Section 1.2: Atomic Structure

Section 1.2 Questions, page 16

1. (a) [Diagram of Ca atom]
   (b) [Diagram of C atom]
   (c) [Diagram of Si atom]

2. In Ca there are 2 valence electrons. In C there are 4 valence electrons. In Si there are 4 valence electrons.

3. Students’ timelines should include the following scientists/experiments/discoveries in chronological order, with a brief description or diagram of each experiment.

   **Formation of the Atomic Theory**

<table>
<thead>
<tr>
<th>Year</th>
<th>Scientist/Experiment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1803</td>
<td>John Dalton</td>
<td>proposes atomic theory</td>
</tr>
<tr>
<td>1897</td>
<td>J.J. Thomson</td>
<td>discovers electron cathode ray tube experiments</td>
</tr>
<tr>
<td>1911</td>
<td>Ernest Rutherford</td>
<td>discovers nucleus gold foil experiment</td>
</tr>
<tr>
<td>1922</td>
<td>Niels Bohr</td>
<td>proposes atomic model has electron shell orbitals experiments with electrical/thermal energy and hydrogen gas experiments with light through a prism onto a screen</td>
</tr>
<tr>
<td>1932</td>
<td>James Chadwick</td>
<td>discovers neutron</td>
</tr>
</tbody>
</table>

Timeline not to scale.

4. Dalton’s atomic theory proposed the following:
   - All matter is made up of tiny, indivisible particles called atoms. This proposal was no longer valid after Rutherford determined that there are subatomic particles (protons and electrons).
   - All atoms of an element are identical. The proposal is still valid for atoms of an element under stable conditions.
   - Atoms of different elements are different. This is correct.
   - Atoms are rearranged to form new substances in chemical reactions, but they are never created or destroyed. This is correct.

5. Table 2 Atoms of Selected Elements

<table>
<thead>
<tr>
<th>Name of element</th>
<th>Symbol</th>
<th>Atomic number</th>
<th>Mass number</th>
<th>Number of protons</th>
<th>Number of neutrons</th>
<th>Number of electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>uranium</td>
<td>U</td>
<td>92</td>
<td>235</td>
<td>92</td>
<td>143</td>
<td>92</td>
</tr>
<tr>
<td>magnesium</td>
<td>Mg</td>
<td>12</td>
<td>25</td>
<td>12</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>iodine</td>
<td>I</td>
<td>53</td>
<td>131</td>
<td>53</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>carbon</td>
<td>C</td>
<td>6</td>
<td>14</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>technetium</td>
<td>Tc</td>
<td>43</td>
<td>99</td>
<td>43</td>
<td>56</td>
<td>43</td>
</tr>
</tbody>
</table>
6. **Models of the Atom**

- **John Dalton**
  - Spherical, indivisible atom

- **J.J. Thomson**
  - Plum-pudding model
  - Positively charged matter
  - Electrons

- **Ernest Rutherford**
  - Nuclear model
  - Electrons surrounding nucleus (negatively charged)
  - Nucleus (positively charged)

- **Niels Bohr**
  - Planetary model
  - Electrons in orbits surrounding the nucleus
  - Nucleus containing positively charged protons and electrons
7. Answers may vary. Sample answer: We learn atomic theory to help us make predictions about the behaviour of matter. The models we study are probably incorrect in some ways, but they offer the best explanation that we are able to make at the present time. We learn about the progression of ideas to understand the scientific process of discovery.

8. Answers may vary. The scale model will have the length of the athletic field representing the radius of the atom and the average distance between the nucleus and an electron. The nucleus would then be about the size of a marble. Some students may also indicate that an electron is approximately 1000 times smaller than the nucleus. Sample sketch:

9. A star’s atomic spectrum would be a combination of the atomic spectra for hydrogen and helium.

10. There are 119 protons, 119 electrons, and 183 neutrons in each atom of this element.

11. Answers may vary. Students will likely find information on the Standard Model (a theoretical framework describing all the currently known elementary particles). Students’ answers will likely mention how neutrons and protons are composed of quarks and describe the six flavours of quarks (up, down, charm, strange, top, and bottom) and some properties of quarks (such as electric charge, colour charge, spin, and mass).