CHAPTER 7 PRACTICE PASSAGE

In the Bohr model of the atom, electrons circle the point-like nucleus similar to the way planets orbit the Sun. Imagining that the atomic model is confined to motion in one plane, the orbit of the electrons can be drawn as circles with the nucleus in the center.

The atomic radius of an atom is defined as the length from the nucleus to the outermost electron and is generally within the tens to hundreds of picometers. The atomic radii of common atoms are as follows: hydrogen = 40 pm, helium = 30 pm, carbon = 80 pm. In the periodic table, atomic radius tends to increase as you go down each column of the table and decrease as you move from left to right across a period.

Current scientific thought suggests that the Bohr model is an oversimplification of atomic structure. Quantum mechanics states that the exact position of an electron at a given point in time cannot be known. Only the probability of electron existence in a region of space is known. However, the Bohr model of the atom wonderfully captures another aspect of quantum mechanics: the quantization of energy. The electrons can only have very specific energy values and the distinct orbitals are a very good visual representation of this. Electrons can only move from one energy level to another if there is the exact energy configuration. When dropping from a higher energy to a lower energy, photons with the exact energy difference are emitted, and electrons can only move to a higher energy level if they absorb a photon of the exact energy difference.

1. What is the magnitude of the electric force a hydrogen nucleus exerts on its only orbiting electron in the Bohr model?

A) 10^{7} N
B) 10 N
C) 10^{-7} N
D) 10^{-18} N

2. What is the electric potential a millimeter away from a carbon atom nucleus?

A) 1.4×10^{-9} V
B) 8.6×10^{-6} V
C) 1.4×10^{-6} V
D) 8.6×10^{-3} V

3. If the electric force between the nucleus and the outermost electron in ^{6}Li is F, what is the electric force between the nucleus and the outermost electron in ^{7}Li, given that the mass of a neutron is approximately 1/9th the mass of ^{6}Li?

A) $F/9$
B) $F/3$
C) F
D) $9F$

4. According to the Bohr model, the atomic radius decreases as you move from left to right in the periodic table. Which of the following helps to explain this phenomenon?

I. The charge of the nucleus decreases as you move from left to right.
II. The electric force between the electrons and the nucleus increases as you move from left to right.
III. The work done by the electrons increases as you move from left to right.

A) I only
B) II only
C) I and II only
D) II and III only

5. An attractive force keeps the electron in ^{1}H orbiting the nucleus. Approximately what is the magnitude of the gravitational force, F_G, between the nucleus and the electron in terms of the magnitude of the electric force, F_E, between them? (Recall that $m_e = 9 \times 10^{-31}$ kg, $m_p = 2 \times 10^{-27}$ kg, and $G = 6 \times 10^{-11}$ m^{3}kg^{-1}s^{-2}.)

A) $10^{-10}F_E$
B) $10^{-20}F_E$
C) $10^{-30}F_E$
D) $10^{-40}F_E$

6. Imagine a lithium atom where the two electrons in the first orbital are at exact opposite sides of the nucleus and the electron in the second orbital is in line with the other electrons so that the three electrons and the nucleus all lie on a straight line. How much work would you need to apply to remove the outermost electron if the atomic radius is 100 pm and the distance between the first and second orbital is 50 pm?

A) $(ke/150) \times 10^{12}$ J
B) $(ke^2/150) \times 10^{12}$ J
C) $(ke/300) \times 10^{12}$ J
D) $(ke^2/300) \times 10^{12}$ J

7. An electron in beryllium moves from an orbital with a radius of r to a different orbital with a radius of $r/2$. If the energy of the orbital is due to the electric potential only, what best describes the transition?

A) The transition emits a photon with an energy of ke^2/r
B) The transition emits a photon with an energy of $4ke^2/r$
C) The transition occurs because a photon with an energy of ke^2/r is absorbed
D) The transition occurs because a photon with an energy of $4ke^2/r$ is absorbed