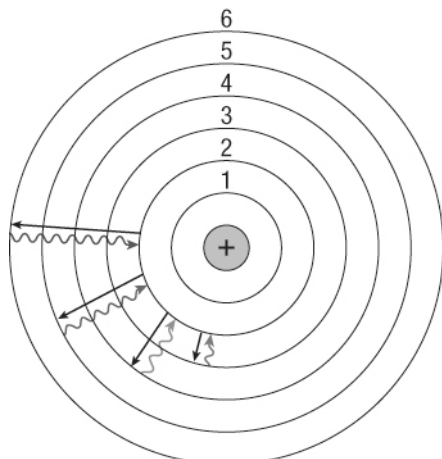


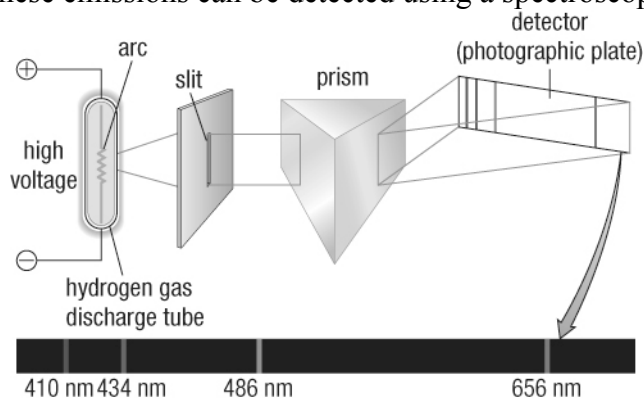
Section 3.2: Bohr's Model of the Atom

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1. The Rutherford model was limited because it predicted that the electrons orbited the nucleus in a similar manner to the way planets orbited the sun. An electron accelerating around an atom in this manner would constantly be accelerating, resulting in the emission of electromagnetic radiation. The energy lost by emitting this radiation would cause the electron to crash into the nucleus. However, most atoms are stable and do not appear to be collapsing. Bohr addressed this limitation in his model by stating that electrons can only move in specific orbits possessing discrete amounts of energy.
2. When atoms or molecules absorb light the electrons absorb the energy and move into higher energy orbits farther away from the nucleus. When the excited electron returns to a lower energy orbit it releases a photon of electromagnetic radiation.
3. Scientists are able to use emission spectra to confirm the presence of an element in materials because each element has a unique emission spectrum resulting from electrons moving between orbits with specific differences in energy levels.
4. Answers may vary. Sample answer: Electrons are excited from ground state and emit photons as the electron returns from various high-energy orbits to the ground state.



These emissions can be detected using a spectroscope.



5. The emission spectrum of an atom or molecule depends on its arrangement of electrons because electrons in different orbits possess varying energy and can only release discrete quantities of energy as they move between available orbits. Different arrangements of electrons result in different wavelengths being present in the emission spectrum.
6. (a) The emission spectrum is sometimes referred to as an element's fingerprint because each

element has a unique emission spectrum, just as every human being has a unique fingerprint.

(b) Answers may vary. Sample answer: Emission spectra could be used to determine the elemental content of a soil sample to determine if a plot of land is useful for agricultural production.

(c) Using an emission spectrum is considered qualitative analysis because it determines the identity of an element. It does not predict the quantity of atoms or molecules in a sample that possess the particular electron arrangement.

7. The spectra for sodium and magnesium are not the same because magnesium contains an additional electron. The extra electron changes the electron–electron repulsions that occur, which changes the energy of the orbits where these electrons are found. This alters the energy that electrons can emit as they fall back down to lower energy orbits.

8. (a) Spectroscopy is a technique for analyzing spectra to determine the properties of their source.

(b) Spectroscopy was useful to the development of early atomic theory because Bohr used the spectra of hydrogen to develop a model of the atom that included electrons possessing distinct quantized energies.

9. (a) Bohr proposed that electrons could move only in specific orbits around the nucleus. When electrons are excited they move to higher energy orbits. Excited electrons release energy in the form of a photon that possesses a distinct energy. The photon emissions form a spectrum that is unique to the electron arrangements.

(b) Bohr’s model of the atom appeared successful in that seemed consistent with observed chemical and physical properties of atoms. Bohr was able to calculate the energy levels of an electron in a hydrogen atom. However, Bohr’ model failed to predict the observed spectra for atoms with more than one electron.

10. The Bohr-Rutherford model of the atom incorporates experimental evidence provided by each of these scientists. Rutherford contributed to the model by showing that the centre of atoms contained a positively charged nucleus. Bohr described how the electron moves between orbits by absorbing and releasing distinct quantities of energy.

11. (a) The energy levels of the electrons within an atom predicted by the original Bohr model are still well supported by atomic spectral evidence.

(b) Answers may vary. Sample answer: Bohr’s atomic theory places electrons in well-defined orbits around the nucleus. We now know that electrons cannot be placed in such specific paths and instead occupy regions of space around the nucleus called orbitals.

12. The line spectra that result will have four wavelengths that are evenly spaced. The energy levels shown in figure 9 is not an accurate representation of the energy levels in an atom because the differences in energy are not evenly spaced— higher energy levels have smaller differences between their energies than lower energy levels do.

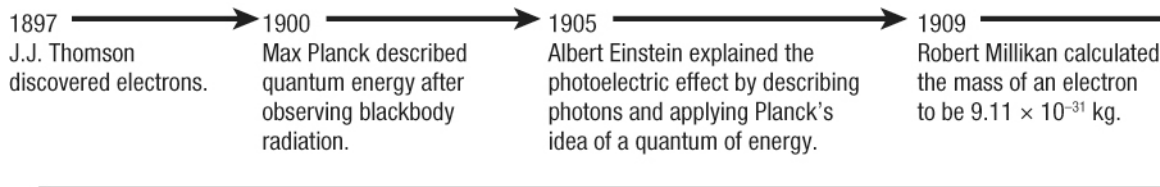
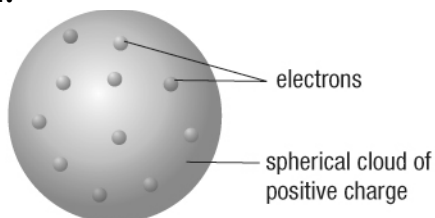
13. (a)

Thomson's model	Bohr's model
- atoms contain positive and negative charges	
- negatively charged electrons are embedded in a diffuse cloud of positive charge	- negatively charged electrons orbit a positively charged nucleus that contains protons - electrons move between orbits of different energy by absorbing or releasing photons

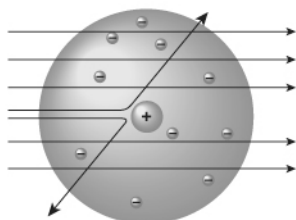
(b)

Rutherford's model	Bohr's model
- atoms contain electrons that orbit a positively charged nucleus containing protons	
- electron orbits are similar to planetary orbits	- electrons move between orbits of different energy by absorbing or releasing photons

14.



1911 Ernest Rutherford observed deflection of alpha particles was caused by a concentrated positive charge at the centre of the atom.



1913 Niels Bohr described electrons that orbit a nucleus at discrete energy levels.

