

## 3.E: Electronic Structure (Exercises)

### 3.1: Light

\*Read about light [here](#) and [here](#).

1. Describe the characteristics of a light wave.
2. What is the frequency of light if its wavelength is  $7.33 \times 10^{-5} \text{ m}$ ?
3. What is the frequency of light if its wavelength is 733 nm?
4. What is the wavelength of light if its frequency is  $8.19 \times 10^{14} \text{ s}^{-1}$ ?
5. Place the following in order of increasing energy.

visible light, microwaves, radio waves, gamma radiation, x-rays, infrared light, ultraviolet light

6. "5G" cell phone signal uses electromagnetic radiation (light) with wavelengths of 0.001 m - 0.01 m. What category (see the previous question) does this fall into?

Answers:

1. Light has a wavelength and a frequency.
2.  $4.09 \times 10^{12} \text{ s}^{-1}$
3.  $4.09 \times 10^{14} \text{ s}^{-1}$
4.  $3.66 \times 10^{-7} \text{ m}$
5. radio waves < microwaves < infrared < visible < ultraviolet < x-rays < gamma
6. microwave

### 3.2: Electron Behaviour

1. Which of the following electron transitions would result in emission of light? ("n" is the shell)
  - a.  $n=1 \rightarrow n=3$
  - b.  $n=2 \rightarrow n=1$
  - c.  $n=2 \rightarrow n=5$
  - d.  $n=1 \rightarrow n=7$
2. Which of the following electron transitions would result in absorption of light? ("n" is the shell)
  - a.  $n=5 \rightarrow n=3$
  - b.  $n=2 \rightarrow n=1$
  - c.  $n=2 \rightarrow n=5$
  - d.  $n=7 \rightarrow n=6$
3. The hydrogen atom only has one electron. What shell represents the "ground state" for that electron?
4. The hydrogen atom only has one electron. What shell(s) represents an "excited state" for that electron?

Answers

1. Which of the following electron transitions would result in emission of light? ("n" is the shell)
  - b.  $n=2 \rightarrow n=1$
2. Which of the following electron transitions would result in absorption of light? ("n" is the shell)
  - c.  $n=2 \rightarrow n=5$
3.  $n = 1$
4.  $n = 2$  through  $n = \infty$

### 3.3 - 3.5: Electron Configurations

1. How many subshells are completely filled with electrons for Na? How many subshells are unfilled?
2. What is the maximum number of electrons in the entire  $n = 2$  shell?
3. Write the complete electron configuration for each atom.
  - a. Si, 14 electrons
  - b. Sc, 21 electron
4. Write the complete electron configuration for each atom.
  - a. Cd, 48 electrons
  - b. Mg, 12 electrons
5. Write the noble gas abbreviated electron configuration for each atom in question 3.

#### Answers

1. Three subshells (1s, 2s, 2p) are completely filled, and one shell (3s) is partially filled.
2. 8 electrons
3. a.  $1s^2 2s^2 2p^6 3s^2 3p^2$ , b.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$
4. a.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10}$ ,  $1s^2 2s^2 2p^6 3s^2$
5. a.  $[\text{Ne}]3s^2 3p^2$ ,  $[\text{Ar}]4s^2 3d^1$

### 3.6: Periodic Trends

1. State the trends in atomic radii as you go across (right) and down the periodic table.
2. State the trends in IE as you go across and down the periodic table.
3. Which atom of each pair is larger?
  - a. Na or Cs
  - b. N or Bi
  - c. C or Ge
  - d. C or B
4. Which atom has the higher IE?
  - a. Na or S
  - b. Cl or Br
5. Which atom has the greater magnitude of EA?
  - a. Cl or F
  - b. Al or Cl

#### Answers

1. Across (right) = smaller radius/size, down = larger radius/size
2. Across (right) = higher IE, down = lower IE
3. Which atom of each pair is larger?
  - a. Cs
  - b. Bi
  - c. Ge
  - d. B
4. Which atom has the higher IE?
  - a. S
  - b. Cl
5. Which atom has the greater magnitude of EA?
  - a. F
  - b. Cl

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