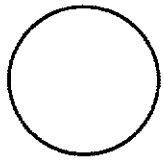
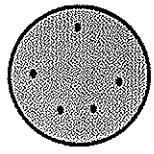
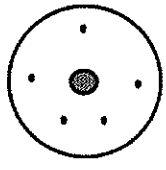
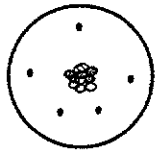
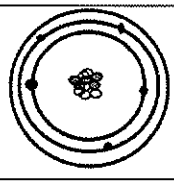
Unit 3 – Atomic History

33. List the parts of Dalton's Atomic Theory. What contributions to the atom did Rutherford and Thomson make? What experiments lead them to their discoveries?

Scientist	Experiment	Discovery	Model
Dalton	none	Atomic Theory • atoms of an element are identical • atoms of different elements are different	
Thomson	cathode ray tube experiment	plum pudding model → • discovered negative particle -electron-	
Millikan	oil drop experiment	charge and mass of an electron	None
Rutherford	gold foil experiment	• discovered dense center of positive charge -nucleus- -protons-	
Chadwick	none	• discovered neutral particle -neutron-	
Bohr	none	• quantized energy levels hold the electrons	

34. Which subatomic particle is responsible for the identity of an element?

protons - # of protons provides the identity

35. What is an:

a. Isotope

atoms of an element with a different # of neutrons
different neutrons means different masses.

b. Ion

atom of an element that has gained or lost an electron
so it has a positive or negative charge.

36. Complete the table for each of the following:

	atomic number	mass number	protons	neutrons	electrons
$^{23}_{11}Na^{+}$	11	23	11	12	10
$^{80}_{35}Br^{-}$	35	80	35	45	36
$^{9}_{4}Be$	4	9	4	5	4
$^{32}_{16}S^{-2}$	16	32	16	16	18

37. How are different types of electromagnetic radiation similar? How do they differ?

different wavelengths and frequencies and energies
same speed (speed of light)

38. List the visible spectrum in order of **increasing** frequency.

Radiowaves, microwaves, infrared, visible, ultraviolet, x-rays, gamma

$$\Delta E = E_f - E_i$$

$c = \lambda f$
$c = 3.00 \times 10^{17}$ nm/s
$c = 3.00 \times 10^{8}$ m/s

$$E = \frac{hc}{\lambda}$$

$E = hf$
$h = 3.989 \times 10^{-13}$ kJ s /mol
$h = 6.626 \times 10^{-34}$ Js

39. Which equation relates wavelength and frequency?

$c = \lambda f$

40. Which equation relates frequency and energy?

$E = hf$

41. What equation relates wavelength and energy?

$E = \frac{hc}{\lambda}$

42. What is the frequency of light with a wavelength of 250 nm?

$c = \lambda f$ $\quad f = \frac{c}{\lambda} = \frac{3.00 \times 10^{17}\ nm/s}{250\ nm} = 1.2 \times 10^{15}\ Hz$

43. The energy emitted from a wave is 4.8×10^{-19} J. What is the wavelength in nm? Show all your work. $E = \frac{hc}{\lambda}$ $\quad \lambda = \frac{hc}{E} = \frac{6.626 \times 10^{-34}\ Js \times 3.00 \times 10^{17}\ nm/s}{4.8 \times 10^{-19}\ J} = 410\ nm$

44. How much energy is emitted if the wavelength is 4.8×10^{2} nm? Show all your work.

$E = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34}\ Js \times 3.00 \times 10^{17}\ nm/s}{480\ nm} = 4.1 \times 10^{-19}\ J$

$= \frac{3.989 \times 10^{-13}\ kJ/mol \times 3.00 \times 10^{17}\ nm/s}{480\ nm} = 250\ kJ/mol$

45. What does it mean that the energy levels of hydrogen are quantized? What experimental evidence exists for this?

Energy levels are quantized. Only certain values are allowed. It's like a ramp vs. a staircase

46. What causes hydrogen (elements) to emit light?

electrons absorb energy, they jump to a higher energy level when the electrons drop back down to ground state the energy the release is in the form of light.

47. Calculate the change in energy, ΔE, in kJ/mol when a mole of electrons are excited from the 1st energy level (-1312 kJ/mol) to the 4th (-82.00 kJ/mol). Is this amount of energy absorbed or released? How do you know?

$\Delta E = E_f - E_i$

$\Delta E = E_4 - E_1$

$= -82.00 - -1312 \text{ kJ/mol} = 1230 \text{ kJ/mol}$

↑ jump up
energy is absorbed
$+\Delta E$

48. Which electron transition would emit the most energy: 6-1, 5-1, or 3-1?

6→1 is largest difference jump, so most energy emitted

Unit 4 - Periodic Table

49. Define the following terms:

a. Group vertical column on periodic table

b. Period horizontal row on periodic table

50. Which elements have similar properties, elements in the same column or same row?

same column → groups have similar properties.

51. Where are metals located? What are the properties?

left of the metalloids

- ductile
- malleable
- lustrous
- mostly silvery color
- good conductors
- mostly solids

52. Where are metalloids located? What are the properties?

along the stair step

properties of both metals/nonmetals

53. Where are the nonmetals located? What are the properties?

right of the metalloids

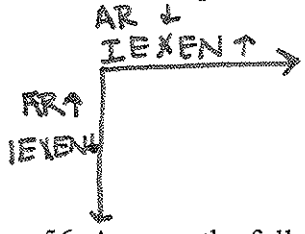
- brittle
- dull
- poor conductors
- mostly solids/gases

54. Where is the most reactive non metal located? Where is the most reactive metal located?

Bottom left -Fr

top right F (excludes noble gas)

55. Describe the trends for atomic radius, ionization energy, and electronegativity as you move across a period and down a group on the periodic table?



AR - Increases down because electrons are added to new energy levels. Decreases across because electrons are in the same level, but attraction increases.

IE/EN - decreases down because atom is larger and attraction is smaller. Increases across because atom is smaller and attraction is larger.

56. Arrange the following sets of elements in order of increasing ionization energy:

a. Li, K, Cs — Cs, K, Li

b. Li, C, F — Li, C, F

c. F, Cl, I — I, Cl, F

d. Ge, Ga, In — In, Ga, Ge

57. Arrange the following sets of elements in order of decreasing radius (size)

~~a. O, O^-, O^{-2}~~

b. Ge, Ga, In — Ge, Ga, In

c. Li, Cs, Rb — Li, Cs, Rb

d. Pb, Sn, Sb — Sb, Sn, Pb

58. Arrange the following sets of elements in order of increasing electronegativity:

a. C, N, O — C, N, O

b. S, Se, Cl — Se, S, Cl

c. Si, Ge, Sn — Sn, Ge, Si

d. Tl, S, Ge — Tl, Ge, S

59. Describe an electron's orbital according to the quantum mechanical model. How often is an electron found in this orbital?

area where an electron is likely to be found 90% of the time. Not a circular orbit. 3D shape

60. Complete the following chart for the sublevels in the quantum model.

	Shape	Number of orbitals	Maximum number of electrons
s	sphere	1	2
p	dumbbell	3	6
d	clover	5	10
F	crazy	7	14

61. What are the Auf bau Principle, Pauli Exclusion Principle, and Hund's Rule?

Auf bau - fill lowest energy level first

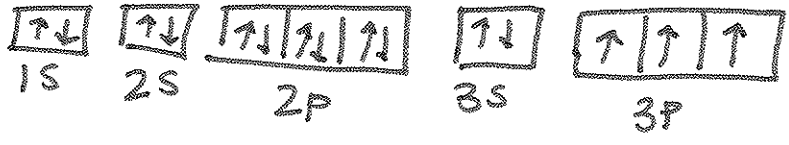
Pauli Exclusion Principle, - if 2 electrons are in the same orbital they have opposite spins

Hund's Rule - electrons spread in separate equal energy orbitals before doubling up.

62. Write the electron configuration, orbital diagram and abbreviated noble gas notation for Phosphorus P. 15e⁻

$1s^2 2s^2 2p^6 3s^2 3p^3$

$[Ne]\ 3s^2 3p^3$



63. Complete the following table:

	Period	Group	Element	Type (metal/ non metal/ metalloid)
$[Ne]3s^2 3p^2$	3	14	Si	metalloid
$[Kr]5s^2 4d^2$	5	4	Zr	metal
$[Ar]4s^2 3d^7$	4	9	Co	metal
$[Ne]3s^2 3p^6$	3	18	Ar	nonmetal
$[Kr]5s^2 4d^{10} 5p^5$	5	17	I	non metal

64. Given the electron configuration for the following neutral atoms, determine the number of valence electrons, and predict the charge of the ion it commonly forms:

Element Symbol	Configuration	Valence electrons	Predicted Charge
Mg	$1s^2 2s^2 2p^6 3s^2$	2	+2
Na	$1s^2 2s^2 2p^6 3s^1$	1	+1
Ne	$1s^2 2s^2 2p^6$	8	0
F	$1s^2 2s^2 2p^5$	7	-1
B	$1s^2 2s^2 2p^1$	3	+3

65. Be able to identify the number of valence electrons, empty orbitals, unpaired electrons, etc. for any element.