Question 4

Calcium carbonate is mined. What is the percentage of calcium in calcium carbonate?

    (a)   100%
    (b)   40%
    (c)   60%
    (d)   None of the above.

Question 5

Sodium and potassium are found in group 1 of the periodic table but in different periods. They are expected to have

    (a)   different chemical properties.

    (b)   same atomic radius.

    (c)   same atomic mass.

    (d)   one valence electron.

Element	Number of electrons	Number of protons	Number of neutrons
A	36	34	
B	18		18
C		36	47
D	26	28	

Question 6

Which of the above elements is a 2^+ cation?
- (a) A
- (b) B
- (c) C
- (d) D

Question 7

Which of the above elements is a noble gas?
- (a) A
- (b) B
- (c) C
- (d) D

Question 8

Element B is a 1^- anion. What is the name of this element?
- (a) Phosphorous
- (b) Sulfur
- (c) Chlorine
- (d) Argon

Question 9

What is the charge on the ion represented by element A?
- (a) 2^-
- (b) 1^-
- (c) 1^+
- (d) 2^+

Question 10

What is element C?
- (a) Fe
- (b) Ni
- (c) Kr
- (d) Si

Question 11

What is the molar mass(formula mass) of element D?
- (a) 26 g/mol
- (b) 28 g/mol
- (c) 54 g/mol
- (d) 59 g/mol

3

Question 12

Which statement below accurately describes Avogadro's number (N_A)?

    (a)   The number of atoms present in a 12 g sample of pure carbon.

    (b)   The number of atoms present in one litre of oxygen gas.

    (c)   The estimated number of atoms present within the universe.

    (d)   The estimated number of hydrogen atoms present within the sun.

Question 13

In chemical equations, letters in brackets are often used after the name of a compound. For example,

$$Na_2CO_3(s) + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O(l) + CO_2(g)$$

What do the letters *s*, *l* and *g* represent?

    (a)   They indicate what chemicals will react with one another.

    (b)   They indicate the states of matter that each compound is present as.

    (c)   They represent whether compounds are metals or non-metals.

    (d)   They represent unique letters that correspond to trends in the periodic table.

Question 14

An experiment on a compound finds that the compound has a formula mass of 18 g/mol. Further investigation reveals that this compound is composed of oxygen and one other element. What is the chemical formula of this compound?

    (a) H_2O
    (b) CuO
    (c) MnO_2
    (d) CO_2

Question 15

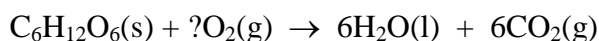When cations and anions are created, which subatomic particle is either removed or added?

    (a)   Proton
    (b)   Neutron
    (c)   Electron
    (d)   Nucleus

Question 16

Consider the following reaction. What number needs to be placed in front of the $O_2(g)$ to balance this equation?

$$C_6H_{12}O_6(s) + ?O_2(g) \rightarrow 6H_2O(l) + 6CO_2(g)$$

    (a)   1
    (b)   2
    (c)   4
    (d)   6

One aspect of cooking relies on chemicals in the kitchen that react and produce carbon dioxide. In fact, it is the production of carbon dioxide in cooking bread that is responsible for the bubbles that occur inside it.

One reaction that produces carbon dioxide is between vinegar and sodium hydrogen carbonate (which is known as "bicarb of soda" in the kitchen). In this reaction, acetic acid (vinegar) and sodium hydrogen carbonate react to produce water, carbon dioxide and sodium acetate. This is described by the balanced chemical equation below.

$$NaHCO_3(s) + CH_3COOH(aq) \rightarrow H_2O(l) + CO_2(g) + CH_3COONa(aq)$$
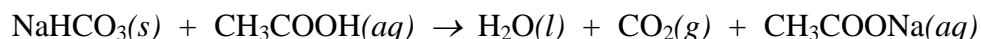
Question 17

How many moles of sodium hydrogen carbonate are required to produce a 0.5 mol of carbon dioxide?
   (a)   0.25
   (b)   0.5
   (c)   1
   (d)   2

Question 18

What is the formula mass of sodium acetate?
   (a)   60
   (b)   82
   (c)   84
   (d)   44

Question 19

How many atoms would be present in **two molecules** of acetic acid?
   (a)   16
   (b)   12
   (c)   8
   (d)   6

Question 20

Given the above formula for sodium acetate, what would the predicted formula for calcium acetate to be?
   (a) $Ca(HCO_3)_2$
   (b) CH_3COOCa
   (c) $(CH_3COO)_2Ca$
   (d) $(CH_3COOH)_2Ca$

Question 21

The mass number for an element gives:
   A   the number of electrons and protons
   B   the weight of the atom
   C   the number of neutrons
   D   the sum of neutrons and protons

Question 22

In the Periodic Table, elements which have the same number of outer shell electrons are found in

A   Horizontal rows called Groups
B   Horizontal rows called Periods
C   Vertical columns called Groups
D   Vertical columns called Periods.

Question 23

Choose from the following, the alternatives that contain species all of which have the same number of electrons in the outer shell: Li^+, Mg^{2+}, Al^{3+}, K^+, Ne

A Li^+, Al^{3+}
B K^+, Mg^{2+}, Ne
C Mg^{2+}, Al^{3+}
D K^+, Li^+

Question 24

Rutherford's gold leaf experiment revealed that the

A   volume of the atom is mainly space with most of its mass located in the small nucleus
B   neutron has a neutral charge
C   neutron has a negative charge
D   presence of protons in the nucleus

Question 25

Isotopes are:
A   elements with the same number of protons and neutrons
B   elements that are radioactive
C   elements with the same atomic number but different mass number
D   elements that have the same number of protons, electrons and neutrons

Question 26

The element with atomic number 7 is likely to have similar chemical properties to the element with atomic number

A   9
B   2
C   15
D   17

Question 27

The atomic number of boron is 5 and its mass number is 11. The number of protons is therefore

A   2
B   3
C   5
D   11

Question 28

Covalent bonding results from:
A   a sharing of electrons between non-metal atoms
B   a transfer of electrons from metal atoms to non-metal atoms
C   a sharing of electrons between metal atoms
D   a transfer of electrons between non-metal atoms

Question 29

The rate of reaction depends on:
        1   *concentration of reactants*
        2   *concentration of products*
        3   *the temperature*

A   1 only
B   1 and 2 only
C   2 and 3 only
D   1 and 3 only

Question 30

When a solution of calcium nitrate is mixed with a solution of sodium carbonate a whoite solid is formed. Which comment below is true?
A   The solid is nitrate carbonate with a formula NO_3Na
B   The solid is calcium nitrate with a formula of Na_2CO_3
C   The solid is calcium carbonate with a formula of $CaCO_3$
D   The solid is pure calcium metal.

In Section B there are a total of 70 marks. Aim to spend around 50 mins. on this section.

Question 1

Draw a diagrammatic representation of an atom. Include at least two energy shells. Clearly label the following on your diagram.   *(5 marks)*

     (a)   Proton and its charge (if any).
     (b)   Electron and its charge (if any).
     (c)   Neutron and its charge (if any)
     (d)   Electron shells
     (e)   Nucleus
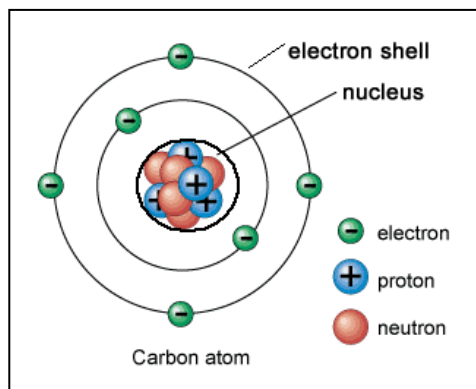
Question 2

Name the following compounds.   *(5 marks)*

(a) Li_2O lithium oxide

(b) $MgCO_3$ magnesium carbonate

(c) NH_4NO_3 ammonium nitrate

(d) $Ca(HSO_4)_2$ calcium hydrogen sulfate

(e) $NaHCO_3$ sodium hydrogen carbonate

Question 3

Write the chemical formulae for the following compounds.   *(5 marks)*

(a)   Calcium bromide $CaBr_2$ ....

(b)   Lithium sulfate Li_2SO_4 ....

(c)   Barium phosphate $Ba_3(PO_4)_2$..

(d)   Hydrogen iodide HI…………………………………………………………………….

(e)   Carbon monoxide CO …………………………………………………………………..

Question 4

Balance the following chemical equations. *(10 marks)*

(a) H_2SO_4 + $C_6H_{12}O_6$ → 6C + $6H_2O$ + H_2SO_4

(b) $Ba(NO_3)_2$ + $(NH_4)_2SO_4$ → $BaSO_4$ + $2NH_4NO_3$

(c) C_7H_{16} + $18O_2$ → $7CO_2$ + $8H_2O$

(d) $MgCl_2$ + $2AgNO_3$ → $2AgCl$ + $Mg(NO_3)_2$

(e) CH_3COOH + Na_2CO_3 → CO_2 + H_2O + CH_3COONa
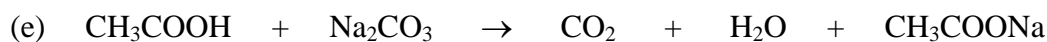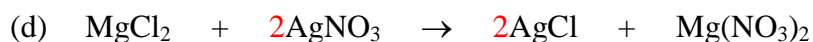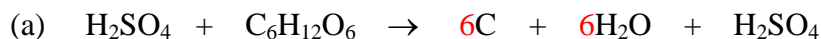
Question 5

What are the masses of the following elements. *(6 marks)*

(a) 2 mol of iron atoms $2 \times 55.8 = 111.6$ g ....

(b) 6.02×10^{23} tin atoms 118.7 g..

(c) 3.01×10^{23} sodium atoms $0.5 \times 23 = 11.5$g ....

(d) 3 mol of potassium atoms $3 \times 39.1 = 117.3$g..

(e) 1.806×10^{23} sodium atoms $0.3 \times 23 = 6.9$ g ....

(f) One argon atom $39.9 / 6.02 \times 10^{23} = 6.63 \times 10^{-23}$ g...

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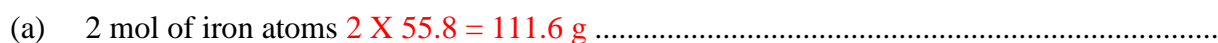
Question 6

A mining company discovered a deposit of hydrated copper sulphate ($CuSO_4.5H_2O$). A geologist estimated that approximately 100,000 kg of this ore is present in this deposit.

(a) Calculate the percentage of copper in hydrated copper sulphate

Step 1 Calculate the formula mass of $CuSO_4.5H_2O$
=> 63.55 (Cu) + **32.07** (S) + 4 × 16.00 (O) + 5 × [2 × 1.01 (H) + 16.00 (O)] = **249.7**

Step 2 Find the percentage of copper
=> (63.5 / 249.7) X 100 = 25.43%

(b) Calculate the percentage of water in hydrated copper sulphate

Find the percentage of water
=> (5 X 90 / 249.7) X 100 = 36.04%

(c) What is the amount of water present, in kg, in 100,000 kg of hydrated copper sulphate?

(36.04% /100) X 100,000 = 36,040 kg

(d) What mass, in kg, of copper could be recovered from the mine?

(25.43% /100) X 100,000 = 25,430 kg

(e) Another mine, nearby, was found with copper carbonate deposits ($CuCO_3$). The amount of copper carbonate was also 100,000 kg. Which deposit yields the most copper per ton of ore? Show all calculations

Calculate the amount of copper that can be recovered from the copper carbonate deposit.

Step 1 calculate the percentage of copper in $CuCO_3$
=> Formula mass of $CuCO_3$ = 63.55 (Cu) + 12.0(C) + 3 X 16.0 (O) = 123.55

Step 2 Find the percentage composition of Cu
=> (63.55 / 123.55) 100 = 51.4%

Step 3 compare the two mines.
For 100,00 kilograms of ore hydrated copper sulphate will produce 25,40 kg of copper.
For the same amount of ore the $CuCO_3$ will produce 51,400 kg of copper.

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Question 7

Using the idea of particles, explain why:

a)   a solid expands when it is heated

(2marks)

As the particles are heated they gain more kinetic energy and vibrate more vigorously thus taking up more space in the solid.

b)   a gas, but not a solid, can be compressed into a smaller volume.

(2marks)

Particles of a gas have a great deal of space between them and so can be compressed so that they occupy the space that surrounds them.

Question 8

Draw a diagram to show the electron transfer when calcium and chlorine react to form calcium chloride .

(4 marks)

2,8,8,2

Calcium has two outer shell electrons, the outer shell is incomplete so not stable therefore these two electrons are transferred to another atom, forming a stable calcium ion with a charge of 2+

Chlorine has an outer shell of seven electrons. To get a full outer shell one electron each is gained by two chlorine atoms forming 2 chloride ions with a single negative charge

2,8,7

the formula of calcium chloride is $CaCl_2$

Question 9

The reaction between a fixed quantity of marble chips (calcium carbonate) and hydrochloric acid produces carbon dioxide gas.

Calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide
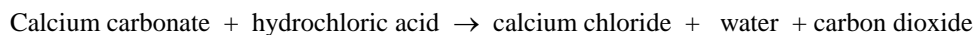
The table below shows the results of a practical investigation involving marble chips and hydrochloric acid. *(TOTAL 5 marks)*

| Time /minutes | Mass of gas (g) | |
| | Experiment 1 | Experiment 2 |
	15°C	30°C
0	0.00	0.00
1	0.07	0.14
2	0.12	0.23
4	0.23	0.33
6	0.30	0.41
8	0.35	0.43
10	0.39	0.44
12	0.41	0.44
14	0.43	0.44
16	0.44	0.44

a)   How many grams of gas is produced during the first minute in experiment 1?

(1 mark)

b)   How long does the reaction in experiment 2 take to stop?

(1mark)

c)   What conclusion can you draw from this experiment about the rate of reaction?

(1mark)

d)   What experimental condition was kept constant?

(1 mark)

e)   Graph the results using the graph paper provided in the exam paper. Label all axis and label the graph.

(3 marks)

Question 10

When hydrochloric acid reacts with zinc metal, hydrogen gas and zinc chloride are produced. The formulae for these substances are HCl, H_2, Zn, and $ZnCl_2$. *(TOTAL = 10 marks)*

(a) Name the reactants in this reaction? *(1 mark)*

HCl and Zn...

(b) Write a **balanced** chemical equation for the reaction between zinc and hydrochloric acid using the given chemical formulae. *(2 marks)*

$$2HCl + Zn => ZnCl_2 + H_2$$

....

(c) From the balanced chemical equation, how many moles of zinc are required to produce each mole of H_2 gas? *(1 mark)*

One...

....

(d) What is the molar mass of zinc in g/mol? *(1 mark)*

65.4...

(e) Write down the formula used to calculate the number of moles present in a given mass? *(1 mark)*

Mol = mass / molar mass ....

(f) Calculate the number of moles present in 20g of zinc? *(1 mark)*

20 / 65.4 = 0.31 ....

....

(g) Using the number of moles calculated in part (f) along with the relationship determined in part (c), calculate the number of moles of hydrogen gas produced when all 20g of zinc have reacted. *(1 mark)*

0.31...

....

(h) Write down the formula used to convert moles into mass. *(1 mark)*

Mass = mol X molar mass ....

(i) Calculate the mass of H_2 gas that will have been produced when 20g of zinc have fully reacted with hydrochloric acid. *(1 mark)*

Mass = 0.31 X 2 = 0.62 grams

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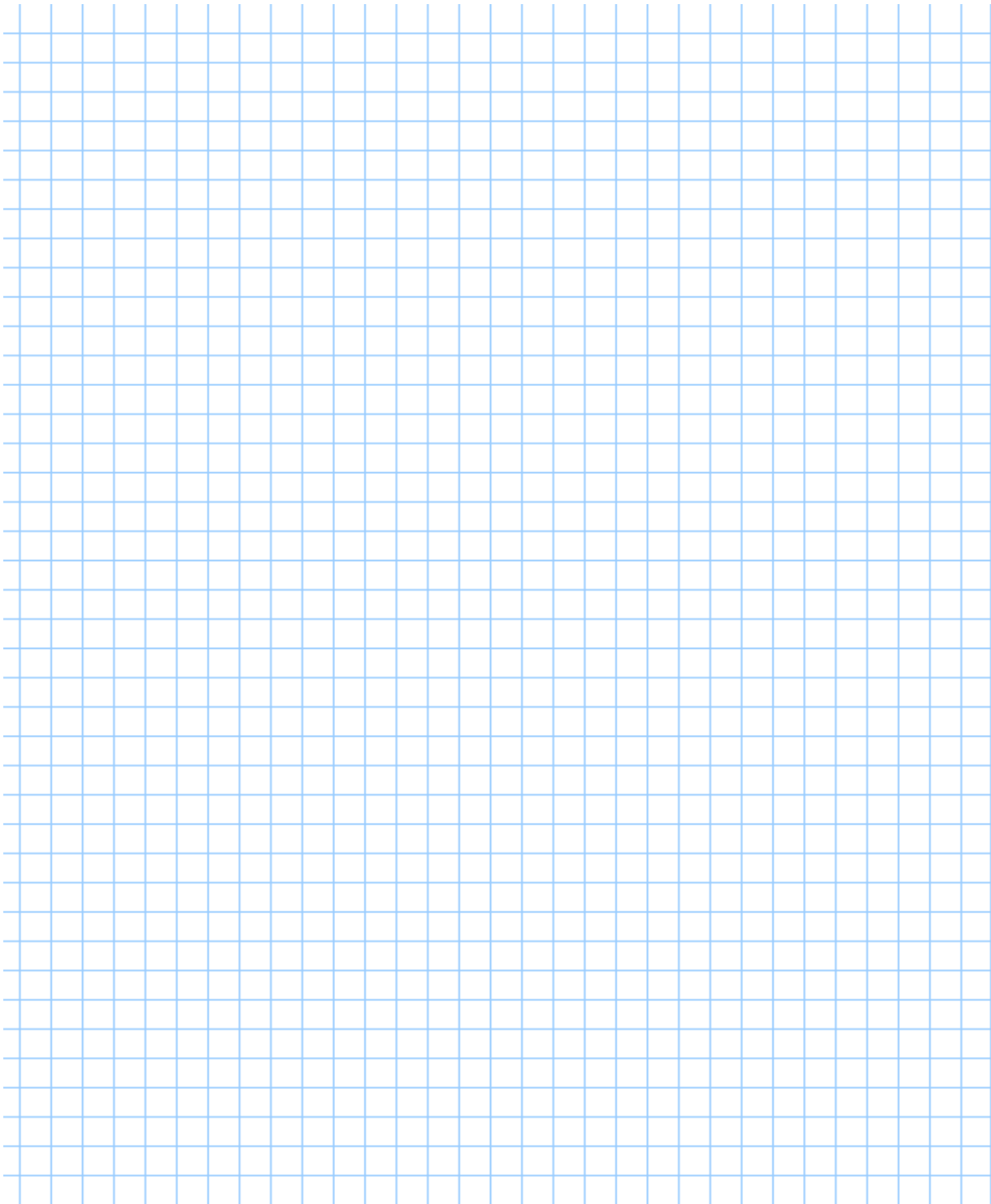
Charge of 1+	Charge of 2+	Charge of 3+
Ammonium(NH_4^+)	Magnesium(Mg^{2+})	Aluminium(Al^{3+})
Hydrogen(H^+)	Calcium(Ca^{2+})	Chromium(Cr^{3+})
Lithium(Li^+)	Barium(Ba^{2+})	Iron(III)(Fe^{3+})
Sodium(Na^+)	Zinc(Zn^{2+})	
Potassium(K^+)	Copper(II)(Cu^{2+})	
Silver(Ag^+)	Mercury(Hg^{2+})	
Copper(Cu^+)	Iron(II)(Fe^{2+})	
	Nickel(Ni^{2+})	
	Tin(II)(Sn^{2+})	
	Lead(II)(Pb^{2+})	
Charge of 1-	Charge of 2-	Charge of 3-
Hydroxide(OH^{-1})	Oxide(O^{-2})	Nitride(N^{-3})
Hydrogen sulfide(HS^{-1})	Sulfide(S^{-2})	Phosphate(PO_4^{-3})
Nitrite(NO_2^{-1})	Sulfate(SO_4^{-2})	
Nitrate(NO_3^{-1})	Sulfite(SO_3^{-2})	
Acetate(CH_3COO^{-1})	Carbonate(CO_3^{-2})	
Fluoride(F^{-1})	Dichromate($Cr_2O_7^{-2}$)	
Chloride(Cl^{-1})		
Bromide(Br^{-1}))		
Iodide(I^{-1})		
Permanganate(MnO_4^{-1})		

The Periodic Table
Of The Elements

I 1	II 2	3	4	5	6	7	8	9	10	11	12	III 13	IV 14	V 15	VI 16	VII 17	VIII 18
1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.71	29 **Cu** 63.54	30 **Zn** 65.37	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.91	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.4	47 **Ag** 107.87	48 **Cd** 112.40	49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
55 **Cs** 132.91	56 **Ba** 137.34	57 **La*** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.09	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.37	82 **Pb** 207.19	83 **Bi** 208.98	84 **Po** (210)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac**** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Uun** (269)	111 **Uuu** (272)	112 **Uub** (277)						