

ASTR101
Unit 5 Assessment
Answer Key

1. Democritus believed that matter consisted of discrete units. Not much changed with this model until the start of the nineteenth century. John Dalton used the concept of atoms to explain chemical reactions. In the late nineteenth century, it was established that electrons were components of the atom and the first model to include them was J. J. Thomson's plumb pudding model. In this model, the volume of the atom was composed of a positively charged substance with the negatively charged electrons embedded, canceling out the positive charge. Ernest Rutherford showed that the positive charge and almost all of the mass of the atom were contained in a tiny nucleus at the center of the atom.

2. When alpha particles are fired at a thin gold foil, most pass through either undeflected or slightly deflected. This shows that atoms are mostly empty space. Some, however, are backscattered. The backscattering can only be explained by a more or less head-on collision of the alphas with a much more massive, concentrated object—the nucleus of the gold atom.

3. Bohr used the planetary nuclear model and restricted the energy of the atom (and therefore the radius of the electron's orbit) to certain allowed values.

4. The Bohr model was the first to explain how the discrete emission and absorption spectra of atoms are produced. Because the energy of the Bohr atom is quantized, only certain energies, those corresponding to the differences between allowed energy levels, can be emitted or absorbed by the atom. His model was able to calculate from theory the Balmer series, the known visible spectrum of hydrogen.

5. Early in the nineteenth century, Thomas Young showed that light could be bent around obstacles and that two beams of light could interfere with each other. Both of these are properties of waves. In midcentury, the speed of light was measured to be less than the speed of light in air, as predicted by the wave model. The most convincing evidence was Maxwell's theory of electromagnetism in which light was shown to be an electromagnetic wave. In the twentieth century, the photoelectric effect and Compton scattering were shown to be incompatible with the wave model, but they could be explained by the particle model.

6. The nucleus is unstable and will emit some type of radiation in order to become more stable. It is either too massive (like uranium), has too much energy and will emit a photon, or has the wrong neutron to proton ratio. For each element, there is an appropriate ratio of neutrons to protons, and if the ratio is not correct, a proton can change into a neutron or vice versa by emitting beta radiation.

7. Radio, infrared, visible, ultraviolet, X-ray, gamma ray. All travel at the speed of light. They differ in wavelength and the way in which they are produced.

8. A continuous spectrum contains all wavelengths within a certain range and is produced by a solid, liquid, or high-density gas. An emission spectrum contains only certain discrete wavelengths and is produced by a low-density gas when an atom goes from a higher to a lower energy state. An absorption spectrum is missing certain discrete wavelengths and is produced when a continuous spectrum passes through a low-density gas and the atoms go from a lower to a higher energy state.

