

Name: _____ Class: _____ 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. You are allowed the use of a molecular model kit.

[5 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) Proposed electrons are located in orbitals around the nucleus like planets 1(a) _____
around the sun

(b) Created a mathematical model that described where electrons are found 1(b) _____
around an atoms called Quantum Mechanics.

(c) 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. "Wave-Particle Duality" 1(c) _____

(d) His model was the first to place electrons in orbitals and explained line spectra successfully .
1(d) _____

(e) Protons are in the middle and the electrons are in a cloud around the nucleus 1(e) _____

(f) His model explained Line Spectra. 1(f) _____

[4 pt] 2. Give the associated symbol and what about feature of orbitals/electrons each Quantum Number describes:

(a) Principal quantum number

(b) Angular-momentum quantum number:

(c) The Magnetic quantum number:

(d) Electron spin quantum number:

[4 pt] 3. Sketch **AND** label an S, P, and D orbital. How many electrons fit into each orbital type?

	s-orbital	p-orbital	d-orbital
Shape of Orbital			
# of Sub-Orbitals			
# electrons in orbital			

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[5 pt] 4. Place each letter in the box with the appropriate quantum number. More than one correct answer exists. Some statements may not match any quantum number.

- (a) Determines the number of sub-orbitals
- (b) Principle Quantum Number
- (c) Determines that orbitals hold 2 electrons
- (d) Magnetic Quantum Number
- (e) Determines the distance of the orbital from the nucleus
- (f) Determines the shape of orbitals
- (g) Angular Momentum Quantum Number
- (h) Determines the orientation of orbitals
- (i) Determines the color of the electron
- (j) Electron Spin Quantum Number

n	l
m_l	m_s

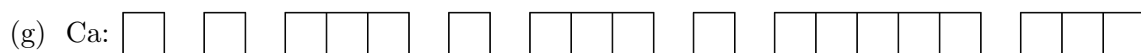
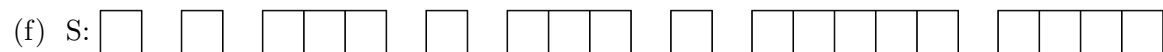
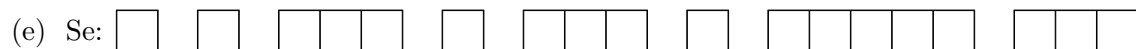
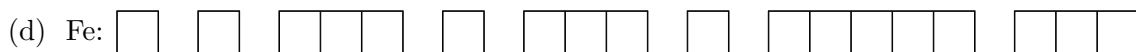
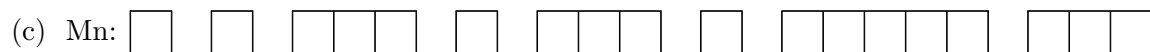
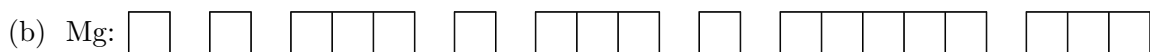
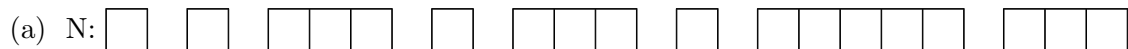
[3 pt] 5. Describe the location of electrons in an atom **AND** sketch a picture of the atom according to Rutherford. Why does the model fail to explain Line Spectra?

[4 pt] 6. Describe the location of electrons in an atom **AND** sketch a picture of the atom according to Bohr. What major improvement to the Rutherford Model did Bohr make? How does this explain line spectra?

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- [3 pt] 7. Sketch a picture of the atom according to de Broglie. How did the model explain the quantization of orbitals (ie what he most famous for saying)?
- [3 pt] 8. In what order are the electron orbitals (1s, 2s etc) from lowest to highest energy, up to the 7s orbital.
- [3 pt] 9. What is the significance of each part of the designation $3d^3$
- [6 pt] 10. Give the electron configuration (1s 2s etc.) for the following elements:
- (a) C
 - (b) Cl
 - (c) Fe
 - (d) Ca
 - (e) Mn
 - (f) Se
 - (g) As

[6 pt] 11. Draw orbital diagrams for the following elements. Ignore any extra boxes provided.



[4 pt] 12. Define the term Valence electron. Why are they important?

[5 pt] 13. Halogens form -1 ions. Write the formation reaction for a Fluorine ion from a Fluorine atom using (1) chemical equation (2) Lewis Structures and (3) electron configurations. What is the driving force (ie why does Fluorine want to form a -1 ion) behind the formation of the ion?

[3 pt] 14. Why do the Alkali Metals only form +1 cations (lose only one electron)? What electron configuration do they all have in common?

[5 pt] 15. Explain using (1) Electron Configurations, (2) Lewis Structures, and (3) Words the driving force (why the reaction occurs) for the reaction $\text{K(s)} + \text{F(g)} \longrightarrow \text{KF(s)}$.

[6 pt] 16. Explain using (1) Electron Configurations, (2) Lewis Structures, and (3) Words the driving force (why the reaction occurs) for the reaction $\text{Ca(s)} + 2\text{F(g)} \longrightarrow \text{CaF}_2\text{(s)}$.

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[5 pt] 17. For each of the following periodic trends does it (D)ecrease/(I)ncrease/(S)tay the Same?

- (a) Atomic radius down a column? 17(a) _____
- (b) Atomic radius across a row? 17(b) _____
- (c) Size of cation formed from a neutral atom? 17(c) _____
- (d) Ionization energy down a column? 17(d) _____
- (e) Ionization energy across a row? 17(e) _____

[5 pt] 18. Complete each of the the following questions about Periodic Trends using Bigger, Smaller or Same.

- (a) A neutral atom is _____ than a cation.
- (b) The size of an atom gets _____ down a column.
- (c) Ionization energy gets _____ across a row.
- (d) An anion is _____ than a neutral atom.
- (e) Ionization energy gets _____ as you remove more and more electrons.

[6 pt] 19. Answer the following questions about Periodic Trends:

- (a) Which is bigger a F atom or Cl atom. Explain. 19(a) _____

- (b) Which atom has the larger ionization energy Na or Cl? Explain. 19(b) _____

- (c) Which has a larger ionization energy Mg^{+1} or Mg^{+2} . Explain. 19(c) _____

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[6 pt] 20. Answer the following questions about Ionization Energy (IE):

(a) Define Ionization Energy

(b) Write an equation showing the ionization of a Na atom. Be sure to include energy in the equation.

(c) Is the reaction Endothermic or Exothermic? Explain why.

21. Explain why the atomic radius of an atom increases as you go down a column. (For example Cs is larger than Li)

22. Explain why the atomic radius of an atom decreases as you go across a row. (For example Li is larger than F)

23. Answer the following questions about Ionization Energy (IE):

(a) Define Ionization Energy

(b) Write an equation showing what is meant by IE. Be sure to include energy in the equation.

[6 pt] 24. Complete the following table:

# atoms bonded	# lone pairs	Molecular Shape	Bond Angle
4	0		
3	1		
2	2		
3	0		
2	1		
2	0		

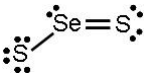
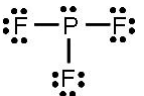
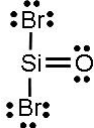
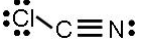
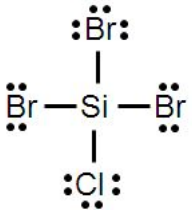
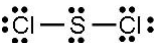
[10 pt] 25. For each of the following molecules indicate the shape (bent, linear, tetrahedral, trigonal planar, trigonal pyramidal) and bond angle (109.5, 120, 180) around the central atom(s). Also indicate whether the molecule is nonpolar (NP) or dipolar (DP).

Molecule	Shape	Angle	NP or DP
$\text{:}\ddot{\text{O}}\text{--}\ddot{\text{S}}\text{=}\ddot{\text{O}}\text{:}$			
$\left[\begin{array}{c} \text{:}\ddot{\text{O}}\text{:} \\ \parallel \\ \text{:}\ddot{\text{O}}\text{--}\text{C}\text{--}\ddot{\text{O}}\text{:} \end{array} \right]^{-2}$			
$\begin{array}{c} \text{:}\ddot{\text{F}}\text{:} \\ \\ \text{C}\equiv\text{N}\text{:} \end{array}$			
$\begin{array}{c} \text{:}\ddot{\text{F}}\text{:} \\ \\ \text{P} \\ \\ \text{:}\ddot{\text{F}}\text{:} \end{array}$			
$\text{:}\ddot{\text{Cl}}\text{--}\ddot{\text{O}}\text{--}\ddot{\text{Cl}}\text{:}$			

[10 pt] 26. For each of the following molecules indicate the shape (bent, linear, tetrahedral, trigonal planar, trigonal pyramidal) and bond angle (109.5, 120, 180) around the central atom(s). Also indicate whether the molecule is nonpolar (NP) or dipolar (DP).

Molecule	Shape	Angle	NP or DP
$\begin{array}{c} \text{:}\ddot{\text{F}}\text{--}\ddot{\text{N}}\text{--}\ddot{\text{F}}\text{:} \\ \\ \text{:}\ddot{\text{F}}\text{:} \end{array}$			
$\text{:}\ddot{\text{Cl}}\text{:}\backslash\text{C}\equiv\text{N:}$			
$\text{:}\ddot{\text{O}}\text{--}\ddot{\text{Se}}=\ddot{\text{O}}\text{:}$			
$\text{:}\ddot{\text{Cl}}\text{--}\ddot{\text{S}}\text{--}\ddot{\text{Cl}}\text{:}$			
$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$			

27. Complete the following table:

Molecule	Molecular Shape	Bond Angle	Dipolar or Nonpolar
			
			
			
			
			
			

[10 pt] 28. Draw the lewis structure for the following molecules (all of which obey the octet rule).

(a) C_2H_2	(b) CH_3COOH
(c) CH_2Cl_2	(d) SF_2
(e) NaNO_3	

[10 pt] 29. Draw the lewis structure for the following molecules (all of which obey the octet rule).

(a) SF_2	(b) PF_3
(c) HCN	(d) SiH_4
(e) HSO_4^-	

[20 pt] 30. Draw the Lewis Structure for the following molecules (all of which obey the octet rule). Next to each picture predict the molecular shape, bond angle, for all atoms with shapes and determine the molecular polarity (Dipolar or Nonpolar).

30(a) H_2S

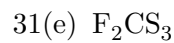
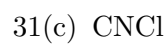
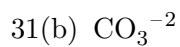
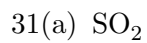
30(b) CH_2S

30(c) FCP

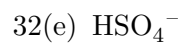
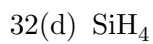
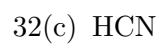
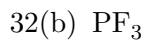
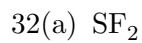
30(d) $\text{C}_2\text{H}_4\text{O}_2$

30(e) SeO_3^{-2}

[20 pt] 31. Draw the Lewis Structure for the following molecules (all of which obey the octet rule). Next to each picture predict the molecular shape, bond angle, and polarity (Dipolar or Nonpolar).

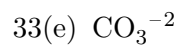
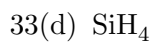
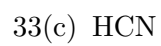
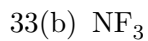
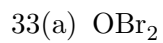


[20 pt] 32. Draw the lewis structure for the following molecules (all of which obey the octet rule). Next to each picture predict the molecular shape, bond angle, and polarity (Dipolar or Nonpolar).



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33. Draw the lewis structure for the following molecules (all of which obey the octet rule). Next to each picture predict the molecular shape, bond angle, and polarity (Dipolar or Nonpolar).



[6 pt] 34. How does Quantum Mechanics lead to the shape of the periodic table?

(a) What is different about the 4 major regions of the periodic table (ie why are they 2, 6, 10 and 14 elements wide)?

(b) What is the same about each row?

(c) What is the same about each column?

[4 pt] 35. What are the major differences (give at least 2) between classical mechanics and quantum mechanics. Use complete sentences.