5.3 PHYSICS AND THE QUANTUM MECHANICAL MODEL

Section Review

Objectives

- Describe the relationship between the wavelength and frequency of light
- Explain how the frequencies of light are related to changes in electron energies
- Distinguish between quantum mechanics and classical mechanics
- Identify the cause of the atomic emission spectrum

Vocabulary

- amplitude
- wavelength (λ)
- frequency (ν)
- hertz (Hz)

- electromagnetic radiation
- spectrum
- atomic emission spectrum
- ground state

- photons
- Heisenberg uncertainty principle

Key Equations

- $c = \lambda\nu$
- $E = h \times \nu$
- $\lambda = \dfrac{h}{m\nu}$

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

According to quantum mechanics, the motions of subatomic particles may be described as ___**1**___. The frequency and wavelength of all waves are ___**2**___ related.

Every element emits ___**3**___ if it is heated by passing an electric discharge through its gas or vapor. Passing this emission through a prism gives the ___**4**___ of the element.

The quantum concept developed from Planck's studies of ___**5**___ and Einstein's explanation of the ___**6**___ effect. Planck showed that the amount of radiant energy absorbed or emitted by a body is proportional to the ___**7**___ of the radiation.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

_____ **8.** The speed of light is a constant that can be obtained by dividing the frequency of light by its wavelength.

_____ **9.** The amplitude of a wave is the distance between the crests.

_____ **10.** The energy of a body can change only in small discrete units.

_____ **11.** The position and velocity of an electron in an atom can be determined with great certainty.

_____ **12.** The photoelectric effect will occur no matter what frequency of light strikes a metal.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A	Column B
_____ **13.** photons	**a.** predicts that all matter exhibits wavelike motions
_____ **14.** de Broglie's equation	**b.** the distance between two consecutive wave crests
_____ **15.** visible light	**c.** light quanta
_____ **16.** ground state	**d.** the lowest energy level for a given electron
_____ **17.** wavelength	**e.** example of electromagnetic radiation

Part D Questions and Problems

Answer the following in the space provided.

18. What is the frequency of radiation whose wavelength is 2.40×10^{-5} cm?

19. Apply quantum theory to explain the photoelectric effect.

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