The Structure of the Atom

Section 4.1 Early Theories of Matter

In your textbook, read about the philosophers, John Dalton, and defining the atom.

For each statement below, write true or false.

false 1. Ancient philosophers regularly performed controlled experiments.
true 2. Philosophers formulated explanations about the nature of matter based on their own experiences.
true 3. Both Democritus and Dalton suggested that matter is made up of atoms.
true 4. Dalton’s atomic theory stated that atoms separate, combine, or rearrange in chemical reactions.
false 5. Dalton’s atomic theory stated that matter is mostly empty space.
false 6. Dalton was correct in thinking that atoms could not be divided into smaller particles.
true 7. Dalton’s atomic theory stated that atoms of different elements combine in simple whole-number ratios to form compounds.
false 8. Dalton thought that all atoms of a specific element have the same mass.
true 9. Democritus proposed that atoms are held together by chemical bonds, but no one believed him.
true 10. Dalton’s atomic theory was based on careful measurements and extensive research.
false 11. There are no instruments powerful enough to magnify atoms so that they can be seen.
true 12. The smallest particle of an element that retains the properties of that element is called an atom.

Section 4.2 Subatomic Particles and the Nuclear Atom

In your textbook, read about discovering the electron and the nuclear atom.

For each item in Column A, write the letter of the matching item in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Thomson</td>
<td>c. Rutherford</td>
</tr>
<tr>
<td>b. Millikan</td>
<td></td>
</tr>
<tr>
<td>1. Proposed the nuclear atomic model</td>
<td>2. Determined the mass-to-charge ratio of an electron</td>
</tr>
<tr>
<td>3. Calculated the mass of an electron</td>
<td></td>
</tr>
</tbody>
</table>

Draw and label a diagram of each atomic model.

4. plum pudding model

Drawing should look like a ball of chocolate chip cookie dough. The chocolate chips should be labeled with negative charge or as electrons. The dough should be labeled as evenly distributed positive charges.

5. nuclear atomic model

Drawing should look like a peach with a pit. The pit should be labeled nucleus and should include labeled protons and neutrons. The outer circle of the peach should be labeled electrons.

Complete the following table of proton, electron, and neutron characteristics.

<table>
<thead>
<tr>
<th>Particle</th>
<th>Symbol</th>
<th>Location</th>
<th>Relative Charge</th>
<th>Relative Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Proton</td>
<td>p⁺</td>
<td>In the nucleus</td>
<td>1+</td>
<td>1</td>
</tr>
<tr>
<td>7. Neutron</td>
<td>n₀</td>
<td>In the nucleus</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8. Electron</td>
<td>e⁻</td>
<td>In the space surrounding the nucleus</td>
<td>1−</td>
<td>1/1840</td>
</tr>
</tbody>
</table>
Section 4.3 How Atoms Differ

In your textbook, read about atomic number.

For each statement below, write true or false.

1. The number of neutrons in an atom is referred to as its atomic number. false
2. The periodic table is arranged by increasing atomic number. true
3. Atomic number is equal to the number of electrons in an atom. true
4. The number of protons in an atom identifies it as an atom of a particular element. true
5. Most atoms have either a positive or a negative charge. false

Answer the following questions.

6. Lead has an atomic number of 82. How many protons and electrons does lead have? 82 protons; 82 electrons
7. Oxygen has 8 electrons. How many protons does oxygen have? 8 protons
8. Zinc has 30 protons. What is its atomic number? 30
9. Astatine has 85 protons. What is its atomic number? 85
10. Rutherfordium has an atomic number of 104. How many protons and electrons does it have? 104 protons; 104 electrons
11. Polonium has an atomic number of 84. How many protons and electrons does it have? 84 protons; 84 electrons
12. Nobelium has an atomic number of 102. How many protons and electrons does it have? 102 protons; 102 electrons

In your textbook, read about isotopes and mass number.

Determine the number of protons, electrons, and neutrons for each isotope described below.

13. An isotope has atomic number 19 and mass number 39. 19 protons, 19 electrons, 20 neutrons
14. An isotope has 14 electrons and a mass number of 28. 14 protons, 14 electrons, 14 neutrons
15. An isotope has 21 neutrons and a mass number of 40. 19 protons, 19 electrons, 21 neutrons
Section 4.4 Changes to the Nucleus—Nuclear Reactions

In your textbook, read about radioactivity.

For each item in Column A, write the letter of the matching item in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The rays and particles that are emitted by a radioactive material</td>
<td>c. radioactive decay</td>
</tr>
<tr>
<td>2. A reaction that involves a change in an atom’s nucleus</td>
<td>b. beta radiation</td>
</tr>
<tr>
<td>3. The process in which an unstable nucleus loses energy spontaneously</td>
<td>d. nuclear reaction</td>
</tr>
<tr>
<td>4. Fast-moving electrons</td>
<td>a. alpha particles</td>
</tr>
</tbody>
</table>

In your textbook, read about types of radiation.

Use the diagram to answer the questions.

5. Which plate do the beta particles bend toward? Explain.
   - the positive plate, because beta particles are negatively charged

6. Explain why the gamma rays do not bend.
   - Gamma rays have no charge.

7. Explain why the path of the beta particles bends more than the path of the alpha particles.
   - The beta particles have less mass than the alpha particles and are more greatly affected by the electric field.

Complete the following table of the characteristics of alpha, beta, and gamma radiation.

<table>
<thead>
<tr>
<th>Radiation Type</th>
<th>Composition</th>
<th>Symbol</th>
<th>Mass (amu)</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Alpha</td>
<td>Helium nuclei, or alpha particles</td>
<td>αHe</td>
<td>4</td>
<td>2+</td>
</tr>
<tr>
<td>9. Beta</td>
<td>Electrons, or beta particles</td>
<td>β</td>
<td>1/1840</td>
<td>1-</td>
</tr>
<tr>
<td>10. Gamma</td>
<td>High-energy electromagnetic radiation</td>
<td>γ</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>