**Unit II**

**Atomic Theory**

**Worksheets**

**Lesson            Date                Topic                                                                                      WS #**

[1.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/1.atomictheory.ppt)                                             Early Atomic Theory                                                              [1](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws1)

[2.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/2.atomictheory.ppt)                                             Bohr Evidence                                                                        [2](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws2)

[3.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/3.bohrdiagrams.ppt)                                             Bohr Diagrams                                                                        [3](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws3)

[4.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/4.quantumorbitals.ppt)                                             Quantum Theory                                                                      [4](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws4)

[5.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/5.massspectrometers.ppt)                                             Mass Spectrometer/ Elegant Universe-1                                 [5](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws5)

[6.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/6.classifyingmatterlab.ppt)                                             Elegant Universe-2/Periodic Chem                                         [6](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws6)

[7.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/7.periodicchemistry.ppt)                                             Ionic Theory                                                                            [7](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws7)

8.                                             Classifying Matter Lab                                                            [8](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws8)

[9.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/8.nomenclature.ppt)                                             Classifying and Naming Formulas 1                                        [9](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws9)

10.                                           Classifying and Naming Formulas 2                                       [10](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws10)

[11.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/10.%20Electron%20Dot.ppt)                                           Electron Dot Diagram Structural Formula 1                           [11](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws11)

[12.](http://iannonechem.com/Mark/My%20Documents/MarksStuff/Projects/chem11notes/atomictheory/11.PolyatomicLewisDiagrams.ppt)                                           Electron Dot Diagram 2                                                          [12](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws12)

13.                                           Practice Test 1                                                                        [13](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws13)

14.                                           Practice Test 2                                                                        [14](http://iannonechem.com/Sc/workbookanswers/3.answers.htm#ws14)

15.                                           Test

**Worksheet # 1               Early Atomic Theory**

Briefly describe each atomic theory listed below.  Include a diagram.

1.       The Four-Element Theory

              The Four Element Theory

          (a) evidence                                                 (b) explanation within theory

          **No evidence                                                Nonscientific Theory**

2.       Dalton’s Atomic Theory

          (a) Evidence                                                         (b) Explanation within theory

**Conservation of mass                                          Atoms are indestructible**

**Law of Constant composition                             Elements combine in simple ratios**

3.       The Thompson Atom

          (a) Evidence                                                         (b) Explanation within theory

**Electrical Nature of Matter                                Positive and negative particles**

**Worksheet # 2               Early Atomic Theory**

1.       The Rutherford Atom

          (a) Evidence                                                         (b) Explanation within theory

**A few alphas are radically deflected                   Small dense nucleus**

**Most alphas are not deflected                             Most of atom is empty space**

2.       The Bohr Atom

          The Bohr Atom

          (a) evidence                                                 (b) explanation within theory

          **Line spectrum of discharge tubes             Electrons are in orbitals**

**Worksheet # 3               Bohr Diagram**

Draw Bohr atomic diagrams for the following atoms.  Be sure to include protons, neutrons and electrons.

1.       Oxygen                                    7.       Calcium

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2.       Silver                                       8.       Barium

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3.       Cs                                            9.       I



4.       Na                                                     10.     V

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5.       Cl-                                                     11.     Al3+

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6. Se2-                                                     12.     Ca2+

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**Worksheet #4                Quantum Mechanics**

1.       What is the main difference between the Bohr Theory of the atom and the Quantum Mechanical Theory?

          **Electrons are waves in Quantum Theory and particles in the Bohr Theory.**

2.       How many electrons will fill the smallest orbital in quantum mechanical theory?

          **Two**

3.       How is a 3s orbital different than a 2s orbital in terms of shape and distance from the nucleus?

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          **They are both spherical in shape but the 3s is further from the nucleus.**

4.       Explain what happens to the energy when an electron falls from a 3s orbital to a 2s orbital.

          **Energy is emitted in the form of a photon of light with energy corresponding to the difference between the two     orbitals.**

Use your Quantum Periodic Table to write quantum electron configurations for each element below.

5.       F       **1s22s22p5**

6.       K       **1s22s22p63s23p64s1**

7.       C       **1s22s22p2**

8.       Kr     **1s22s22p63s23p63d104s24p6**

9.       S       **1s22s22p63s23p4**

10.     Rb     **1s22s22p63s23p63d104s24p65s1**

11.     Co     **1s22s22p63s23p63d74s2**

12.     P       **1s22s22p63s23p3**

13.     Ca     **1s22s22p63s23p64s2**

14.     Al      **1s22s22p63s23p1**

15.     Ag     **1s22s22p63s23p63d104s24p64d95s2**

16.     1s22s22p63s1                                                                                     **Na**

17.     1s22s22p63s23p5                                                                       **Cl**

18.     1s22s22p63s23p63d94s2                                                             **Cu**

19.     1s22s22p63s23p63d104s24p64d105s25p5                                               **I**

20.     1s22s22p63s23p63d104s24p64d104f145s25p66s2                                   **Ba**

21.             Give the formula of four chemical species that are isoelectronic (same electron configuration) as Ar.

**S2-               P3-Cl-               K+Ca2+**

**Worksheet # 5               Mass Spectrometry**

Calculate the average atomic mass for each element.  Round off to the correct number of sig figs.  Write down the atomic mass from the periodic table rounded off to the same number of sig figs.

Isotope       Mass                    % Abundance                Average Mass                Atomic Mass (table)

1.

14N              14.0030744           99.6340                        **14.0067 amu                 14.0067 amu**

15N              15.000108            0.366001

**0.996340(14.0030744)  +  0.00366001(15.000108)  =  14.0067 amu**

2.

20Ne            19.992404            90.92                             **20.2 amu**                       **20.1798 amu**

21Ne            20.993849            0.257

22Ne            21.991385            8.82

          **0.9092(19.992404)  +  0.00257(20.993849)  +  0.0882(21.991385)  =  20.2 amu**

3.

46Ti             45.952633            7.93                               **47.9 amu             47.90 amu**

47Ti             46.95176              7.28

48Ti             47.947948            73.94

49Ti             48.947867            5.51

50Ti             49.944789            5.34

          **You will lose marks if you don’t show the work!**

4.

54Fe             53.93962    5.8202                                     **55.847 amu                   55.845 amu**

56Fe             55.93493    91.660

57Fe             56.93539    2.1901

58Fe             57.93327    0.33001

**You will lose marks if you don’t show the work!**

 5.      Silver has two common isotopes. One is 106.90508 amu and 51.35 % and the other is 48.65 %.  If the average atomic mass is 107.9730 amu, what is the atomic mass of the other isotope?

**106.90508 (.5135) +  X  (0.4865)   =  107.9730 amu**

**NOW SOLVE FOR X**

**109.1 amu**

6.                 Copper has two common isotopes. One is 62.92959 amu and 69.09 % and the other is 30.91 %.  If the average atomic mass is 63.5472 amu, what is the atomic mass of the otherisotope.

**62.92959 (.6909) +  X  (0.3091)   =  63.5472 amu**

**NOW SOLVE FOR X**

**64.92 amu**

7.       Complete the chart below.

|  |  |  |  |
| --- | --- | --- | --- |
|   | protons | electrons | neutrons |
| 28Si | **14** | **14** | **14** |
| 29Si | **14** | **14** | **15** |
| 30Si | **14** | **14** | **16** |

8.       Write a quantum electron configuration for each of the following.

          a) Ne                    **1s22s22p6**

          b) Mg

          c) Ti            **1s22s22p63s23p63d24s2**

          d) Cr

          e) Sr            **1s22s22p63s23p63d104s24p65s2**

          f) Ag

          g) Br           **1s22s22p63s23p63d104s24p5**

9.       What was the first atomic theory to account for the Law of Conservation of Mass?

          Explain how the theory accomplished this.

          **Dalton.                          Atoms are indestructible.**

10.     What was the first atomic theory to account for electromagnetic radiation (light)?

          Explain how the theory accomplished this.

**Bohr Theory.                Electrons are in orbitals.**

11.     What was the first atomic theory to account for the small, dense nucleus?

          Explain how the theory accomplished this.

          **Rutherford Atom.        A few alpha particles were radically deflected.**

12.     What was the first atomic theory to have a wave theory for the electron?

          Explain how the theory accomplished this.

          **Quantum Theory.        Electrons vibrate around the nucleus in 3 dimensional wavelike orbitals.**

13.     What was the first atomic theory to account for positive and negative charges in matter?  Explain how the theory           accomplished this.

          **Thomson Atom. The matter in the atom was positive with negative particles throughout.**

**Worksheet # 6               Periodic Chemistry**

1.       Define the following:

a)       Oxidation                **Loss of electrons**

b)      Reduction             **Gain of electrons**

c)       Anion                     **Negative ion**

d)      Cation                  **Positive ion**

**e)       Atom                     Neutral particle of an element**

f)       Chemical family     **Column on Periodic Table**

g)       Period                   **Row on Periodic Table**

2.       Why are noble gases stable?    **Full outer or valence shells**

3.       Why are non-noble gases un-stable or reactive?  **Incomplete outer or valence shells**

4.       Draw Bohr diagrams for the following chemical species.

a)       He                                            b)      K

c)       K+                                            d)      S2-

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e)       P3-                                            f)       Li+

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5.       Fill in the chart below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| symbol | atom,cation oranion | protons | neutrons | electrons | valence electrons | stable or reactive? |
|  Mg2+ | **cation** | **12** | **12** | **10** | **8** | **stable** |
|  Mg | **atom** | **12** | **12** | **12** | **2** | **unstable** |
|  F | **atom** | **9** | **10** | **9** | **7** | **unstable** |
|  F- |  **anion** | **9** | **10** | **10** | **8** | **stable** |
|  Ne |  **atom** | **10** | **10** | **10** | **8** | **stable** |
|  C |  **atom** | **6** | **6** | **6** | **4** | **unstable** |
|  Be |  **atom** | **4** | **5** | **4** | **2** |  unstable |
|  Be2+ |  **cation** | **4** | **5** | **2** | **2** | **stable** |
|  N3- |  **anion** | **7** | **7** | **10** | **8** | **stable** |

**Worksheet # 7               Ionic Chemistry**

1.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| symbol | atom,cation oranion | protons | neutrons | electrons | valence electrons | stable or reactive? |
|  Ga | **Atom** | **31** | **39** | **31** | **3** | **Reactive** |
|  Ga3+ | **Cation** | **31** | **39** | **28** | **18** | **Stable** |
|  Br | **Atom** | **35** | **45** | **35** | **7** | **Unstable** |
|  Br- | **Anion** | **35** | **45** | **36** | **8** | **Stable** |
|  Kr | **Atom** | **36** | **48** | **36** | **8** | **Stable** |
|  Ca | **Atom** | **20** | **20** | **20** | **2** | **Unstable** |
|  Ca2+ | **Cation** | **20** | **20** | **18** | **8** | **Stable** |
|  P | **Atom** | **15** | **16** | **15** | **5** | **Unstable** |
|  P3- | **Anion** | **15** | **16** | **18** | **8** | **Stable** |

2.       What happens to protons, electrons and neutrons as you move form left to right within a row on the periodic table?

          **Protons, Electrons, and Neutrons all increase.**

3.       Write half-reactions to show how each atom forms an ion. Label each as oxidation     or reduction. The first two are done for you.

a)       **K       →      K+     +       1e-oxidation**

b)      **N2      +       6e-     →      2N3- reduction**

c)       **P**       **+       3e-     →      P3-reduction**

d)      **O2     +       4e-     →      2O2-                   reduction**

e)       **Ca     →      Ca2+    +   2e-                       oxidation**

f)       **Br2****+       2e-     →      2Br-                 reduction**

g)       **I2****+       2e-     →      2I-                  reduction**

h)      **Al      →      Al3+    +   3e-                         oxidation**

i)       **Ba     →      Ba2+    +   2e-                        oxidation**

j)       **Cs     →      Cs+    +       1e-oxidation**

k)      **Mg    →      Mg2+    +   2e-                      oxidation**

l)       **Zn     →      Zn2+    +   2e-                        oxidation**

m)     **Ga     →      Ga3+    +   3e-                       oxidation**

n)      **Cl2****+       2e-     →      2Cl-                  reduction**

o)      **F2****+       2e-     →      2F-                   reduction**

4.       Describe five properties of:

          a) Metals

          **Shiny                   Conductors                   Malleable             Ductile        Lose electrons          Left side of periodic table**

          b) Non-metals

          **Dull            Nonconductors             Brittle                   Gain electrons               Right side of periodic table**

5.       Draw Bohr diagrams for each of the following.

          a) Na                                                 b) Na+

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          c) O                                                   d) O2-

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          e) Ca                                                 f) Ca2+

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**Worksheet # 8**

1.       Complete the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|    |  Salt |  Base |  Acid | Covalent Nonacid |
|  Litmus | **Neutral** | **Blue** | **Red** | **Neutral** |
|  Conductivity | **Good** | **Good** | **Good** | **Non** |

2.       Put each formula into the table below.

Ca(OH)2                         NH4OH                CH3OH                 C12H24O11

HCl                                PI3                        K2SO4                  RbOH

H3PO4                            NaOH                  CaCl2Li2SO4

H2SO3                            BaF2                     BCl5                     CH3COOH

H2CO3                            CsOH                  S2Cl2                     Fr2S

|  |  |  |  |
| --- | --- | --- | --- |
|  Salt |  Base |  Acid |  Covalent Nonacid |
| **K2SO4** | **Ca(OH)2** | **HCl** | **CH3OH** |
| **CaCl2** | **NH4OH** | **H3PO4** | **C12H24O11** |
| **Li2SO4** | **RbOH** | **H2SO3** | **PI3** |
| **BaF2** | **NaOH** | **CH3COOH** | **BCl5** |
| **Fr2S** | **CsOH** | **H2CO3** | **S2Cl2** |

3.       Draw Bohr diagrams for each of the following.

          a) K+                                                           b) P3-

|  |  |  |  |
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4.       Write half-reactions to show how each atom forms an ion. Label each as oxidation or reduction. The first two are done for you.

**a)      Ca     →      Ca2+  +       2e-oxidation**

**b)      O2     +       4e-     →      2O2-reduction**

**c)       I2       +       2e-     →      2I-                    reduction**

**d)      N2      +       6e-     →      2N3-reduction**

**e)       Cs     →      Cs+    +       e-                      oxidation**

**f)       Ba     →      Ba2+  +       2e-                    oxidation**

**g)      Al      →      Al3+   +       3e-                     oxidation**

**h)      F2 +   2e-     →      2F-                             reduction**

**i)       H2     →      2H+      +      2e-                    oxidation**

**j)       Na++   1e-          →   Na(s)reduction**

**k)      N3-     →      N2      +       6e-oxidation**

**l)       Ca2++   2e-→      Ca                          reduction**

**m)     Ba2+** **+   2e-   →      Ba                            reduction**

**Worksheet # 9**

1.       Complete the following table by classifying and naming each compound.

|  |  |  |
| --- | --- | --- |
|  Formula |  Classification |  Name |
| **CuS(s)** | **Salt** | **Copper II sulphide** |
| **H3PO4(s)**  | **covalent nonacid (acids must be aq)** | **Hydrogen phosphate** |
| **P2O5(s)**  | **Nonacid** | **Diphosphorus pentoxide** |
| **NH4OH(s)**  | **Base** | **Ammonium hydroxide** |
| **Al2O3(s)**  | **Salt** | **Aluminum oxide** |
| **MgSO4(s)**  | **Salt** | **Magnesium sulphate** |
| **HCl(g)**  | **covalent nonacid (acids must be aq)** | **Hydrogen chloride** |
| **HCl(aq)**  | **Acid** | **Hydrochloric acid** |
| **H2SO4(l)**  | **covalent nonacid (acids must be aq)** | **Hydrogen sulphate** |
| **H2SO4(aq)**  | **Acid** | **Sulphuric acid** |
| **NI3(s)**  | **Nonacid** | **Nitrogen triiodide** |
| **N3Cl3(s)**  | **Nonacid** | **Trinitrogen trichloride** |
| **CO(g)**  | **Nonacid** | **Carbon monoxide** |
| **K2CrO4(s)**  | **Salt** | **Potassium chromate** |
| **H2Cr2O7(aq)**  | **Acid** | **Dichromic acid** |
| **H2O(l)**  | **Nonacid** | **Water** |
| **CrCO3(s)**  | **Salt** | **Chromium II carbonate** |
| **HBr(g)**  | **covalent nonacid (acids must be aq)** | **Hydrogen bromide** |
| **P3O5(s)**  | **Nonacid** | **Triphosphorus pentoxide** |

**Worksheet # 10**

**2.       Complete the following table by classifying and naming each compound.**

|  |  |  |
| --- | --- | --- |
| **Formula** | **Classification** | **Name** |
| **HI (aq)**  | **Acid** | **Hydroiodic acid** |
| **(NH4)3PO4(s)**  | **Salt** | **Ammonium phosphate** |
| **NCl3(l)**  | **Nonacid** | **Nitrogen trichloride** |
| **Ba(OH)2(s)**  | **Base** | **Barium hydroxide** |
| **Rb2SO4(s)**  | **Salt** | **Rubidium sulphate** |
| **CuCl2(s)**  | **Salt** | **Copper II chloride** |
| **Al2O3(aq)**  | **Salt** | **Aluminum oxide** |
| **N3Cl3(aq)**  | **Nonacid** | **Trinitrogen trichloride** |
| **CO(g)**  | **Nonacid** | **carbon monoxide** |
| **H2SO3(aq)**  | **Acid** | **Sulphurous acid** |
| **CuSO4.6H2O(aq)**  | **Salt** | **Copper II sulphate hexahydrate** |
| **H3PO3(s)**  | **covalent nonacid (acids must be aq)** | **Hydrogen phosphite** |
| **Mg3(PO4)2(aq)**  | **Salt** | **Magnesium Phosphate** |
| **HCH3COO(aq)**  | **Acid** | **Acetic Acid or Ethanoic acid** |
| **HF(aq)**  | **Acid** | **Hydrofluoric acid** |
| **N2O5(aq)**  | **Nonacid** | **Dinitrogen pentoxide** |
| **Na3PO4. 5H2O(aq)**  | **Salt** | **Sodium phosphate pentahydrate** |
| **Ni(NO3)3(aq)**  | **Salt** | **Nickel III nitrate** |
| **SO(g)**  | **Nonacid** | **Sulphur monoxide** |

Use your Quantum Periodic Table to write quantum electron configurations for each element below.

3.       Sr                **1s22s22p63s23p63d104s24p65s2**

4.       V                **1s22s22p63s23p63d34s2**

5.       **Mg**              1s22s22p63s2

6.       **P**                 1s22s22p63s23p3

7.       **Cr**               1s22s22p63s23p63d44s2

 Pick the best answers.  Answers can be used more than once.

**Answers:    Four Element Theory**

**Dalton’s Atomic Theory**

**Thomson’s Atomic Theory**

**Rutherford’s Atomic Theory**

**Bohr’s Atomic Theory**

**Quantum Mechanical Theory**

8.       **Rutherford’s Atomic Theory**          The 1st model of the atom to explain the gold foil experiment

9.       **Bohr’s Atomic Theory**                     The 1st model to explain light

10.     **Dalton’s Atomic Theory**                  The 1st model to account for the Law of Constant Composition

11.     **Rutherford’s Atomic Theory**          The 1st model to have a small, dense nucleus

12.     **Quantum Mechanical Theory**         The 1st model to have an electron as a wave

13.     **Four Element Theory**                      Non-scientific Theory

14.     **Thomson’s Atomic Theory**              The 1st model to have electrons

15.     **Dalton’s Atomic Theory**                  The 1st model to account for the Law of Conservation of Mass

16.     **Quantum Mechanical Theory**         Modern theory of the atom

17.     **Rutherford’s Atomic Theory**          The 1st model to claim the atom is mainly “empty space”

**Worksheet # 11             Electron Dot Diagrams**

Draw structural and electron-dot diagrams for each.

|  |  |  |
| --- | --- | --- |
|   | Structural | Dot-Diagram |
|  CH4 | **H4** | **H4** |
|  CI4 | **I4** | **I4dot** |
|  S2 | **2** |  **2** |
|  P2 | **2 Struc** |  2-dot |
|  C2Cl6 | **2H6** | 2H6dot |
|  C2F4 |   2F4 |                 **2F4dot**  |
|  NF3 | F3-Struc | F3-Dot |
|  CS2 |  S2-struc |  S2-dot  |
|  N2Cl2 |  2Cl2-struc |  **2Cl2-dot** |
|  HCN | CN-struc | CN-dot |
|  CH4N2O(symmetrical) | **H4N2O-struc** |  **H4N2O-dot** |
|  C6H6 (cyclic) | enzene structure |  enzene dot |
|  CF4 |   | **..****: F :****..     ..    ..****:  F  ׃ C ׃ F :****..     ..   ..****: F :****..** |
|  N2Cl4 | **Cl – N  –  N – Cl****|        |****Cl     Cl** |   |
|  NBr3 | **Br – N – Br****|****Br** | **..     ..    ..****: Br : N : Br :****..      ..    ..****: Br :****..** |
|  N2 | **N  ≡  N** | **: N : : : N :** |
|  O2 | **O = O** | **..      ..****: O : : O :** |
|  I2 | **I  -  I**  | **..     ..****: I  :  I :****..     ..** |
|  CO2 | **O = C = O** | **..              ..****: O : : C : : O :**  |
|  COBr2 | **Br****|****O = C****|****Br** |  **..****: Br :****..****: O : : C****..****: Br :****..**  |
|  CNCl2F(symmetrical) |  http://iannonechem.com/Sc/pics/CNCl2F.png |  **..****: Cl:****..               ..****: F :  C : : :N****..               ..****: Cl :**                            **..** |

Name each compound

1.              CH3COOH(aq)       **Acetic or ethanoic acid**

2.              HBr(aq)                  **Hydrobromic acid**

3.              HF(g)                     **Hydrogen fluoride**

4.              HNO3(aq)               **Nitric acid**

5.              HClO4(aq)               **Perchloric acid**

Write the quantum electron configurations for the following.

6.              Cl-               **1s22s22p63s23p6**

7.              Sr2+             **1s22s22p63s23p63d104s24p6**

8.              I                  **1s22s22p63s23p63d104s24p64d105p5**

Write a dissociation equation for each to show how each ionizes in water.

9.       **CH3COOH(l)→      H+(aq)    +    CH3COO-(aq)**

10.     **HNO3(l)                 →      H+(aq)    +    NO3-(aq)**

11.     **Al2(SO4)3(s)           →      2Al3+(aq)    +    3SO42-(aq**)

12.     **Co3(PO4)2(s)          →**      **3Co2+(aq)    +    2PO43-(aq)**

Name each compound above.

13.     **Hydrogen acetate**

14.     **Hydrogen nitrate**

15.     **Aluminum sulphate**

16.     **Cobalt II phosphate**

17. Classify the following compounds.

NaOH                                        BaF2                            BCl5                     CH3COOH

H2CO3                            CsOH                   S2Cl2                     BaCl2

|  |  |  |  |
| --- | --- | --- | --- |
|  Salt |  Base |  Acid |  Covalent Nonacid |
| **BaF2**  | **NaOH** | **CH3COOH** | **S2Cl2** |
| **BaCl2**  | **CsOH** | **H2CO3** | **BCl5** |

**Worksheet # 12             Electron Dot Diagrams**

Draw structural and electron-dot diagrams for each.

|  |  |  |  |
| --- | --- | --- | --- |
|   ClO3-  |  iO3- |   PO43- |  http://iannonechem.com/Sc/workbookanswers/3.answers_files/image021.gif            **..**               3**-****: O :****..    ..   ..****: O : P : O :****..    ..    ..****: O :****..** |
|   IO3-   |                        **-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image022.gif**..****: O : I : O :****..****: O :****..** |   BrO3- | **-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image023.gif**..     ..   ..****: O :Br: O :****..    ..    ..****: O :****..**   |
|   CN-   |     |   NO3- |         **-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image024.gif**..            ..****: O : N :: O :****..     ..****: O :****..**   |
|   SO42-   |                     **2-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image025.gif**..****: O :****..    ..    ..****: O : S : O :****..   ..    ..****: O :****..**  |   CaCO3 | **2+**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image026.gif**Ca**          http://iannonechem.com/Sc/workbookanswers/3.answers_files/image031.gif  |
|   Li2SO4   | **+**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image028.gif**2      Li**                    **2-****..**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image029.gif**: O :****..    ..    ..****: O : S : O :****..   ..    ..****: O :****..**   |   CCl4 | **..****: Cl :****..      ..     ..****:  Cl  ׃ C ׃ Cl :****..      ..    ..****: Cl :****..** |
|   NI3   | **..    ..    ..****:  I  ׃ N ׃ I :****..   ..    ..****: I :****..** |   NSCl | **..             ..****: Cl : N : : S :**                                  **..** |
|   NH4+   | http://iannonechem.com/Sc/workbookanswers/3.answers_files/image030.gif**H**              **+****..****H : N : H****..****H** |   H3O+ | http://iannonechem.com/Sc/workbookanswers/3.answers_files/image044.gif                  |
|   NaCl   | **+                    −**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image032.gifhttp://iannonechem.com/Sc/workbookanswers/3.answers_files/image033.gif**..                  ..****: Na :          : Cl :****..       ..**  |   ClO3- |                       **http://iannonechem.com/Sc/workbookanswers/3.answers_files/image066.gif**  |

Draw structural and electron-dot diagrams for each.

|  |  |  |  |
| --- | --- | --- | --- |
|   BrO4-  |                                3**-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image035.gif**..****: O :****..     ..   ..****: O : Br : O :****..****: O :****..**  |   PO33- |                           3**-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image067.gif**..****: O :****..    ..   ..****: O : P : O :****..** |
|   IO4-   |                                      **-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image037.gif**..****: O :****..    ..   ..****: O : I  : O :****..   ..    ..****: O :****..**  |  NO3- | http://iannonechem.com/Sc/workbookanswers/3.answers_files/image038.gif**..**                **-****: O :****..    ..   ..****: O : N : : O :** **..**  |
|   HCN   |   **H : C : : : N :**  |   SO32- |                            2**-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image039.gif**..****: O :****..     ..   ..****: O : S : O :****..    ..    ..**  |
|   CO32-   |   |   CaS |   **2+**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image040.gif**Ca****2-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image041.gif**..****: S :****..**       |
|   Na2SO4     | http://iannonechem.com/Sc/workbookanswers/3.answers_files/image042.gif**+****2      Na****2-**http://iannonechem.com/Sc/workbookanswers/3.answers_files/image043.gif**..****: S :****..**  |   NCl3 |   |
|   N2   |     |   O2 |   **..      ..****: O : : O :**  |
|   Cl2   |  **..      ..****: Cl  : Cl :****..      ..**   |   C2H6 |   |
|   C2H4   |   |   C2H2 |         |

          Draw electron dot diagrams for each ionic compound

|  |  |
| --- | --- |
|   LiCl   |  **..****[  Li  ]+    [ :Cl: ]-****..** |
|   Na2O   | **..****[ Na ]+[ :O: ]2-[ Na ]+****..** |
|   K2S   | **..** **[K ]+[ : S : ]2-[ K ]+****..** |
|   BaO   |  **..****[ Ba ]2+    [ :O: ]2-****..** |
|   GaH3   |                    **[ H: ]-****[ H: ]-[ Ga ]3+[ H: ]-** |

**Worksheet # 13   Practice Test # 1**

1.       Classify as **stable** or **reactive**.

          **Na**               **N+**                         **Ne**                        **Cl-**                        **S2-**               **S3-**

          **P**                 **P3-**                        **Ca**              **Ca2+**            **NaCl**          **N3-**

2.       Describe a metal and a nonmetal in terms of gaining or losing electrons.

          **Metals lose electrons and nonmetals gain electrons.**

3.       Why are noble gases always stable?

          **Full outer shells**

4.       Determine the number of valence electrons for:

          Ca     **2**        Ca2+     **8**     Cl      **7**        Cl-       **8**

          O        **6**      O2-       **8**     Al      **3**

5.       Draw a Bohr diagram for

          Ca                                  Ca2+                               N                                    N3-

|  |
| --- |
|  |
|  | http://iannonechem.com/Sc/workbookanswers/3.answers_files/image069.gif |

6.       Determine the number of protons, neutrons, and electrons in each.

|  |  |  |  |
| --- | --- | --- | --- |
|   | Protons | Neutrons | Electrons |
| S | **16** | **16** | **16** |
| S2-     | **16** | **16** | **18** |
| Al | **13** | **14** | **13** |
| Al3+   | **13** | **14** | **10** |
| 42Ca | **20** | **22** | **20** |

7.       Classify as **ionic** or **covalent** compounds.

          **HCl**                      **CH3OH**               **H2O**                      **NH4OH**

          **NaCl**                    **MgSO4**                 **CoCl2**                **H3PO4**

          **NH3**                      **P2O5**                    **Ba(OH)2**

8.       Classify the above compounds into acids, non-acids, salts and bases.

          Acids                    **H3PO4HCl**

**Bases                    NH4OH      Ba(OH)2**

**Non-acids            H2O            NH3**

**Salts                     MgSO4       NaCl**

9.       Calculate the average atomic mass for magnesium using the following percentage abundance data.

24Mg            78.70%       (24.00 amu)

25Mg            10.13%       (25.00 amu)

26Mg            11.17%       (26.00 amu)

          **0.7870(24.00) + .1013(25.00)  +  .1117(26.00)  =  24.32 amu**

10.     Write the formulas for each ionic compound.

          Magnesium chloride       **MgCl2**

          Silver phosphate            **Ag3PO4**

          Cobalt III oxide              **Co2O3**

          Zinc phosphate              **Zn3(PO4)2**

          Calcium nitride              **Ca3N2**

          Copper I nitrate             **CuNO3**

11.     Name each ionic compound.

          Fe2(SO4)3              **iron III sulphate**                     CoCl3                   col

          Na2O                    **sodium oxide**                          AgCl

          Na3PO4                 **sodium phosphate**                  CaF2

          NH4OH                **ammonium hydroxide**           Ca(NO3)2

          K2Cr2O7                **potassium dichromate**            MgCrO4

12.     Name each covalent compound.

          P2O5                     **diphosphorus pentoxide**                N2O3             **dinitrogen trioxide**

          CO                       **carbon monoxide**                             CO2             **carbon dioxide**

          SO2                        **sulphur dioxide**                     P3O5           **triphosphorus pentoxide**

          C6H6                     **hexacarbon hexahydride**       H2SO4(l)       **hydrogen sulphate**

          HCl(l)                    **hydrogen chloride**                  HNO3(l)       **hydrogen nitrate**

          H2CrO4(aq)             **chromic acid**                           HF(aq)          **hydrofluoric acid**

          H3PO4(l)                **hydrogen phosphate**              H2CO3(aq)     **carbonic acid**

13.     Complete the chart below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | Protons | Neutrons | Electrons | Reactive or stable? | # of valence electrons |
| **Li+** | **3** | **4** | **2** | **stable** | **2** |
| **S2-** | **16** | **16** | **18** | **stable** | **8** |
| **22Mg2+** | **12** | **10** | **10** | **stable** | **8** |

14.     Write dissociation equations showing how each salt or acid dissolves in water and

          forms ions. The first one is done for you.

          **MgCl2       →       Mg2+    +    2Cl-**

          **FeCl3**     **→         Fe3+    +    3Cl-**

          Co2(SO4)3      **→   2Co3+    +    3SO42-**

          HClO3      **→         H+    +    ClO3-**

          H2Cr2O7      **→      2H+    +    Cr2O72-**

16.     Name each acid:

          HCl(aq)                            **hydrochloric acid**                             HClO3(aq)                **chloric acid**

          HNO3(aq)               **nitric acid**                                         HBr(aq)                  **hydrobromic acid**

17.     Classify each as **formula units** or **molecules**.

          **NaF**                                                   **H2O**

          **CH4**                                                   **NH4Cl**

**Ionic compounds start with metals and have formula units.**

**Covalent compounds start with nonmetals and have molecules.**

          **CaSO4**                                            **CH3OH**

          **H2SO4**

18.     Indicate the solutions that **conduct** electricity.

          NaCl(s)         **solid**                    **NaCl(aq)**

          **Ca(OH)2(aq)**                             **HCl(aq)**

          **NH4OH(aq)**                               C6H12O6(aq)

19.     Consider the following electron configuration 1s22s22p6. Determine the element and

some ions that have the above electron configuration.

          Element                          **Ne**

          Cation                  **Na+ or Mg2+**

          Anion                                      **F-      O2-     N3-**

20.     Describe why NaCl(s)doesn’t conduct electricity.  Describe what happens to

NaCl(s)when it is dissolved in water.  Why does it conduct electricity?

          **The ions in NaCl(s) are not free to move and conduct electricity.**

**When it is dissolved in water, the NaCl dissociates into ions that conduct electricity.**

**NaCl(s) →   Na+(aq)  +   Cl-(aq)**

21.     Write the quantum electron configuration for each (1s22s2p.....)

          He               **1s2**                                           Ar     **1s22s22p63s23p6**

          Na                        **1s22s22p63s1**                             Na+     **1s22s22p6**

          Cl                **1s22s22p63s23p5**                       Cl-      **1s22s22p63s23p6**

          K                **1s22s22p63s23p64s1**                   K+       **1s22s22p63s23p6**

          Br               **1s22s22p63s23p63d104s24p5**       Br-     **1s22s22p63s23p63d104s24p6**

22.     What two particles make up most of the mass within an atom?   **Protons and neutrons.**

23.     I am an atom with 35p   40n.  Who am I?                               **Br**

24.     I am a cation with 56p    81n   &  54e.   Who am I?                         **Ba2+**

25.     Define isotopes.   **Elements that have the same atomic number but different**

**atomic mass because of having different amounts of neutrons.**

26.     In Rutherford’s Gold foil experiment some particles were completely

un-deflected and others were radically deflected. Describe the significance of each in terms of the structure of the atom.

          **There is a small dense positive nucleus in the center of the atom with most of the mass.**

27.     Define ionic and covalent bonding.

          **Ionic bonding transfers an electron from the metal, which becomes a cation to the nonmetal,**

**which becomes the anion.**

**Covalent bonding occurs between two nonmetals and involves shared electrons**.

28.     How many valence electrons are in the calcium ion?

          **8**

29.     How many valence electrons are in the fluoride ion?

          **8**

30.     What is the name of the family that has and electron configuration of:

a)        s2p5           **Halogens**

b)      s1                          **Alkali Metals**

c)       s2p2                      **Carbon Family**

31.     Consider the following electron configuration 1s22s22s22p63s23p6 . Determine the element and some ions that have the above         electron configuration. These are calledisoelectronic.

          Element:               **Ar**

          Cations:                **K+**     **Ca2+**

          Anions:                **Cl-    S2-   N3-**

Draw electron dot diagrams for the following using brackets for ions. Write a dissociation equation first.

32.     NaCl

       **..**

**[ Na ]+    [ :Cl: ]-**

**..**

33.     Li2O

**..**

**[ Li ]+[ :O: ]2-[ Li ]+**

**..**

34.     CaF2

 **..                               ..**

**[ :F: ]-[ Ca ]2+[ :F: ]-**

**..                                ..**

Name and classify each compound as an acid, molecular, salt, or base.

35.     CuSO4(aq)              **Salt                      Copper II sulphate**

36.     P2O4(s)                   **Molecular            Diphosphorus tetroxide**

37.     H2SO4(aq)               **Acid                     Sulphuric acid**

38.     H2Cr2O7(aq)            **Acid                     Dichromic acid**

39.     H2Cr2O7(l)             **covalent nonacid   Hydrogen dichromate**

40.     Ca(OH)2 **.** 5H2O    **Base**                     **Calcium hydroxide pentahydrate**

41.     HBr(aq)                  **Acid                     Hydrobromic acid**

42.     Calculate the average atomic mass for neon if there are three naturally occurring isotopes and they are:

20Ne  mass = 19.9924404 amu  abundance =       90.92 %

21Ne  mass = 20.993849 amu  abundance =                   0.2570 %

22Ne  mass = 21.991385 amu  abundance =                   8.820 %.

          Show some work if you want some marks. Round to an appropriate number of sig           figs.

          **0.9092(19.9924404) + 0.002570(20.993849) + 0.08829(21.991385) = 20.17 amu**

Ca(OH)2          **calcium hydroxide**                  NH4OH           **ammonium hydroxide**

CH3OH            **methanol**                       C12H22O11**sucrose**

HCl                 **hydrochloric acid**                    PI3                   **phosphorus triiodide**

K2SO4             **potassium sulphate**                RbOH              **rubidium hydroxide**

H3PO4             **phosphoric acid**                      NaOH              **sodium hydroxide**

CaCl2**calcium chloride**                     Li2SO4**lithium sulphate**

SiO2                **silicon dioxide**                        BaF2                **barium fluoride**

BCl5                **boron pentachloride**              CH3COOH      **acetic acid**

H2CO3             **carbonic acid**                          CsOH              **cesium hydroxide**

S2Cl2               **disulphur dichloride**               Fr2S                 **francium sulphide**

Fe2(SO4)3       **iron (III) sulphide**                   ZnCl2              **zinc chloride**

Co3(PO4)2       **cobalt (II) phosphate**             Ag2Cr2O7        **silver dichromate**

**Worksheet # 14   Practice Test** # 2

Balance each equation.

1.       **2C16H34+  49O2         →    32CO2        +       34H2O**

2.       **2Ga    +   3H2SO4          →      3H2  +       1Ga2(SO4)3**

Write a balanced equation including phase symbols.

3.       Solid carbon reacts with chlorine gas to produce liquid tetracarbon decachloride.

          **4C(s)    +  5Cl2(g)   →  C4Cl10(l)**

Write chemical formulas for each ionic or molecular compound.

4.       Strontium sulphide                                     **SrS**

5.       triphosphorous hexoxide                           **P3O6**

6.       Osmium IV sulphide                         **OsS2**

Name each chemical formula

7.       Sn(CO3)2.5H2O                                  **Tin IV carbonate pentahydrate**

8.       Si3F8                                                  **Trisilicon octafluoride**

9.       NaHCO3                                            **Sodium bicarbonate**

Classify the following as acids, bases, salts, and molecular non-acids. Name each.

10.     Sn(SO4)2                        **Salt                      Tin IV sulphate**

11.     Ca(OH)2                         **Base**                     **Calcium hydroxide**

12.     CH3COOH                     **Acid                     Acetic Acid**

13.     S2O5                               **Molecular            Disulphur pentoxide**

Round off each measured number to three significant figures.

14.     0.0056349                               **0.00563**

15.     539663                                    **540000**       **or   5.40  x  105**

Add or subtract the measured quantities.

16.     153.267  +  0.53493                                             **153.802**

17     ( 4.5631  x  1024 ) ( 2.36   x   10- 23 )                    **108**

Simplify the following rounding to the correct number of significant figures.

18.     (5.6 x 10 -24)  (5.37894  x 10-25)(6.532   x 1015)             =                 **1.9  x  10-67**

          (2.059378 x 1024)(5.23  x  1022)(9.37894  x 10-13)

Use unit analysis and the conversion factors to perform the following conversions:

2.210 lb  =  1.000 kg               14 lb  = 1 stone (defined)

2000 lb   =  1 ton (defined)      1.61 km   =   1.00 mile

4.54 L  =  1.00 gallon              16 oz  =  1 lb (defined)

19.     236 oz to stone

                   **236 oz  x              1 lb      x              1 stone        =       1.05 stone**

**16 oz                    14 lb**

20.     8.53 stone to oz

                   **8.53 stone  x        14 lb    x     16 oz =       1.9  x  103  oz**

**1 stone          1 lb**

21.     25.6 mi/h to km/s

 **25.6 mi   x 1.61 km       x      1 h              =       0.0114 km/s**

**h         1.00 mi                 3600s**

State the model of the atom is best described by each statement below.

22.     First model to account for The Law of Conservation of Mass.                  **Dalton**

23.     The first theory to explain the emission of photons.                        **Bohr**

24.     First model to account for positive and negative charges.                          **Thomson**

25.     First model to account for the wave properties of electrons.            **Quantum**

26.     First model to include a small dense nucleus.                                   **Rutherford**

27.     Describes the atom as a small dense nucleus surrounded with electrons, which are not in orbitals.      **Rutherford**

28.     Describes the atom as a small dense nucleus surrounded with electrons, which are in spherical orbitals.**Bohr**

29.     Describes the atom as a spherical atom that is indestructible and combines in simple whole number ratios to form compounds.            **Dalton**

30.     Describes electrons as being contained in a complex 3D orbitals as negative clouds of vibrational energy. **Quantum**

31.     Non-scientific theory that delayed modern theories of the atom for 1800 years and was shown to be incorrect. **Aristotle’s**

What did the evidence tell us about the nature of the atom?

32.     99 % of alphas in the gold foil experiment were completely un-deflected.

          **Most of the atom is empty space.**

33.     1 % of alphas in the gold foil experiment were radically deflected.

          **There is a small dense positive nucleus.**

34.     Flame spectroscopy of an element produces an emission spectrum consisting of 4 photons.

          **Electrons are in orbitals**

35.     A beam of negative particles is produced in a Crooke’s tube.

          **There are electrons.**

36.     There are five naturally occurring isotopes of Germanium. Complete the chart to show the number of protons neutrons and electrons.

                   protons       neutrons     electrons     At. Mass     Abundance

70Ge            **32               38               32**               69.92428    20.52%

72Ge            **32**               **40**               **32**               71.92174    27.43%

73Ge            **32**               **41**               **32**               72.9234      7.760%

74Ge            **32**               **42**               **32**               73.92115    36.54%

76Ge            **32**               **44**               **32**               75.9214      7.760%

37.     Calculate the average atomic mass of Germanium. Show some work if you want some marks. Round to an appropriate number of significant figs.

**0.2052(69.92428)  +  0.2743(71.92174)  +  .07760(72.9234)  +  0.3654(73.92115)  +  .07760(75.9214)  =  72.64 amu**

38.     Write the quantum electron configurations for the following atoms or ions.

39.     F                           **1s22s22p5**

40.     Ga                        **1s22s22p63s23p63d104s24p1**

41.     Br-                        **1s22s22p63s23p63d104s24p6**

42.     Rb+                       **1s22s22p63s23p63d104s24p6**

Determine the element that has the following electron configuration.

43.     1s22s22p63s2                   **Mg**

Determine a cation that has the following electron configuration.

44.     1s22s22p63s23p6      **K+               Ca2+                     Ga3+**

Determine an anion that has the following electron configuration.

45.     1s22s22p63s23p6             **P3-             S2-               Cl-**

Complete the following chart.

Symbol      p                 e                  n        valance el.   stable/unstable         atom/cation/anion

46.     **Na     11               11               12               1        unstable                         atom**

47.     P-3     **15               18               16               8        stable                             anion**

48.     Xe    **54               54               77               8        stable                             atom**

49.     Sr+2  **38               36               50               8        stable                             cation**

Name and classify each compound as an acid, molecular, salt, or base.

50.     CuSO4(aq)              **Salt                           Copper II sulphate**

51.     P2O4(s)                   **Molecular                 Diphosphorus tetroxide**

52.     H2SO4(aq)               **Acid                          Sulphuric acid**

53.     H2CO3(aq)              **Acid                          Carbonic acid**

54.     H2CO3(l)                **Nonacid Covalent    Hydrogen carbonate**

55.     Ba(OH)2. 2H2O     **Base**                     **Barium hydroxide dihydrate**

56.     HF(aq)                    **Acid                           Hydrofluoric acid**

Write structural diagrams and electron-dot diagrams for each.

57.     CCl4

**..**

**: Cl :**

**..       ..    ..**

**:  Cl**׃**C**׃**Cl :**

**..       ..    ..**

**: Cl :**

**..**

58.     S2

**..      ..**

**: S : : S :**

59.     NH3

**..**

**H : N : H**

**..**

**H**

60.     CO2

 **..               ..**

**: O : : C : : O :**

Write electron-dot diagrams for each.

61.     NaCl

       **..                     ..**

**[ : Na : ]+    [ : Cl : ]-**

**..                      ..**

62.     SO42-

                    **2-**

**..**

**: O :**

**..    ..    ..**

**: O : S : O :**

**..    ..    ..**

**: O :**

                **..**

63.     Na3PO4

64.     NO3-

           **..           ..             -**

**: O : N :: O :**

**..     ..**

**: O :**

**..**

65.     NH4+

66.     IO4-

                              **-**

**..**

**: O :**

**..    ..    ..**

**: O : I  : O :**

**..   ..    ..**

**: O :**

**..**