

9. What type of spectrum is created by applying a high potential difference to a pure atomic gas?
- A. an emission spectrum
 - B. an absorption spectrum
 - C. a continuous spectrum
 - D. a visible spectrum
10. What type of spectrum is used to identify elements in the atmospheres of stars?
- F. an emission spectrum
 - G. an absorption spectrum
 - H. a continuous spectrum
 - J. a visible spectrum
11. What is the speed of a proton ($m = 1.67 \times 10^{-27}$ kg) with a de Broglie wavelength of 4.00×10^{-14} m?
- A. 1.59×10^{-30} m/s
 - B. 1.01×10^{-7} m/s
 - C. 9.93×10^6 m/s
 - D. 1.01×10^7 m/s
12. What does Heisenberg's uncertainty principle state?
- F. It is impossible to simultaneously measure a particle's position and momentum with infinite accuracy.
 - G. It is impossible to measure both a particle's position and its momentum.
 - H. The more accurately we know a particle's position, the more accurately we know the particle's momentum.
 - J. All measurements are uncertain.

SHORT RESPONSE

13. What is the energy of a photon of light with frequency $f = 2.80 \times 10^{14}$ Hz? Give your answer in both J and eV.
14. Light of wavelength 3.0×10^{-7} m shines on the metals lithium, iron, and mercury, which have work functions of 2.3 eV, 3.9 eV, and 4.5 eV, respectively. Which of these metals will exhibit the photoelectric effect? For each metal that does exhibit the photoelectric effect, what is the maximum kinetic energy of the photoelectrons?

15. Identify the behavior of an electron as primarily like a wave or like a particle in each of the following situations:
- a. traversing a circular orbit in a magnetic field
 - b. absorbing a photon and being ejected from the surface of a metal
 - c. forming an interference pattern

EXTENDED RESPONSE

16. Describe Bohr's model of the atom. Identify the assumptions that Bohr made that were a departure from those of classical physics. Explain how Bohr's model accounts for atomic spectra.
17. Electrons are ejected from a surface with speeds ranging up to 4.6×10^5 m/s when light with a wavelength of 625 nm is used.
- a. What is the work function of this surface?
 - b. What is the threshold frequency for this surface? Show all your work.
18. The wave nature of electrons makes an electron microscope, which uses electrons rather than light, possible. The resolving power of any microscope is approximately equal to the wavelength used. A resolution of approximately 1.0×10^{-11} m would be required in order to "see" an atom.
- a. If electrons were used, what minimum kinetic energy of the electrons (in eV) would be required to obtain this degree of resolution?
 - b. If photons were used, what minimum photon energy would be required?

Test TIP

When answering multiple-choice questions, read each answer carefully. Do not be misled by wrong answers that seem right at first glance.