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Chapter 3 Practice Worksheet:
Periodicity and Atomic Structure

1) An infrared wave is measured to have a wavelength of 5.6×10^4 nm. What is its frequency?

2) Almost all commercially available microwave ovens employ radiation with a frequency of 2.45×10^9 s^{-1}. Calculate the wavelength of this radiation.

3) An FM radio station broadcasts at a frequency of 9.87×10^7 s^{-1} (98.7 MHz). Calculate the wavelength of the radio waves. What is the energy of one photon of this radiation?

4) Both blue and green light eject electrons from the surface of potassium. In which case will the ejected electrons have the higher average kinetic energy? Explain your answer.

5) What is the speed of an electron that has a de Broglie wavelength of 100.0 nm? (Mass of an electron = 9.11×10^{-31} kg)

6) Find the wavelength (in nm) of an electron of mass 9.11×10^{-31} kg moving at 3.00×10^7 m/s.

7) Find the wavelength (in nm) of a baseball of mass 0.14 kg moving at 85 mph.

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8) a. Describe the difference between absorption and emission spectra. How is each one obtained? Go to http://www.wwnorton.com/chemistry/tutorials/ch3.htm, section 3.3 tutorial for an overview.

9) Why do elements exhibit line spectra instead of continuous emission spectra?

10) What is meant by the word orbital?

11) Describe the difference between a shell, a subshell, and an orbital. Which quantum number corresponds to each?

12) What happens to the probability of finding an electron as you move further away from the nucleus?

13) Draw the shapes of the ***s***, ***p***, and ***d*** orbitals. How many orientations exist for each set?

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14) Draw orbital energy diagrams for the n=1, n=2, n=3 and n=4 energy levels for an atom. Include all sublevels and orbitals. Place the sublevels in the correct "filling order".

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15) a. What is the maximum number of electrons that can exist in a single orbital?

b. How many electrons can exist in the p subshell? What is the m value for each?

c. How many electrons can exist in the $2p_x$ orbital?

d. How many p orbitals are in the n = 2 shell?

e. How many electrons can exist in the d subshell? What is the ℓ value of the d subshell?

f. How many subshells are allowed in the n = 3 shell? What is the ℓ value of each?

g. How many d orbitals are allowed in the n = 3 shell? What is the m number of each?

h. How many electrons can exist in the n = 3 shell?

16) Describe the Aufbau Principle, the Pauli Exclusion Principle, and Hund's Rule. Give an example of each with orbital diagrams.

17) Write electron configurations for the following atoms (using the **long-hand** notation):

a) Ca

b) Cl

c) Ga

d) Ti

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18) Write electron configurations for the following atoms or ions (using short-hand notation):

a) Br

b) Cr

c) O

d) Ag

e) Cu

f) Rb

g) Mo

19) Draw orbital diagrams (**valence electrons only**) for the following atoms and ions:

a) Cr

b) O

c) Ag

d) Ti^{+}

20) Why do elements with the same electron configurations exhibit similar chemical properties (i.e., chemical reactivity)?