

## LIGHT CALCULATIONS & PROPERTIES OF LIGHT WORKSHEET

- 1.) Look at the EM spectrum to answer this question.  
As you move across the visible light spectrum from red to violet...
  - (A) Does the wavelength increase or decrease?
  - (B) Does the frequency increase or decrease?
  - (C) Does the energy increase or decrease?
- 2.) A beam of microwaves has a frequency of  $1.0 \times 10^9$  Hz. A radar beam has a frequency of  $5.0 \times 10^{11}$  Hz. Which type (microwave or radar)...
  - (A) has a longer wavelength?
  - (B) is closer to visible light on the EM spectrum?
  - (C) is closer to x-rays in frequency value?
- 3.) What is the frequency of an EM radiation wave if its wavelength is  $3.6 \times 10^{-9}$  meters?
- 4.) A beam of EM radiation has a wavelength of  $4.257 \times 10^{-7}$  cm. What is its frequency?
- 5.) A photon of light has a wavelength of  $3.20 \times 10^5$  meters. Find...
  - (A) the frequency
  - (B) the energy
  - (C) the region of the EM spectrum/type of radiation
- 6.) A photon has an energy of  $4.00 \times 10^{-19}$  J. Find...
  - (A) the frequency
  - (B) the wavelength
  - (C) the region of the EM spectrum/type of radiation
- 7.) A bright line spectrum contains a line with a wavelength of 518 nm. Determine...
  - (A) the wavelength in meters
  - (B) the frequency
  - (C) the energy
  - (D) the color
- \*8.) Cobalt-60 is an artificial radioisotope that is produced in a nuclear reactor for use as a gamma ray source in the treatment of certain types of cancer. If the wavelength of the gamma radiation from a cobalt-60 source is  $1.00 \times 10^{-3}$  nm, calculate the energy of a photon of this radiation.
- 9.) Which has a longer wavelength, orange or violet light?
- 10.) Which has a higher energy, x-rays or gamma rays?
- 11.) Which has a lower frequency, radio waves or green light?
- 12.) Which has the shortest wavelength, violet or ultraviolet light?
- 13.) Which has lower energy, infrared light or x-rays?

- 14.) \_\_\_\_\_ formed a theory to explain the structure of an atom by revising physical theories.
- 15.) As the energy level increases, the amount of energy an electron will possess \_\_\_\_\_.
- 16.) Electrons give off energy in finite amounts called \_\_\_\_\_ when returning to the ground state.
- 17.) When this energy is released in the form of light it is called a \_\_\_\_\_.
- 18.) Bohr chose the element \_\_\_\_\_ to prove his theory.

True or False

- 19.) Electrons may regularly occupy spaces between energy levels.
- 20.) The varying wavelengths on the electromagnetic radiation spectrum travel at different speeds.
- 21.) Atoms release energy when electrons jump to higher energy levels.

### **ELECTRON ARRANGEMENT WORKSHEET**

1. What is an electron cloud?
2. Name the three major divisions within an electron cloud with respect to the energy of an electron.
3. What letter represents the principal quantum number?
4. What does the principal quantum number tell about an electron?
5. What formula is used to determine the maximum number of electrons that can occupy any energy level?
6. What is the maximum number of electrons for each of the following?  
(A) 1st energy level    (B) 4th energy level    (C)  $n = 3$     (D)  $n = 5$
7. Energy levels are divided into \_\_\_\_\_.
8. How can we determine the possible number of sublevels in any energy level?
9. Name the four primary sublevels in order of increasing energy.
10. Circle the sublevel that represents the lowest energy in each pair.  
(A) 1s or 2s    (B) 2s or 2p    (C) 4f or 4d    (D) 3d or 4s    (E) 7s or 5d  
(F) 6s or 4s    (G) 4p or 5p    (H) 3s or 3d    (I) 2p or 3s
11. Sublevels are divided into \_\_\_\_\_.
12. Each orbital can hold up to \_\_\_\_\_ electrons.
13. How many orbitals are in each sublevel?  
(A) s \_\_\_\_\_    (B) p \_\_\_\_\_    (C) d \_\_\_\_\_    (D) f \_\_\_\_\_

### **QUANTUM NUMBERS WORKSHEET**

	<u>1s</u>	<u>2s</u>	<u>2p</u>	<u>3s</u>	<u>3p</u>	<u>3d</u>	<u>4s</u>	<u>4p</u>	<u>4d</u>	<u>4f</u>	<u>5s</u>	<u>5p</u>
1.)	-	-	----	-	----	-----	-	----	-↑----	-----	-	----
2.)	-	↑	----	-	----	-----	-	----	-----	-----	-	----
3.)	-	-	---↓	-	----	-----	-	----	-----	-----	-	----
4.)	-	-	----	-	----	-----	-	----	-----	-----	-	----



5. Which has a higher energy, gamma or x-rays?
6. Which has a shorter wavelength, radio or ultraviolet?
7. Which has a lower frequency, yellow or green light?
8. In the equation  $E = h \cdot \nu$ , energy and frequency are \_\_\_\_\_ proportional.
9. In the equation  $c = \lambda \cdot \nu$ , wavelength and frequency are \_\_\_\_\_ proportional.
10. The symbol for wavelength is \_\_\_\_\_.
11. Electrons give off energy in the form of a \_\_\_\_\_ when returning to the ground state.
12. Which scientist proposed the idea that electrons travel around the nucleus in fixed paths?
13. When an electron moves from the ground state to the excited state, energy is \_\_\_\_\_.
14. Bohr chose the element \_\_\_\_\_ to prove his theory.
15. The dual wave-particle nature of electrons describes how the electrons in atoms can behave as \_\_\_\_\_ and \_\_\_\_\_.

### Section III - Electrons

16. What is the maximum number of electrons in any orbital?
17. The principal quantum number,  $n$ , indicates the \_\_\_\_\_.
18. The maximum number of electrons in an energy level can be determined by the equation \_\_\_\_\_.  
That means the maximum number of electrons in the 3rd energy level is \_\_\_\_\_.
19. The number of sublevels in any energy level can be determined by \_\_\_\_\_.
20. The number of orbitals in an energy level can be determined by the equation \_\_\_\_\_.  
3rd energy level has \_\_\_\_ orbitals. (\_\_\_\_ = "s" orbital, \_\_\_\_ = "p" orbitals, and \_\_\_\_ = "d" orbitals)
21. List the four sublevels according to increasing energy.
22. The "s" sublevel is shaped like a \_\_\_\_\_ and has \_\_\_\_ orbitals.
23. A "p" sublevel is shaped like a \_\_\_\_\_ and has \_\_\_\_ orbitals.
24. The "d" sublevel has \_\_\_\_ orbitals and the "f" sublevel has \_\_\_\_ orbitals.

### Section IV - Electron configuration, noble gas configuration, valence electrons, orbital notations

25. What is the electron configuration for phosphorus?
26. How many total electrons are in a neutral atom of phosphorus?
27. Write the noble gas configuration for phosphorus.
28. What is the highest occupied energy level for phosphorus?
29. What is the atomic number of phosphorus?
30. Draw the orbital notation for the highest occupied energy of phosphorus.
31. Circle the last electron added to phosphorus in #30. What are the four quantum numbers for this electron?  
 $n =$                        $l =$                        $m =$                        $s =$

32. How many electrons are in the highest occupied energy level of phosphorus?
33. How many inner-shell electrons does phosphorus have?
34. In which orbitals are the inner-shell electrons located?
35. Draw the electron dot diagram for phosphorus.

Section V - Quantum numbers (Honors level only)

36. How many electrons can be described by the quantum numbers  $n = 3$  and  $\ell = 1$ ?
37. How many electrons in an atom can have the quantum numbers  $n = 2$  and  $\ell = 3$ ?
38. How many electrons can have the value  $n = 3$ ?
39. How many electrons in an atom have the quantum numbers  $n = 4$  and  $\ell = 2$ ?
40. Which of the following sets of quantum numbers does NOT represent a possible set of quantum numbers? (There may be more than one correct answer.)

	<u>n</u>	<u>ℓ</u>	<u>m</u>	<u>s</u>
(A)	4	8	-4	$\frac{1}{2}$
(B)	6	5	-5	$\frac{1}{2}$
(C)	3	2	2	$\frac{1}{2}$
(D)	6	0	1	$\frac{1}{2}$