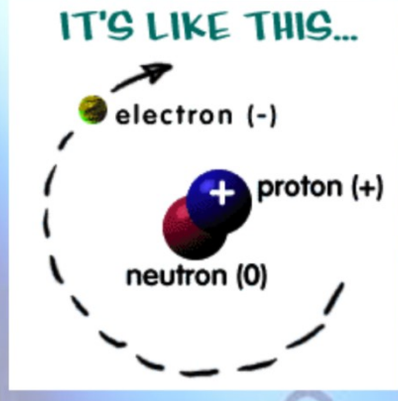
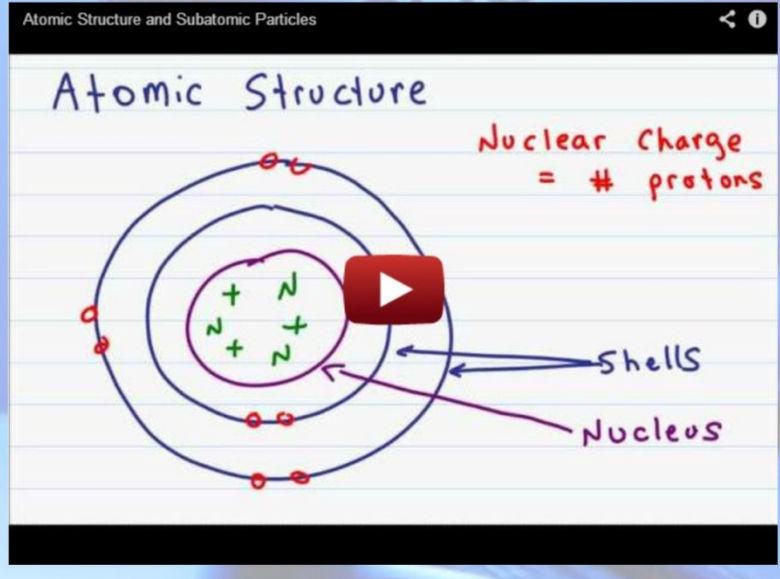
KEY *KEY*

Chemistry

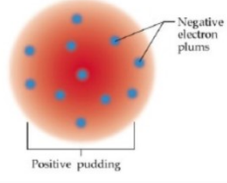
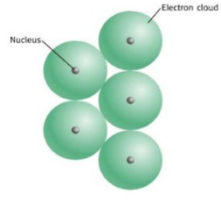
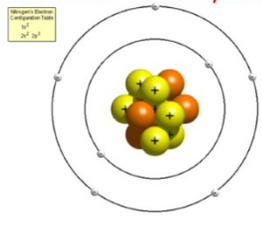
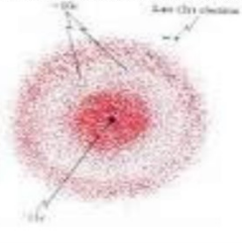
PRACTICE PACKET

Unit 2: Atomic Theory





History of Atomic Theory

Name of Researcher	Equipment/ Experiment	Sketch & Name of Model	Major Idea/Discovery
Dalton	N/A	Cannonball 	1. All matter is composed of indivisible particles called atoms 2. All atoms of an element are identical in mass and properties. 3. Compounds are formed by a combination of 2 or more atoms 4. 4. Atoms cannot be created, destroyed, or converted during chemical reactions
Thomson	Cathode Ray Tube	Plum Pudding 	Discovered subatomic called the electron
Rutherford	Alpha Emitter/ Gold foil	Nuclear Model 	1. The atom is mostly empty space 2. At the center of the atom is a dense, positive core called the nucleus
Bohr	N/A	Bohr or Planetary Model 	Electrons travel around the nucleus in well-defined paths called **ORBITS** (like planets in a solar system)
Many Scientists	X-Ray Diffraction	Wave-Mechanical Model 	1. Electrons have distinct amounts of energy and move in areas called **ORBITALS** 2. Energy can behave as both waves & particles

Regents Chemistry **Atomic Theory** **Name** _____

1. Which statement describes the distribution of charge in an atom?

   A) A positively charged nucleus is surrounded by one or more positively charged electrons.
   B) A neutral nucleus is surrounded by one or more positively charged electrons.
   C) A positively charged nucleus is surrounded by one or more negatively charged electrons.
   D) A neutral nucleus is surrounded by one or more negatively charged electrons.

2. As a result of the gold foil experiment, it was concluded that an atom

   A) contains a small, dense nucleus
   B) contains protons, neutrons, and electrons
   C) is a hard, indivisible sphere
   D) has positrons and orbitals

3. The gold foil experiment led to the conclusion that each atom in the foil was composed mostly of empty space because most alpha particles directed at the foil

   A) remained trapped in the foil
   B) were deflected by the nuclei in gold atoms
   C) were deflected by the electrons in gold atoms
   D) passed through the foil

4. Which conclusion was a direct result of the gold foil experiment?

   A) An atom is mostly empty space with a dense, positively charged nucleus.
   B) An atom is composed of at least three types of subatomic particles.
   C) An electron has a positive charge and is located inside the nucleus.
   D) An electron has properties of both waves and particles.

5. What was concluded about the structure of the atom as the result of the gold foil experiment?

   A) A positively charged nucleus is surrounded by mostly empty space.
   B) A negatively charged nucleus is surrounded by positively charged particles.
   C) A negatively charged nucleus is surrounded by mostly empty space.
   D) A positively charged nucleus is surrounded by positively charged particles.

6. Which sequence represents a correct order of historical developments leading to the modern model of the atom?

   A) most of the atom is empty space → the atom is a hard sphere → electrons exist in orbitals outside the nucleus
   B) most of the atom is empty space → electrons exist in orbitals outside the nucleus → the atom is a hard sphere
   C) the atom is a hard sphere → most of the atom is empty space → electrons exist in orbitals outside the nucleus
   D) the atom is a hard sphere → electrons exist in orbitals outside the nucleus → most of the atom is empty space

7. Experiments performed to reveal the structure of atoms led scientists to conclude that an atom's

   A) positive charge is evenly distributed throughout its volume
   B) negative charge is mainly concentrated in its nucleus
   C) volume is mainly unoccupied
   D) mass is evenly distributed throughout its volume

8. Compared to the entire atom, the nucleus of the atom is

   A) larger and contains most of the atom's mass
   B) smaller and contains most of the atom's mass
   C) smaller and contains little of the atom's mass
   D) larger and contains little of the atom's mass

Atomic Theory

9. Base your answer to the following question on Given the table below that shows student's examples of proposed models of the atom:

Proposed Models of the Atom

Model	Location of Protons	Location of Electrons
A	in the nucleus	specific shells
B	in the nucleus	regions of most probable location
C	dispersed throughout the atom	specific shells
D	dispersed throughout the atom	regions of most probable location

Which model correctly describes the locations of protons and electrons in the wave-mechanical model of the atom?

A) *A* **B) *B*** C) *C* D) *D*

10. An orbital of an atom is defined as the most probable location of

A) an electron B) a positron
C) a proton D) a neutron

11. According to the wave-mechanical model of the atom, electrons in an atom

A) travel in defined circles
B) are located in orbitals outside the nucleus
C) are most likely found in an excited state
D) have a positive charge

12. Which group of atomic models is listed in historical order from the earliest to the most recent?

A) electron-shell model, hard-sphere model, wave-mechanical model
B) hard-sphere model, wave-mechanical model, electron-shell model
C) hard-sphere model, electron-shell model, wave-mechanical model
D) electron-shell model, wave-mechanical model, hard-sphere model

13. Which statement correctly describes the charge of the nucleus and the charge of the electron cloud of an atom?

A) The nucleus is negative and the electron cloud is negative.
B) The nucleus is positive and the electron cloud is negative.
C) The nucleus is positive and the electron cloud is positive.
D) The nucleus is negative and the electron cloud is positive.

14. In the late 1800s, experiments using cathode ray tubes led to the discovery of the

A) electron B) neutron
C) proton D) positron

15. A proton has a charge that is opposite the charge of

A) an alpha particle B) a neutron
C) an electron D) a positron

Atomic Structure Worksheet

****Assume all are neutral atoms!**

Fill in the blanks in the following worksheet. Please keep in mind that the isotope represented by each space may NOT be the most common isotope or the one closest in atomic mass to the value on the periodic table.

Atomic symbol	Atomic number	Protons	Neutrons	Electrons	Mass number
C	6	6	8	6	14
Mg	12	12	12	12	24
Ga	31	31	40	31	71
Zr	40	40	49	40	89
Zn	30	30	35	30	65
Mo	42	42	56	42	98
W	74	74	109	74	183
Lu	71	71	105	71	176
Am	95	95	148	95	243
Cr	24	24	27	24	51
Bi	83	83	126	83	209
Th	90	90	142	90	232
Md	101	101	158	101	259
Se	34	34	46	34	80
Zr	40	40	51	40	91

Notice there are two different atoms of zirconium (Zr) listed. They have drastically different mass numbers. What are these two therefore considered to be in relation to one another? **They are ISOTOPES**

Atomic Theory- Neutral Atoms and their subatomic parts

How many **protons, neutrons, and electrons** are present in the following neutral atoms?

vanadium
P = 23
N = 28
e = 23

potassium
P = 19
N = 20
e = 19

nitrogen
P = 7
N = 7
e = 7

platinum
P = 78
N = 117
e = 78

argon
P = 18
N = 22
e = 18

helium
P = 2
N = 2
e = 2

What is the name of the element that has neutral atoms that contain

5 protons?
Boron

16 electrons?
Sulfur

17 protons?
Chlorine

32 electrons?
Germanium

25 protons?
Manganese

1 electron?
Hydrogen

82 protons?
Lead

8 electrons?
Oxygen

92 protons?
Uranium

2 electrons?
Helium

Complete the following chart: (assume the overall charge on all atoms = 0….except the last one!)

Element	Symbol	Atomic Number	# of Protons	# of Neutrons	Mass Number (amu)	# of Electrons
Hydrogen	**H**	**1**	**1**	1	**2**	**1**
Helium	He	**2**	**2**	**2**	4	**2**
Sodium	Na	**11**	**11**	12	**23**	**11**
Potassium	**K**	**19**	**19**	**20**	39	**19**
Calcium	**Ca**	20	**20**	20	**40**	**20**
Iron	**Fe**	**26**	26	30	**56**	**26**
Rubidium	Rb	**37**	**37**	**49**	86	**37**
Carbon	**C**	**6**	**6**	6	**12**	**6**
Xenon	**Xe**	**54**	**54**	**77**	131	**54**
Phosphorus	**P**	**15**	**15**	16	**31**	15
Astatine	At	**85**	**85**	126	**211**	**85**
Nitrogen	**N**	**7**	**7**	**7**	14	7
Copper	**Cu**	**29**	**29**	**35**	64	**29**
Neon	Ne	**10**	**10**	10	**20**	**10**
Vanadium	**V**	**23**	23	27	**50**	**23**
Lithium Ion	Li^+	**3**	**3**	3	**6**	**2**

P, n, e of ions

IMPORTANTIf the mass number is not given to you, round the atomic mass that you find on the Periodic Table for that element.

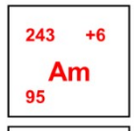
Write the full chemical symbol **for the ion with:**

1) 12 protons and 10 electrons: 

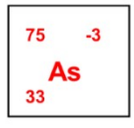
p > e → + ion

2) 74 protons and 68 electrons: 

p > e → + ion

3) 95 protons and 89 electrons: 

p > e → + ion

4) 33 protons and 36 electrons: 

p < e → - ion

Determine the number of p, n, e for the following ions:

Cu^{2+}
p = 29
n = 35
e = 27

Li^{+}
p = 3
n = 4
e = 2

O^{2-}
p = 8
n = 8
e = 10

Cl^{-}
p = 17
n = 18
e = 18

Al^{3+}
p = 13
n = 14
e = 10

I^{7+}
p = 53
n = 74
e = 46

	# protons	# electrons	# neutrons	Atomic #	Mass #
Lithium^{1+}	3	**2**	4	**3**	**7**
Phosphorus^{3-}	**15**	18	**16**	**15**	31
Vanadium^{0}	**23**	**23**	**28**	23	51
Krypton^{0}	**36**	**36**	48	36	**84**
Barium^{4+}	56	**52**	**81**	**56**	137
Uranium^{5-}	**92**	97	146	**92**	**238**

For the following atoms/ions determine the number of protons, neutrons, electrons, mass number, and nuclear charge.

	ATOM or ION?	PROTONS	NEUTRONS	ELECTRONS	MASS NUMBER	NUCLEAR CHARGE
^{15}N	ATOM	7	8	7	15	7
Cu^{+2}	ION	29	35	27	64	29
$^{8}B^{+3}$	ION	5	3	2	8	5
^{17}O	ATOM	8	9	8	17	8
F^{-1}	ION	9	10	10	19	9
^{206}Pb	ATOM	82	124	82	206	82
^{208}Pb	ATOM	82	126	82	208	82
Ag^{+1}	ION	47	61	46	108	47
Zn^{+2}	ION	30	35	28	65	30
Mg	ATOM	12	12	12	24	12
S^{-2}	ION	16	16	18	32	16

Question: Which of the above atoms are isotopes of one another? Explain how you know this. Pb-206 and Pb-208, because they are the same element with a different mass number (or a different number of neutrons)

	ATOM or ION?	PROTONS	NEUTRONS	ELECTRONS	MASS NUMBER	NUCLEAR CHARGE
Al^{+3}	Ion	13	14	10	27	13
^{37}Cl	Atom	17	20	17	37	17
$^{23}Na^{+1}$	Ion	11	12	10	23	11
He	Atom	2	2	2	4	2
$^{15}O^{-2}$	Ion	8	7	10	15	8
^{14}C	Atom	6	8	6	14	6
C-12	Atom	6	6	6	12	6
Au^{+3}	Ion	79	118	76	197	79
U	Atom	92	146	92	238	92
^{222}Rn	Atom	86	136	86	222	86
Cu^{+1}	Ion	29	35	28	64	29
Cu^{+2}	Ion	29	35	27	64	29

Question: Which of the above atoms are isotopes of one another? Explain how you know this. C-12 & C-14 → Same element, different mass #

Calculate the atomic mass of each of the following isotopes. SHOW ALL WORK.

	Element	Mass	Percent Abundance
1)	copper-63	62.9396 amu	69.17%
	copper-65	64.9278 amu	30.83%
			63.5525 amu
2)	uranium-235	235.0439 amu	0.72%
	uranium-238	238.0510 amu	99.28%
			238.029 amu
3)	hydrogen-1	1.0078 amu	99.985%
	hydrogen-2	2.0140 amu	0.015%
			1.00795 amu
4)	element Q-8	8.0 amu	10.0%
	element Q-9	9.0 amu	20.0%
	element Q-10	10.0 amu	70.0%
			9.6 amu

Weighted Averages HW (SHOW ALL WORK!) Name _____

*You can round the masses given to you or use them as given – just be consistent!

1) Element X exists in three isotopic forms. The isotopic mixture consists of 10.0% ^{10}X, 20.0% ^{11}X, and 70.0% ^{12}X. What is the average atomic mass of this element?

11.6 amu

2) Element Y exists in three isotopic forms. The Isotopic mixture consists of 15.0% ^{21}X, 65.0% ^{22}X, and 20.0% ^{23}X. That is the average atomic mass of this element?

22.05 amu

3) A mystery element occurs in nature as two isotopes. Isotope A has a mass of 10.0130 amu and its abundance is 19.9%; Isotope B has a mass of 11.0093 amu and its abundance is 80.1%. From this data, calculate the atomic mass of the element and show all work. Lastly, identify the element.

10.8 amu

4) A mystery element occurs in nature as two isotopes. Isotope A has a mass of 62.939598 amu and its abundance is 69.17%; Isotope B has a mass of 64.927793 amu and its abundance is 30.83%. From this data, calculate the atomic mass of the element and show all work. Lastly, identify the element.

63.56 amu

5) A mystery element occurs in nature as three isotopes. Isotope A has a mass of 15.994915 amu and its abundance is 99.762%; Isotope B has a mass of 16.999132 amu and its abundance is 0.0380%; Isotope C has a mass of 17.999160 amu and its abundance is 0.2000%. From this data, calculate the atomic mass of the element and show all work. Lastly, identify the element.

16.0 amu

Isotopes and Average Atomic Mass

Example: A sample of cesium is 75% ^{133}Cs, 20% ^{132}Cs, and 5% ^{134}Cs. What is the average atomic mass?

132.85 amu

Determine the average atomic mass of the following mixtures of isotopes.

1. 80% ^{127}I, 17% ^{126}I, 3% ^{128}I **126.86 amu**

2. 50% ^{197}Au, 50% ^{198}Au **197.5 amu**

3. 15% ^{55}Fe, 85% ^{56}Fe **55.85 amu**

4. 99% ^{1}H, 0.8% ^{2}H, 0.2% ^{3}H **1.012 amu**

5. 95% ^{14}N, 3% ^{15}N, 2% ^{16}N **14.07 amu**

6. 98% ^{12}C, 2% ^{14}C **12.04 amu**

Regents Chemistry **Name** _____

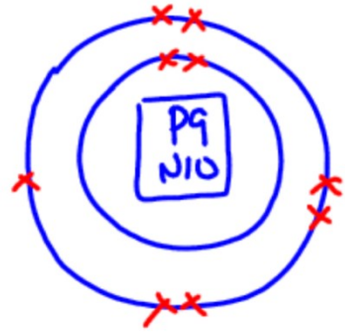
Principal Energy Level Worksheet

Element	e-configuration	
Carbon	2-4 *	1s ⇅ OR 1s ⇅ 2s ⇅ 2p 1 1 __ 2s 1 __ 2p 1 1 1
Helium	2	1s ⇅
Neon	2-8	1s ⇅ 2s ⇅ 2p ⇅ ⇅ ⇅
Oxygen	2-6	1s ⇅ 2s ⇅ 2p ⇅ 1 1
Sulfur	2-8-6 *	1s ⇅ 2s ⇅ 2p ⇅ ⇅ ⇅ 3s ⇅ 3p ⇅ 1 1 3d __ __ __ __ __
Aluminum	2-8-3 *	1s ⇅ 2s ⇅ 2p ⇅ ⇅ ⇅ 3s ⇅ 3p 1 __ __ 3d __ __ __ __ __
Sodium	2-8-1	1s ⇅ 2s ⇅ 2p ⇅ ⇅ ⇅ 3s 1 __ 3p __ __ __ 3d __ __ __ __ __
Lithium	2-1	1s ⇅ 2s 1 __ 2p __ __ __

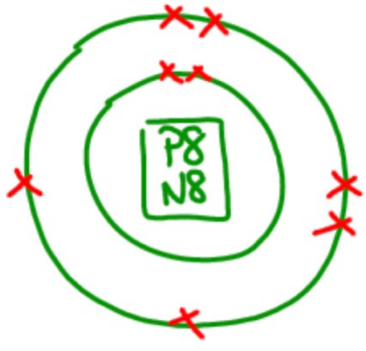
Construct Bohr diagrams for the following:

Na electron configuration 2-8-1

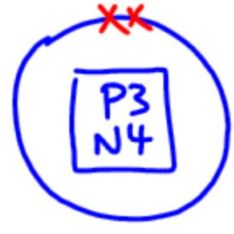
F electron configuration 2-7



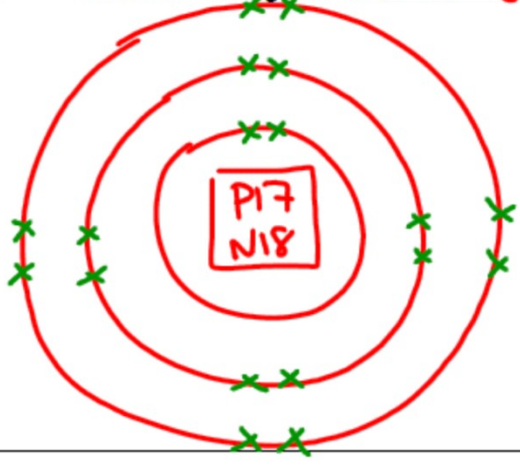
O electron configuration 2-6



Li^+ electron configuration 2



Cl^- electron configuration 2-8-8



Ne electron configuration 2-8

Regents Chemistry **Bohr Model & e- Configuration**

1. An atom that has an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$ is classified as

   A) a transition element
   B) a noble gas element
   C) an alkaline earth metal
   D) an alkali metal

2. The electron configuration of an atom in the ground state is 2-4. The total number of occupied principal energy levels in this atom is

   A) 1 **B) 2** C) 3 D) 4

3. In the wave-mechanical model, an orbital is a region of space in an atom where there is

   A) a high probability of finding a neutron
   B) a high probability of finding an electron
   C) a circular path in which electrons are found
   D) a circular path in which neutrons are found

4. An atom with the electron configuration 2-8-8-2 has an incomplete

   A) 2nd principal energy level
   B) 3s sublevel
   C) 3rd principal energy level
   D) 2s sublevel

5. An atom of which element in the ground state contains electrons in the fourth principal energy level?

   A) He **B) Kr** C) Ne D) Ar

6. Which atom in the ground state has a partially filled second electron shell?

   A) sodium atom B) hydrogen atom
   C) potassium atom **D) lithium atom**

7. What is the electron configuration of a sulfur atom in the ground state?

   A) 2–6 B) 2–4
   C) 2–8–4 **D) 2–8–6**

8. What is the maximum number of electrons that can occupy the second principal energy level?

   A) 18 B) 32 **C) 8** D) 6

9. The maximum number of electrons that a single orbital of the 3*d* sublevel may contain is

   A) 5 **B) 2** C) 3 D) 4

10. Which of the following electron configurations represents an atom having the greatest nuclear charge?

    A) 2-8 B) 2-8-6
    C) 2-8-1 **D) 2-8-7**

11. What is the highest principal energy level for an electron in an atom of sulfur in the ground state?

    A) 1 B) 2 **C) 3** D) 4

12. In a calcium atom in the ground state, the electrons that possess the *least* amount of energy are located in the

    A) second electron shell
    B) first electron shell
    C) third electron shell
    D) fourth electron shell

13. Which atom in the ground state has an outermost electron with the most energy?

    A) K B) Na **C) Cs** D) Li

14. Which of the following elements in Period 2 has all of its sublevels completely filled?

    A) N B) Li C) B **D) Ne**

15. An Mg^{2+} ion has the same electron configuration as

    A) Ar^0 B) Na^0 C) Ca^{2+} **D) F^-**

16. Which atom in the ground state has five electrons in its outer level and ten electrons in its kernel?

    A) C B) Si C) Cl **D) P**

17. Which phrase describes an atom?

    A) a negatively charged electron cloud surrounding a negatively charged nucleus
    B) a positively charged electron cloud surrounding a negatively charged nucleus
    C) a positively charged electron cloud surrounding a positively charged nucleus
    D) a negatively charged electron cloud surrounding a positively charged nucleus

Bohr Model & e- Configuration

18. Which represents the correct electron distribution of a transition element in the ground state?

A) 2-8-8-2 **B) 2-8-18-2**
C) 2-8-18-3 D) 2-8-8-1

19. What is the maximum number of electrons in the third shell of an atom?

A) 6 B) 9 C) 3 **D) 18**

20. Which element has atoms with only one completely filled principal energy level?

A) As B) P **C) N** D) Sb

21. An atom contains a total of 25 electrons. When the atom is in the ground state, how many different principal energy levels will contain electrons?

A) 1 B) 2 C) 3 **D) 4**

22. Which atom in the ground state has the same electron configuration as a calcium ion, Ca^{2+}, in the ground state?

A) Ar B) Ne C) K D) Mg

23. Which statement describes the relative energy of the electrons in the shells of a calcium atom?

A) An electron in the third shell has more energy than an electron in the second shell.
B) An electron in the first shell has more energy than an electron in the second shell.
C) An electron in the third shell has less energy than an electron in the second shell.
D) An electron in the first shell has the same amount of energy as an electron in the second shell.

24. Which electron configuration represents an atom of an element having a completed third principal energy level?

A) 2-8-10-2 B) 2-8-6-2
C) 2-8-18-2 D) 2-8-2

25. What is the electron configuration for Be^{2+} ions?

A) 2-2 B) 1 C) 2-1 **D) 2**

26. In the ground state, all of the atoms of Period 3 elements have the same

A) number of oxidation states
B) atomic mass
C) atomic number
D) number of occupied energy shells

27. Which of the following sublevels has the highest energy?

A) 2*s* B) 2*p* **C) 3*p*** D) 3*s*

28. Which sublevels are occupied in the outermost principal energy level of an argon atom in the ground state?

A) 2*s* and 3*p* B) 2*p* and 3*d*
C) 3*s* and 3*d* **D) 3*s* and 3*p***

Bohr Model & e- Configuration

29. Given the table below that shows student's examples of proposed models of the atom:

Proposed Models of the Atom

Model	Location of Protons	Location of Electrons
A	in the nucleus	specific shells
B	in the nucleus	#174 ions of most probable location
C	dispersed throughout the atom	specific shells
D	dispersed throughout the atom	#174 ions of most probable location

Which model correctly describes the locations of protons and electrons in the wave-mechanical model of the atom?

A) *A* **B) *B*** C) *C* D) *D*

30. Which of the following sublevels contains the greatest number of orbitals?

A) *d* **B) *f*** C) *p* D) *s*

31. The principal quantum number of the outermost electron of an atom in the ground state is $n = 3$. What is the total number of occupied principal energy levels contained in this atom?

A) 1 B) 2 **C) 3** D) 4

32. Which is the electron dot symbol for an atom with an electron configuration of $1s^2 2s^2 2p^3$?

A) B)  C) D)

33. What is the total number of sublevels in the third principal energy level?

A) 1 B) 2 **C) 3** D) 4

34. What is the maximum number of electrons that can occupy the fourth principal energy level (shell) of an atom?

A) 6 B) 18 **C) 32** D) 8

35. What is the total number of valence electrons in an atom with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^3$?

A) 5 B) 11 C) 3 D) 15

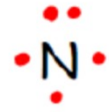
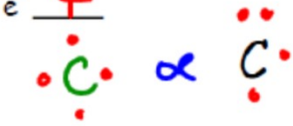
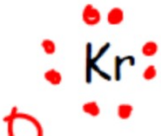
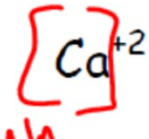
36. What is the total number of completely filled principal energy levels in an atom of argon in the ground state?

A) 1 **B) 2** C) 3 D) 4

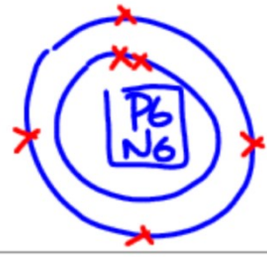
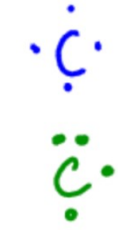
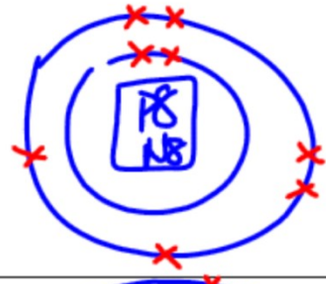
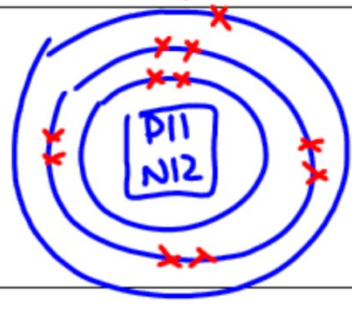
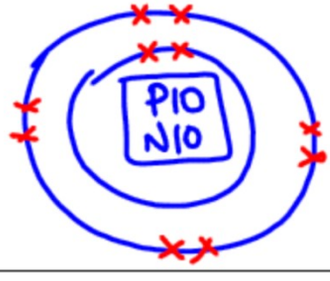
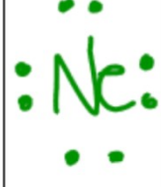
37. What is the maximum number of electrons that may be present in the second principal energy level of an atom?

A) 8 B) 2 C) 18 D) 32

Draw Lewis Dot Diagrams for the following:

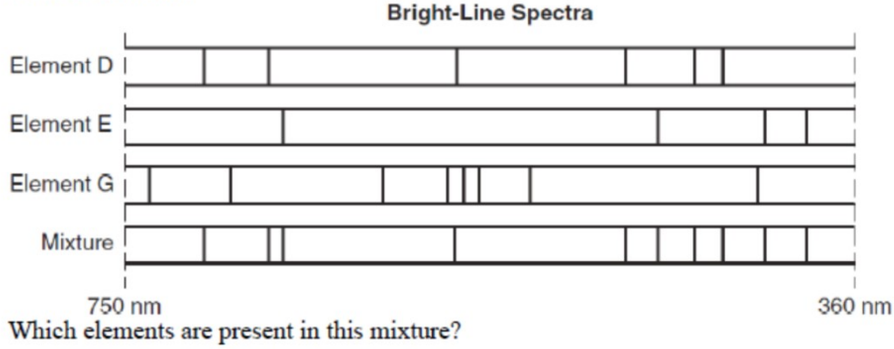
Charge 0 # Valence e⁻ 5  # unpaired valence e⁻ 3 # of bonds 3	Charge 0 # Valence e⁻ 4  # unpaired valence e⁻ ____ # of bonds ____
Charge +1 # Valence e⁻ 2 (not in diagram) [Li⁺] # unpaired valence e⁻ NA # of bonds NA	Charge 0 # Valence e⁻ 2  # unpaired valence e⁻ 0 # of bonds 0
Charge 0 # Valence e⁻ 6  # unpaired valence e⁻ 2 # of bonds 2	Charge 0 # Valence e⁻ 3  # unpaired valence e⁻ 3 # of bonds 3
Charge 0 # Valence e⁻ 6  # unpaired valence e⁻ 2 # of bonds 2	Charge 0 # Valence e⁻ 8  # unpaired valence e⁻ 0 # of bonds 0
Charge −2 # Valence e⁻ 8  # unpaired valence e⁻ NA # of bonds NA	Charge +2 # Valence e⁻ 8 (Not shown)  # unpaired valence e⁻ NA # of bonds NA

Bohr and Lewis Dot Diagrams Name _____

Element	Electron Configuration	Bohr Diagram	# Valence e⁻ # Kernel e⁻	Lewis Dot Diagram
Carbon p = 6 n = 6 e = 6	2-4		Valence e⁻ = 4 Kernel e⁻ = 2	
Oxygen p = 8 n = 8 e = 8	2-6		Valence e⁻ = 6 Kernel e⁻ = 2	
Sodium p = 11 n = 12 e = 11	2-8-1		Valence e⁻ = 1 Kernel e⁻ = 10	
Neon p = 10 n = 10 e = 10	2-8		Valence e⁻ = 8 Kernel e⁻ = 2	

Regents Chemistry **Ground vs. Excited State**

1. Given the bright-line spectra of three elements and the spectrum of a mixture formed from at least two of these elements:



Which elements are present in this mixture?

A) *E* and *D*, only B) *D*, *E*, and *G* C) *E* and *G*, only D) *D* and *G*, only

2. When an excited electron in an atom moves to the ground state, the electron

A) absorbs energy as it moves to a lower energy state
B) emits energy as it moves to a lower energy state
C) absorbs energy as it moves to a higher energy state
D) emits energy as it moves to a higher energy state

3. An electron in a sodium atom gains enough energy to move from the second shell to the third shell. The sodium atom becomes

A) a positive ion
B) a negative ion
C) an atom in the ground state
D) an atom in an excited state

4. A bromine atom in an excited state could have an electron configuration of

A) 2-8-18-6 B) 2-8-18-7
C) 2-8-17-7 **D) 2-8-17-8**

5. Which statement describes how an atom in the ground state becomes excited?

A) The atom absorbs energy, and one or more electrons move to a lower electron shell.
B) The atom releases energy, and one or more electrons move to a lower electron shell.
C) The atom releases energy, and one or more electrons move to a higher electron shell.
D) The atom absorbs energy, and one or more electrons move to a higher electron shell.

6. Which electron configuration represents an excited state for a potassium atom?

A) 2-8-7-2 B) 2-8-8-1
C) 2-8-8-2 D) 2-8-7-1

7. Which electron configuration represents an atom of aluminum in an excited state?

A) 2-8-6 B) 2-8-3 C) 2-7-7 **D) 2-7-4**

8. An electron in an atom moves from the ground state to an excited state when the energy of the electron

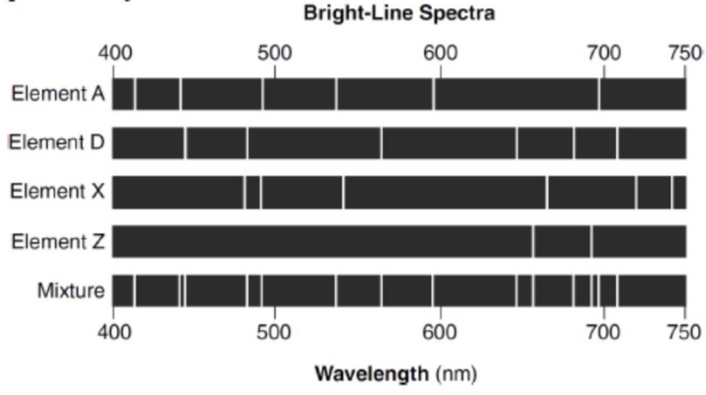
A) decreases **B) increases**
C) remains the same

9. When compared with the energy of an electron in the first shell of a carbon atom, the energy of an electron in the second shell of a carbon atom is

A) greater B) the same
C) less

Ground vs. Excited State

10. The diagram below represents the bright-line spectra of four elements and a bright-line spectrum produced by a mixture of three of these elements.



Which element is *not* present in the mixture?

A) *A* B) *D* **C) *X*** D) *Z*

11. Which electron configuration represents an atom in an excited state?

A) 2-2-1 B) 2-8 C) 2-8-1 D) 2-2

12. As an electron in a hydrogen atom moves from the second principal energy level to the first principal energy level, the energy of the atom

A) decreases B) increases
C) remains the same

13. During a flame test, a lithium salt produces a characteristic red flame. This red color is produced when electrons in excited lithium atoms

A) are gained by the atoms
B) move to higher energy states within the atoms
C) are lost by the atoms
D) return to lower energy states within the atoms

14. The bright-line spectrum of an element in the gaseous phase is produced as

A) electrons move from higher energy states to lower energy states
B) electrons move from lower energy states to higher energy states
C) protons move from higher energy states to lower energy states
D) protons move from lower energy states to higher energy states

15. The isotopes K-37 and K-42 have the same

A) total number of neutrons in their atoms
B) bright-line spectrum
C) mass number for their atoms
D) decay mode

16. Which electron configuration represents the electrons of an atom in an excited state?

A) 2–8–17–6 B) 2–8–1
C) 2–8–18–5 D) 2–8–6

17. When the electrons of an excited atom return to a lower energy state, the energy emitted can result in the production of

A) alpha particles B) protons
C) spectra D) isotopes

18. What causes the emission of radiant energy that produces characteristic spectral lines?

A) movement of electrons to higher energy levels
B) gamma ray emission from the nucleus
C) neutron absorption by the nucleus
D) return of electrons to lower energy levels

19. Which electron transition would result in the greatest absorption of energy?

A) 3*s* to 3*p* B) 3*s* to 2*s*
C) 3*s* to 4*p* D) 3*s* to 2*p*

Regents Chemistry **Name** _____
Electron Configuration Worksheet

For the questions 1-10, assume all atoms are neutral. Use the electron configurations to determine the identity of the element and whether it is in the ground or excited state.

Electron Configuration	Identity	Ground/Excited
1. 2-8-1	Na	GROUND
2. 2-8-16-3	Cu	EXCITED
3. 2-8-2	Mg	GROUND
4. 2-7-8	Cl	EXCITED
5. 1-3	Be	EXCITED
6. 2-8-6	S	GROUND
7. -18-32-18-4	Pb	GROUND
8. -18-32-17-3	Hg	EXCITED
9. 2-7	F	GROUND
10. 1-8	F	EXCITED

Give an electron configuration for the following:

11. Sulfur in its ground state.	2-8-6
12. Helium in an excited state.	1-1

13. Give the ground state electron configuration for calcium. 2-8-8-2
14. Give the correct electron configuration for the Ca^{+2} ion. 2-8-8
15. How many valence electrons are there in atom of bromine? 7
16. How many valence electrons are there in a Cl^- ion? 8
17. How many kernel electrons are there in a phosphorus atom? 10
18. How many valence electrons are there in a neon atom? 8
19. How many principal energy levels are there in a iron atom? 4