

Name: _____ Period: _____ Date: _____
Homework: Electromagnetic Radiation and Quantum Theory

Complete the following wavelength problems.

1. What is the frequency of blue light if its wavelength is 595nm?

$$595 \text{ nm} \times \frac{1 \text{ m}}{1 \times 10^9 \text{ nm}} = 5.95 \times 10^{-7} \text{ m} \quad \nu = \frac{3.0 \times 10^8 \frac{\text{m}}{\text{s}}}{5.95 \times 10^{-7} \text{ m}} = \boxed{5.04 \times 10^{14} \frac{1}{\text{s}}}$$

2. What is the wavelength of a wave if the frequency is 5.56×10^{13} Hz?

$$\lambda = \frac{3.0 \times 10^8 \frac{\text{m}}{\text{s}}}{5.56 \times 10^{13} \text{ Hz}} = \boxed{5.40 \times 10^{-6} \text{ m}}$$

3. What is the frequency of a wave if the wavelength is 2.13m?

$$\nu = \frac{3.0 \times 10^8 \frac{\text{m}}{\text{s}}}{2.13 \text{ m}} = \boxed{1.41 \times 10^8 \frac{1}{\text{s}}}$$

4. What is the wavelength of if the frequency is 3.87×10^{12} Hz?

$$\lambda = \frac{3.0 \times 10^8 \frac{\text{m}}{\text{s}}}{3.87 \times 10^{12} \text{ Hz}} = \boxed{7.75 \times 10^{-5} \text{ m}}$$

Answer the following short answer questions.

5. What characteristic of a light wave determines whether or not the light will cause a positive photoelectric effect?

frequency

6. What is the speed of light?

$$3.0 \times 10^8 \frac{\text{m}}{\text{s}}$$

7. The number of complete waves passing a fixed point in a given time is called?

frequency

8. The wavelength of microwave radiation is (shorter/longer) than the wavelength of visible light.

9. What type of radiation is produced by a heat lamp?

infra red

10. A wave with a high frequency has a (short) wavelength.

Match the following scientists with their contributions. (a scientist may be used more than once)

a. Planck b. Einstein c. Compton d. DeBroglie e. Bohr f. Heisenberg

E 11. Used the atoms line spectrum to explain quantized energy levels.

A 12. Wrote the equation $E = h\nu$.

A 13. Stated that energy is emitted or absorbed in discrete pieces called quanta.

B 14. Proposed the photoelectric effect.

C 15. Demonstrated that an photon could collide with an electron.

D 16. Stated all objects have wavelike behavior, but for most objects their mass is too great for the wave to be observable.

B 17. Proposed that light consists of quanta of energy.

F 18. Proposed that it is virtually impossible to simultaneously measure the momentum and the position of an electron.

C 19. Proved that light consists of tiny particles, or photons.

E 20. Labeled each energy level by its quantum number, n .

Choose the best answer for the following multiple choice.

C 21. DeBroglie derived a mathematical relationship between the mass and velocity of a moving particle and the _____ that it would exhibit.

- a. motion c. wavelength
b. amplitude d. charge

A 22. When radiation is absorbed by a hydrogen electron, the hydrogen atom changes its ground state to _____

- a. an excited state c. another atom
b. a lower state d. the nucleus of the atom

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Homework: Quantum Numbers and Electron Configuration

Answer the following questions based on your knowledge of quantum numbers.

1. What is the name of the set of numbers given to electrons in an atom, (the electrons temporary address).

quantum numbers

2. Describe an orbital pair.

the 2 e⁻ that share a pathway

3. What does Heisenberg's Principle state?

It's impossible to measure speed & location at the same time

4. Which quantum level signifies the number of sublevels?

#2 - azimuthal (l)

5. What is the pathway of an electron called?

orbital

6. What is the maximum number of electrons that the third energy level can have?

n=3 max # e⁻ is 18e⁻

7. What does the magnetic quantum number refer to?

the orbitals direction in space

8. What are the labels for the four principle quantum numbers?

n, l, m, s

9. What does the Pauli Principle state?

the 2e⁻ that share an orbital must have opposite spins

10. Which quantum number refers to the size of an electron cloud?

n (energy level)

Answer the following questions pertaining to quantum numbers.

11. If n=1, what is the total number of orbitals present?

1

12. If n=4, what is the maximum number of electrons that can be present?

32

13. If n=3, what is the maximum number of electrons that can be present?

18

14. If n=2, what is the total number of orbitals present?

4 (1s + 3p)

15. If n=2, what are the names of the sublevels that exist?

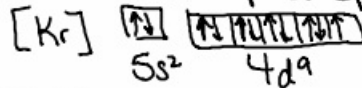
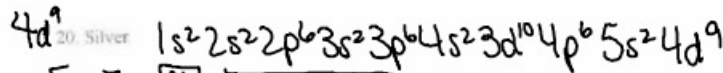
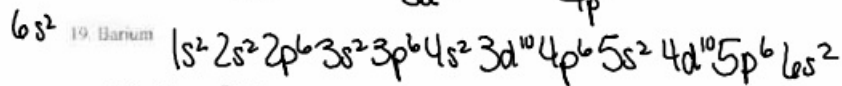
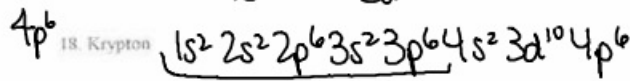
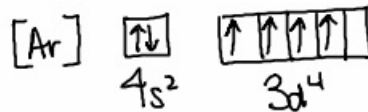
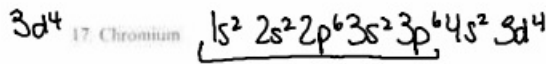
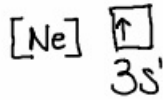
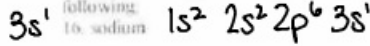
s + p

Full Electron Configuration - always starts at Hydrogen

Shorthand - refers to last completed noble gas [] then lists anything new
 Orbital Filling - build orbital boxes over shorthand

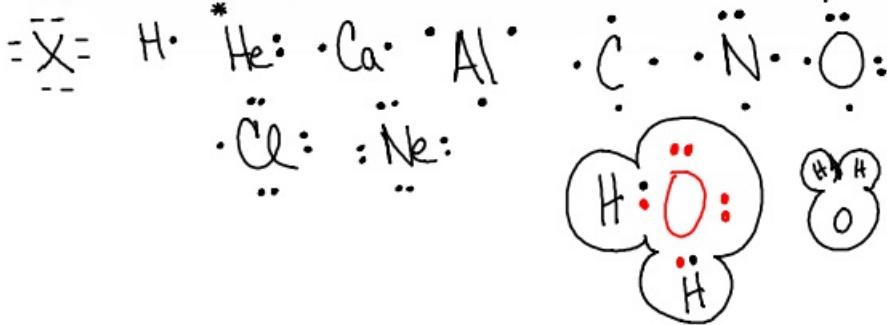
s=1
p=3
d=5
f=7

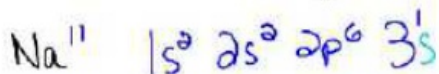
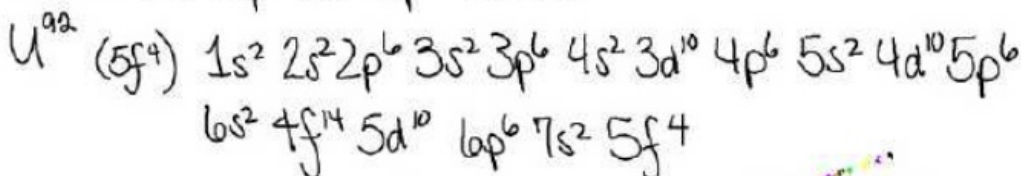
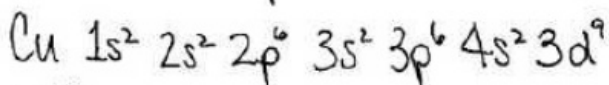
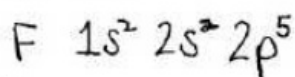
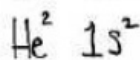
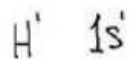
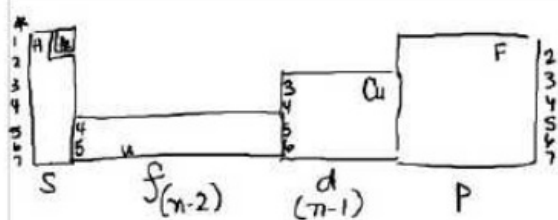
Write the full electron configuration, short hand configuration and orbital notation for the following:



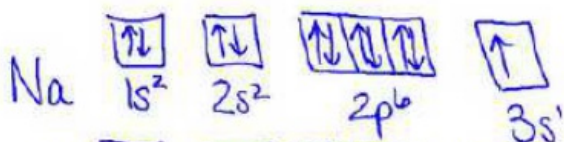
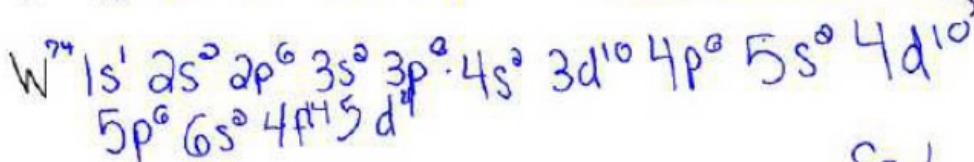
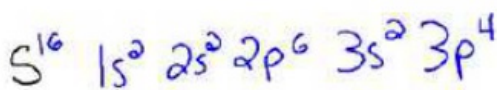
Lewis Dot Diagram -

Illustrates valence e⁻ valence e⁻ come from s & p sublevels





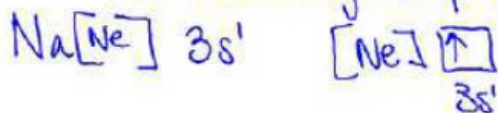
electron configuration
(no spin info)

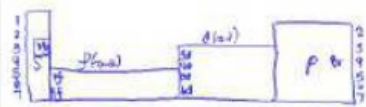


Orbital diagrams
S = 1
P = 3
Include spin
d = 5
f = 7

Short hand - refer to last completed noble gas then record any new portions.

[symbol of Noble gas]





$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^0 4p^6 5s^2 4d^0 5p^6 6s^2 4f^{14} 5d^0 6p^6$
 $7s^2 5f^{14} 6d^0 7p^6$

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

Br $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

Bi $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6$
 $6s^2 4f^{14} 5d^0 6p^3$

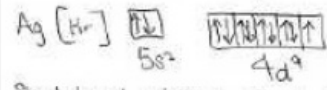
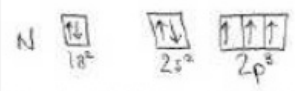
N $1s^2 2s^2 2p^3$

Ag $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^9$

U $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^0 6p^6 7s^2 5f^4$

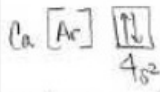
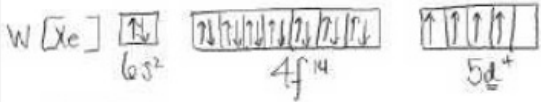
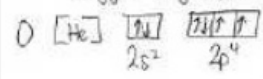
Electron Configuration

Orbital Diagram
 orbitals (2e) s=1 p=3 d=5 f=7

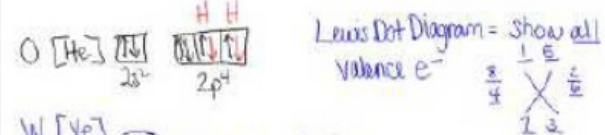
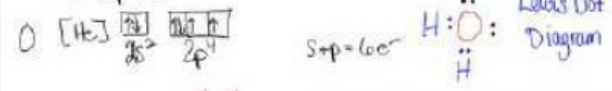


Short hand notation refers to the last completed noble gas:

Practice: Orbital Notation (using shorthand)
 Oxygen, Tungsten, Calcium



Valence e⁻ (involved in bonding & ions)
 s & p e⁻



W [Xe] $(6s^2 4f^{14} 5d^4) \cdot W \cdot$

Al [Ne] $3s^2 3p^1 \text{ valence } = 3e^- \cdot Al \cdot$

