

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Instructions: Answer the following questions. Show ALL work for problems to receive full credit. Make sure to include proper units and significant figures for all answers.**

- [10 pt] 1. Name the scientist associated with each of the following discoveries, experiments or statements. Choices are: Albert Einstein, Christiaan Hugen, Ernest Rutherford, Erwin Schrodinger, James Clerk Maxwell, Louis De Broglie, Max Planck, Niels Bohr, Sir Isaac Newton, Werner Heisenberg, Wolfgang Pauli, and Thomas Young.
- (a) Protons are in the middle and the electrons are in a cloud around the nucleus 1(a) Rutherford
- (b) Created a mathematical model that described electrons as wave functions, and described their location in terms of probabilities. 1(b) Schrodinger
- (c) You can't really know where an electron is (or a car). 1(c) Heisenberg
- (d) Photoelectric effect, and light can be quantized. 1(d) Einstein
- (e) Double Slit experiment, proved light is a wave 1(e) Young
- (f) First scientist to propose light is a wave. 1(f) Huygens or Aristotle
- (g) First scientist to propose light is a particle. 1(g) Newton or Pythagorus
- (h) Scientist who proposed that since light can be both a wave and a particle, then an electron can be both a particle and a wave. 1(h) De Broglie
- (i) His model explained Line Spectra. 1(i) Bohr
- (j) Proposed electrons are located in orbitals around the nucleus like planets around the sun 1(j) Bohr
- [3 pt] 2. Describe the location of electrons in an atom **AND** sketch a picture of the atom according to Rutherford.
- Picture should show tiny nucleus with electrons in a cloud any distance from the nucleus
- Fails to explain line spectra because the electron can be anywhere and therefore emit any color of light.
- [3 pt] 3. Describe the location of electrons in an atom **AND** sketch a picture of the atom according to Bohr. What modification to Rutherford's model did Bohr make.
- Picture should show electrons in well defined orbitals.
- Bohr placed the electrons in orbitals instead of randomly around the atom.

CHE 111 - Exam 2

- [3 pt] 4. Describe the location of electrons in an atom **AND** sketch a picture of the atom according to De Broglie. What modification to Bohr's model did De Broglie make.

Picture should show electrons in well defined orbitals.

Bohr placed the electrons in orbitals instead of randomly around the atom.

- [3 pt] 5. Sketch **AND** label an S, P, and D orbital.

Sphere, Dumbbell, and 4 Leaf Clover

- [4 pt] 6. Schrodinger used 4 Quantum Numbers to describe the atom. Give the associated symbol and what about an electron each Quantum Number describes:

6(a) Principal quantum number:

6(b) Angular-momentum quantum number:

6(c) The Magnetic quantum number:

6(d) Electron spin quantum number:

- [3 pt] 7. Describe what type of orbital is defined by the following 4 quantum numbers,  $(3,1,1,\frac{1}{2})$  **AND** draw a picture of the orbital.

Describes a 3p orbital with a spin 1/2 electron

- [4 pt] 8. Give the electron configuration (1s 2s etc.) for the following elements:

(a) Ca  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$

(b) Mn  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$

(c) Se  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^4$



**CHE 111 - Exam 2**

[6 pt] 13. Complete each statement **AND** explain the trend observed.

(a) Atoms get bigger as you go down a column, for example K is larger than Li.

(b) Atoms get smaller as you go across a row, for example F is smaller than Na.

[4 pt] 14. Complete the following statements about Coulombs Law.

(a) Like charges repel and have a positive energy.

(b) Opposite charges attract and have a negative energy.

(c) The magnitude of the interaction is Inversely Proportional to the distance between the charges.

(d) The magnitude of the interaction is Directly Proportional to the magnitude of the charges.

[3 pt] 15. Define Compound. What is the driving force behind the formation of compounds?

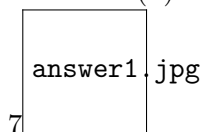
[3 pt] 16. What are the differences between Ionic compounds and Covalent/Molecular compounds?

Property	Ionic	Covalent/Molecular
1. Formed by	Gain/lose e	Share e
2. Between	metal and nonmetal	nonmetal/nonmetal
3. Bond Strength	High	Low

CHE 111 - Exam 2

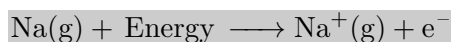
[5 pt] 17. Label the following on the periodic table below:

- (a) Alkali metals (b) Alkaline Earth metals (c) Transition metals (d) Halogens (e) Noble Gases (f) Actinides (h) Lanthinides



[8 pt] 18. Answer the following questions about Ionization Energy (IE):

- (a) Write a reaction showing what is meant by IE using a Sodium atom. Be sure to include energy in the equation.



- (b) In general the first ionization energy (increases, decreases or remains the same down a column? Explain your answer.

Decreases because the electrons are further from the nucleus.

- (c) In general the first ionization energy (increases, decreases, or remains the same across a row? Explain your answer.

Increases because the electrons are closer to the nucleus.

- (d) Explain why removing the 3rd electron from Be requires 10 times the amount of energy required to remove the 2nd electron.

Removing the 3rd electron is breaking an octet/removing it from the core electrons which requires a much larger amount of energy due to the stability of octets/noble gas core/core electrons.

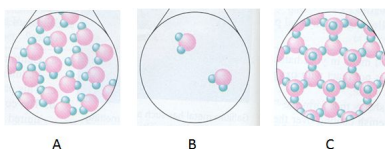
[10 pt] 19. Complete the following table:

Shape and Volume Columns: (D)efinite or (I)ndefinite.

Compressibility: (H)igh, (L)ow, and (N)one.

Density: (H)igh or (L)ow

Picture: Which picture below best represents each state.



Particles: Provide a general description of how particles are arranged **AND** the motion allowed.

IMF: Include how the attractive (Intermolecular Forces) between the molecules relates to the Kinetic Energy (Temperature) available (greater, equal, less than).

**CHE 111 - Exam 2**

State	Shape	Volume	Comp.	Density	Picture	Particles	IMF vs KE
Solid	D	D	N	H	C	Rigid Lattice,	IMF $\gg$ Energy
Liquid	I	D	L/N	H	A	Molecules can move, but attracted to each other.	IMF $\approx$ Energy
Gas	I	I	H	L	B	Molecules move freely, not attracted to each other	IMF $\ll$ Energy

[5 pt] 20. Are the following statements true or false. For the false statements explain why they are false or change them to be a true statement in the space provided.

(a) Mixtures are physically separable. 20(a)     **T**    

(b) Compounds are physically and chemically separable. 20(b)     **F - not P**    

(c) Mixtures can be homogeneous or heterogeneous. 20(c)     **T**    

(d) Mixtures have a fixed composition 20(d)     **F - variable**    

(e) A heterogeneous mixture has the same physical and chemical properties throughout the substance. 20(e)     **F - homo**    

[5 pt] 21. Are the following statements true or false. For the false statements change them to be a true statement in the space provided.

(a) All atoms of an element have the same size and mass. 21(a)     **F-Isotopes/Mass**    

(b) Elements in a compound can have more than one ratio. 21(b)     **F-fixed**    

(c) Opposites attract and Likes repel 21(c)     **T**    

(d) Cations form when an atom gains a proton. 21(d)     **F-electron**

**CHE 111 - Exam 2**

(e) An isotope is formed when an atom gains an electron.

21(e) **F-Anion**

[5 pt] 22. Do the following statements best describe (p)rotons, (n)eutrons or (e)lectrons. There may be more than one correct answer for each question.

(a) Has a negative charge.

22(a) **e**

(b) Responsible for Isotopes.

22(b) **n**

(c) Forms bonds between atoms to form molecules.

22(c) **e**

(d) Has the largest mass.

22(d) **p and n**

(e) Is contained in the nucleus of the atom.

22(e) **p and n**

[5 pt] 23. Answer the following questions about the following isotope:  ${}_{48}^{98}\text{X}^{+2}$ .

(a) How many protons are there?

23(a) **48**

(b) How many electrons are there?

23(b) **46**

(c) How many neutrons are there?

23(c) **50**

(d) What element is this an isotope of?

23(d) **Cd**

(e) Is this a cation or anion?

23(e) **anion**

▪