

**CHAPTER 5** **CHAPTER ASSESSMENT****Electrons in Atoms****Reviewing Vocabulary**

Match the definition in Column A with the term in Column B.

**Column A**

- \_\_\_\_\_ 1. The set of frequencies of the electromagnetic waves emitted by the atoms of an element
- \_\_\_\_\_ 2. The minimum amount of energy that can be lost or gained by an atom
- \_\_\_\_\_ 3. A form of energy that exhibits wavelike behavior as it travels through space
- \_\_\_\_\_ 4. A three-dimensional region around the nucleus of an atom that describes an electron's probable location
- \_\_\_\_\_ 5. The shortest distance between equivalent points on a continuous wave
- \_\_\_\_\_ 6. The lowest allowable energy state of an atom
- \_\_\_\_\_ 7. A particle of electromagnetic radiation with no mass that carries a quantum of energy
- \_\_\_\_\_ 8. The emission of electrons from a metal's surface when light of a certain frequency shines on it
- \_\_\_\_\_ 9. A figure indicating the relative sizes and energies of atomic orbitals

**Column B**

- a. wavelength
- b. photoelectric effect
- c. photon
- d. quantum
- e. atomic orbital
- f. atomic emission spectrum
- g. principal quantum number
- h. ground state
- i. electromagnetic radiation

**Describe how each pair is related**

10. frequency, amplitude

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11. valence electron, electron-dot structure

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12. principal energy levels, energy sublevels

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### Understanding Main Ideas (Part A)

Match the equation in Column A with its description in Column B.

**Column A**

- \_\_\_\_\_ 1.  $E = h\nu$
- \_\_\_\_\_ 2.  $c = \lambda\nu$
- \_\_\_\_\_ 3.  $\lambda = h/mv$
- \_\_\_\_\_ 4.  $\Delta E = E_{\text{higher-energy orbit}} - E_{\text{lower-energy orbit}}$

**Column B**

- a. Relates the wavelength, frequency, and speed of an electromagnetic wave
- b. Describes the energy change of an electron undergoing an orbit transition
- c. Energy relationship developed by Planck
- d. de Broglie's equation

Complete the table.

Principal Quantum Number, $n$	Types of Orbitals	Number of Orbitals Related to Principal Energy Level
5. 1	s	
6.		
7. 3		9
8. 4		

Write the orbital diagram and complete electron configuration for each atom.

9. nitrogen

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10. fluorine

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11. sodium

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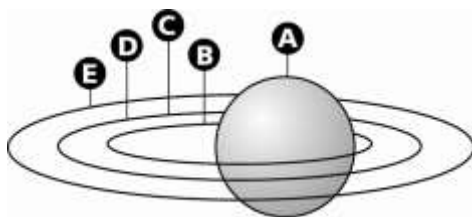
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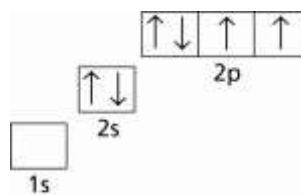
## Understanding Main Ideas (Part B)

Circle the letter of the choice that best completes the statement or answers the question. Use the following figure to answer questions 1 and 2.

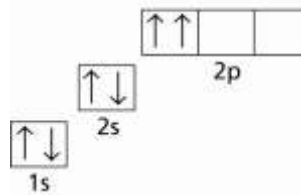


- According to Bohr's atomic model, which letter(s) in the figure represents a place where an electron cannot be?
  - A
  - B, C and E
  - A and D
  - D
- According to the quantum mechanical model of the atom, point E in the figure represents a
  - point where an electron cannot be.
  - position where an electron probably is.
  - position where an electron must be.
  - point beyond which no electron can go.

- What can you conclude from the figure on the right?
  - Hund's rule has been violated.
  - The Pauli exclusion principle has been violated.
  - The Aufbau principle has been violated.
  - This is a valid orbital diagram.



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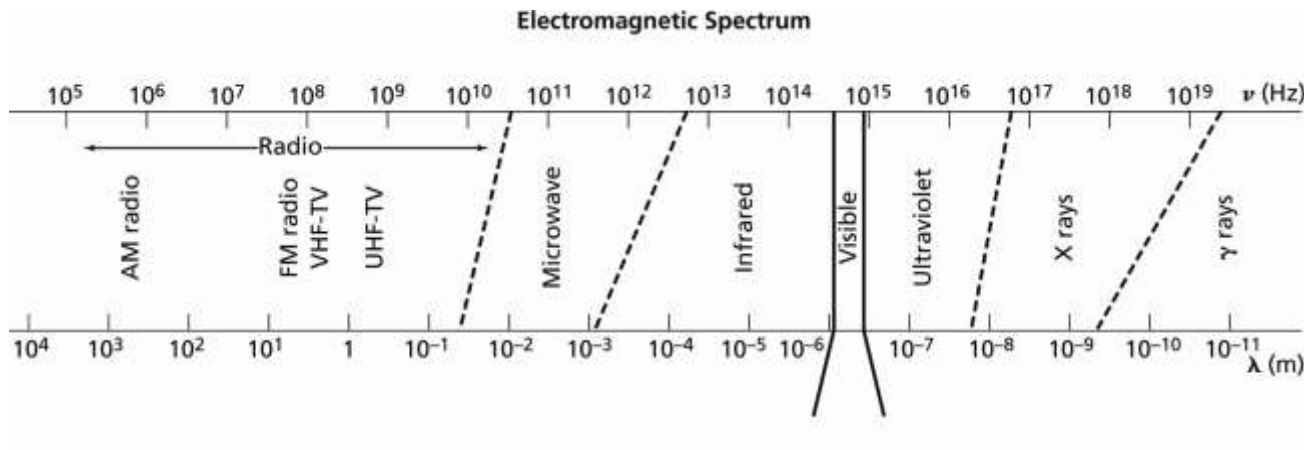


- Which of the following can you conclude based on the de Broglie equation?
  - Waves behave like particles.
  - Most particles are electrons.
  - All matter has an associated wavelength.
  - All matter behaves like particles.
- Which of the following best describes the Heisenberg uncertainty principle?
  - Light behaves like a particle and like a wave.
  - The shorter the wavelength, the higher the frequency.
  - It is impossible to know both the velocity and the position of a particle at the same time.
  - You can measure an object without disturbing it.

## Thinking Critically

Answer the following questions.

1. A radio station has a frequency of 103.7 MHz. (1 MHz =  $10^6 \text{ s}^{-1}$ ) What is the wavelength of the radiation emitted by the station? Indicate where this wavelength falls on the electromagnetic spectrum shown below.




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2. Look at the electromagnetic spectrum again. Are the microwaves used to cook food higher or lower in frequency than radio waves? Are microwaves longer or shorter in wavelength than radio waves?

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3. Write the orbital diagram of aluminum.

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4. Write the complete electron configuration and the noble-gas notation for aluminum.

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5. Write the noble-gas notation for iodine. \_\_\_\_\_

6. Identify each atom.

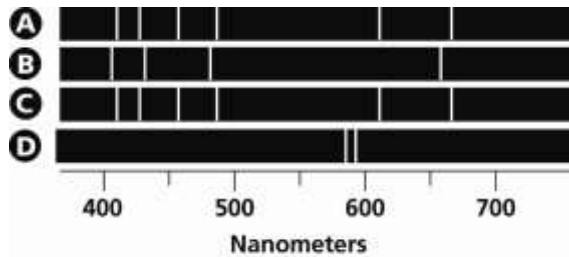


7. Write electron-dot structures for the following atoms.



## Applying Scientific Methods

A chemist isolated four samples, A, B, C, and D. She obtained the following atomic emission spectra of the samples.



1. Examine each sample's atomic emission spectra. Assume that each sample represents a single element. What can you conclude by looking at the spectra? Do the samples represent the same element or different elements?

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2. Which part of the electromagnetic spectrum do the atomic emission spectra show?

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3. Would the atomic emission spectrum for each sample change if you repeated the procedure? Explain your answer.

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4. What does each line in an atomic emission spectrum represent?

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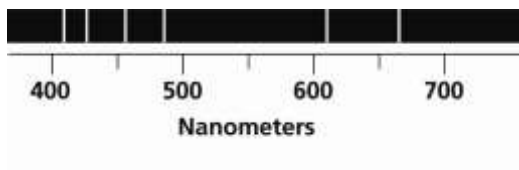
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**Applying Scientific Methods, *continued***

5. You find the following atomic emission spectrum for hydrogen in your textbook. Compare this spectrum to the spectra of the samples that the chemist obtained. What can you conclude? Explain your answer.




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6. Which, if any, of the atomic emission spectra can the Bohr model explain? Explain your answer.

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7. According to Bohr's model, how many times were photons emitted from the excited atoms in each sample to produce its atomic emission spectrum?

**A** \_\_\_\_\_

**B** \_\_\_\_\_

**C** \_\_\_\_\_

**D** \_\_\_\_\_

8. The difference between successive energy levels becomes smaller as  $n$  becomes larger. Explain how hydrogen's emission spectrum demonstrates this statement.

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9. Assume that instead of measuring the photons *emitted* by each sample, the chemist measured the photons *absorbed* by each sample. What would the absorption spectra look like? Explain your answer.

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