Name STURMAN key Date 20 possible Class

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

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

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. waves
2. inversely
3. photon of light energy
4. spectrum
5. light radiation
6. photoelectric
7. frequency

+2

+1

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Part B True-False

$V = f\lambda$

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

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

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

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

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

NT 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
C 13. photons	a. predicts that all matter exhibits wavelike motions
A 14. de Broglie's equation	b. the distance between two consecutive wave crests
E 15. visible light	c. light quanta
D 16. ground state	d. the lowest energy level for a given electron
B 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?

$3.00 \times 10^{8} = f\,(2.40 \times 10^{-7})$

$f = 1.25 \times 10^{15}\ s^{-1}$ (Hz)

19. Apply quantum theory to explain the photoelectric effect.

The photoelectric effect will not occur unless the freq. of light striking a metal is high enough to cause an e^- to be ejected from the metal. The freq. of light must be above the threshold frequency that will provide the necessary quanta of energy.

(3)