Chemistry: Ch. 5 & 13 Worksheet: Name: Answer Key

1. Fill in the following chart.

Isotope	Symbol	Mass Number	# of Protons	# of Neutrons	#of Electrons
Copper-65	^{65}Cu	65	29	36	29
Silicon-30	^{30}Si	30	14	16	14
tungsten-184	^{184}W	184	74	110	74

2. What is the relationship between frequency and wavelength of any electromagnetic wave?

Frequency and wavelength are inversely proportional. As one increases, the other decreases as seen by the equation $c = \lambda \cdot \nu$

3. How do photons relate to wavelengths of waves?

A photon is the smallest unit of light energy and therefore possess all qualities of the wave including wavelength

4. Rank the following waves from shortest to longest wavelengths? Show your work.

a) 8.5×10^{-6} km (0.0085 m) b) 4.7×10^{-1} cm (0.0047 m) c) 4250 nm (4.25×10^{-6} m)

$\frac{8.5\times10^{-6}\text{ km}}{} \cdot \frac{1000\text{ m}}{1\text{ km}}$ $\frac{4.7\times10^{-1}\text{ cm}}{} \cdot \frac{1\text{ m}}{100\text{ cm}}$ $\frac{4250\text{ nm}}{} \cdot \frac{1\text{ m}}{1\times10^{9}\text{ nm}}$ $c < b < a$

5. A source produces green light of wavelength 5.11×10^3 Å . What is this wavelength meters?

$$5.11\times10^{3}\text{ Å} \cdot \frac{1\text{ m}}{1\times10^{10}\text{ Å}} = 5.11\times10^{-7}\text{ m}$$

6. KFOR broadcasts at a frequency of 1240 kHz (kilohertz).

a. What is the wavelength for this wave?

$$\lambda = \frac{c}{\nu} \quad \frac{2.998\times10^{8}\text{ m}}{\text{s}} \cdot \frac{\text{s}}{1240\times10^{3}} = 242\text{ m}$$

b. What is the energy per photon of this wave?

$$E = h\cdot\nu \quad 6.626\times10^{-34}\text{ J}\cdot\text{s} \cdot \frac{1240\times10^{3}}{\text{s}} = 8.22\times10^{-28}\text{ J}$$

7. What is the energy in kJ for light with wavelength 250 nm?

$$E = h\nu = h\cdot\frac{c}{\lambda} \quad 6.626\times10^{-34}\text{ J}\cdot\text{s} \cdot \frac{2.998\times10^{8}\text{ m}}{\text{s}} \cdot \frac{1}{250\text{ nm}} \cdot \frac{1\times10^{9}\text{ nm}}{1\text{ m}} = 7.9\times10^{-19}\text{ J}$$

8. For the electronic transition (movement of electrons) of $n_i = 5$ to $n_f = 1$ in a hydrogen atom, calculate the energy, the frequency, the wavelength, the general type of radiation and whether the radiation is absorbed or emitted.

$$E = R_H\left(\frac{Z^2}{n_i^2} - \frac{Z^2}{n_f^2}\right) = 2.179\times10^{-18}\text{ J}\left(\frac{1}{5^2} - \frac{1}{1^2}\right)$$

$$\boxed{E = -2.09\times10^{-18}\text{ J}}$$

$$\nu = \frac{E}{h} \quad \frac{2.09\times10^{-18}\text{ J}}{6.626\times10^{-34}\text{ J}\cdot\text{s}} = 3.16\times10^{15}\text{ s}^{-1}$$

$$\lambda = \frac{c\cdot h}{E} \quad \frac{2.998\times10^{8}\text{ m}}{\text{s}} \cdot \frac{6.626\times10^{-34}\text{ J}\cdot\text{s}}{2.09\times10^{-18}\text{ J}} = 9.50\times10^{-8}\text{ m}$$

ultraviolet

9. For n = 4 in an atom, what are the possible values of l? For $l = 2$, what are the possible values of m?

if $n = 4$; $l = 0, 1, 2, 3$

if $l = 2$; $m = -2, -1, 0, +1, +2$

10. Which of the following are sets of quantum numbers are permissible for an electron in a hydrogen atom

a. $n = 2$, $l = 1$, $m = 1$, $s = +\frac{1}{2}$ b. $n = 1$, $l = 0$, $m = -1$, $s = -\frac{1}{2}$ c. $n = 4$, $l = 2$, $m = -2$, $s = +\frac{1}{2}$

yes no if $l=0$; $m=0$ yes

For those that are permissible, write the appropriate electron configuration designation (e.g. 1s)

a. 2p c. 4d

For those that are not permissible, explain why they are not correct.

b. No if $n=1$, $l=0$. and $m=0$

↳ s orbital in the s-subshell

13. Write the correct electron configurations for the following elements

a. Rb $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$

b. Se $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

c. Ag $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1 4d^{10}$ (exception to aufbau)

↳ ½ filled or full filled d-subshell by taking (n+1)s electrons

14. Draw an orbital diagram for the following elements

a. Ca ↑↓ : ↑↓ , ↑↓ ↑↓ ↑↓ : ↑↓ , ↑↓ ↑↓ ↑↓ , _ _ _ _ _ : ↑↓

b. Cu ↑↓ : ↑↓ , ↑↓ ↑↓ ↑↓ : ↑↓ , ↑↓ ↑↓ ↑↓ , ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ : ↑

c. Kr ↑↓ : ↑↓ , ↑↓ ↑↓ ↑↓ : ↑↓ , ↑↓ ↑↓ ↑↓ , ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ : ↑↓ , ↑↓ ↑↓ ↑↓

– energy levels are separated by colons

– subshells are separated by commas

15. Calculate the number of aluminum atoms in a piece of aluminum wire weighing 1.000 g.

$$\frac{1.000\text{ g Al}}{} \times \frac{1\text{ amu}}{1.6605\times10^{-24}\text{ g}} \times \frac{1\text{ Al atom}}{26.98150\text{ amu}} = 2.23\times10^{22}\text{ Al atoms}$$

16. Some human proteins are useful in medical treatments. For example, the protein tPA (tissue plasminogen activator) is sometimes useful in treating heart attack victims; it reduces clotting. One way to make this protein for commercial use is to clone the gene into goats in such a way that the goats excrete it in their milk. The demand for tPA is about 75 kilograms per year. A goat produces about 400 L milk per year. The milk contains about 1 g tPA per liter of milk. Approximately how many goats would be needed to produce enough tPA?

$$\frac{75\text{ kg tPA}}{\text{year}} \times \frac{1000\text{ g}}{1\text{ kg}} \times \frac{1\text{ L milk}}{1\text{ g tPA}} \times \frac{1\text{ goat}}{400\text{ L milk}} = 187.5\text{ goats} = 200\text{ goats}$$

17. The Kentucky derby is a 10.0 furlong race. The record time for winning this race is 1 minute and 59 2/5 seconds set by Secretariat in 1973. Convert this to miles per hour.

$$\frac{10.0\text{ furlong}}{119.4\text{ sec}} \times \frac{660\text{ ft}}{1\text{ furlong}} \times \frac{1\text{ mi}}{5280\text{ ft}} \times \frac{60\text{ sec}}{1\text{ min}} \times \frac{60\text{ min}}{1\text{ hr}} = 37.7\text{ mi/hr}$$

1 min = 60 sec + 59 sec + $\frac{2}{5}$ = 119.4 sec