1. **Problem**

Copy the table below into your notebook. Fill in the missing information. Use a periodic table if you need help in identifying the atomic symbol.

<table>
<thead>
<tr>
<th>Chemical notation</th>
<th>Element</th>
<th>Number of Protons</th>
<th>Number of Neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{11}_5\text{B}$</td>
<td>(a)</td>
<td>(b)</td>
<td>(c)</td>
</tr>
<tr>
<td>$^{208}_81\text{Pb}$</td>
<td>(d)</td>
<td>(e)</td>
<td>(f)</td>
</tr>
<tr>
<td>(g) tungsten</td>
<td>(h)</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>(i) helium</td>
<td>(j)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>$^{239}_94\text{Pu}$</td>
<td>(k)</td>
<td>(l)</td>
<td>(m)</td>
</tr>
<tr>
<td>$^{92}_36\text{Ba}$</td>
<td>(o)</td>
<td>26</td>
<td>(p)</td>
</tr>
<tr>
<td>(q) bismuth</td>
<td>(r)</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>(s)</td>
<td>(t)</td>
<td>47</td>
<td>61</td>
</tr>
<tr>
<td>$^{201}_90\text{Bi}$</td>
<td>(v)</td>
<td>(w)</td>
<td>(x)</td>
</tr>
</tbody>
</table>

**What Is Required?**
The element name, number of protons, or number of neutrons has to be determined from the information given for each element.

**What Is Given?**
Either the chemical notation, name, number of protons, or number of neutrons is given.

**Plan Your Strategy**
In a chemical notation, the superscript number to the left of the symbol is the mass number $A$. The subscript number to the left of the symbol is the atomic number $Z$. The number of neutrons $= A - Z$. The atomic number is also the numerical position of the element on the periodic table. Using the information that is given, the periodic table, and this formula, the missing information can be obtained.
Act on Your Strategy

<table>
<thead>
<tr>
<th>Chemical notation</th>
<th>Element</th>
<th>Number of Protons</th>
<th>Number of Neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{11}$B</td>
<td>boron</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>$^{208}$Pb</td>
<td>lead</td>
<td>82</td>
<td>126</td>
</tr>
<tr>
<td>$^{184}$W</td>
<td>tungsten</td>
<td>74</td>
<td>110</td>
</tr>
<tr>
<td>$^{2}$He</td>
<td>helium</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>$^{239}$Pu</td>
<td>plutonium</td>
<td>94</td>
<td>145</td>
</tr>
<tr>
<td>$^{56}$Fe</td>
<td>iron</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>$^{209}$Bi</td>
<td>bismuth</td>
<td>83</td>
<td>126</td>
</tr>
<tr>
<td>$^{108}$Ag</td>
<td>silver</td>
<td>47</td>
<td>61</td>
</tr>
<tr>
<td>$^{20}$Ne</td>
<td>neon</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Check Your Solution
For each element, the number of protons plus the number of neutrons should equal the superscript number in the chemical notation.

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2. Problem
Identify the name and the symbol of the elements in the following locations of the periodic table.
(a) Group 14 (IV A), Period 2
(b) Group 11 (I B), Period 4
(c) Group 18 (VIII A), Period 6
(d) Group 1 (I A), Period 1
(e) Group 12 (II B), Period 5
(f) Group 2 (II A), Period 4
(g) Group 17 (VII A), Period 5
(h) Group 13 (III A), Period 3

What Is Required?
The element in the given period table positions has to be identified.

What Is Given?
The group and period numbers are given for each element.

Plan Your Strategy
The group and period numbers are like coordinates on a map: the Group number gives the vertical or x-coordinate, while the period number gives the horizontal or y-coordinate. The meeting point of these x-y-coordinates is the position of the element.

Act on Your Strategy
(a) carbon  (b) copper  (c) radon  (d) hydrogen  
(e) cadmium  (f) calcium  (g) iodine  (h) aluminum

Check Your Solution
Use various book and online sources of periodic tables to verify the element at the given coordinates.

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3. Problem
Draw boxes to represent the first 20 elements in the periodic table. Using Figure 2.9 as a guide, sketch the electron arrangements for these elements.
What Is Required?
You need to draw the electron arrangement for the first 20 elements in the periodic table.

What Is Given?
Figure 2.9 in Student Book p.44 has been given as the guide. You have access to a periodic table to identify the first 20 elements.

Plan Your Strategy
The number of electrons can be assumed to be equal to the number of protons, which are represented by the atomic number in the periodic table. Each energy level is filled up sequentially with each corresponding increase in atomic number. Remember that the first energy level (closest to the nucleus) carries a maximum of 2 electrons, the next level carries only 8 electrons, while the third level carries up to 8 electrons as well.

Act on Your Strategy

Check Your Solution
For the elements after atomic number 8, the group A numbers on top of the periodic table columns can be used as an indication of the number of valence electrons in the atom. Your diagram should show the same number of valence electrons in the outermost level as the group A number under which the element falls.

4. Problem
Redraw the 20 elements from Practice Problem 3 using Lewis structures.

What Is Required?
You need to draw Lewis structures for the first 20 elements in the periodic table.

What Is Given?
You know the number of valence electrons for each element from the answers in Practice Problem 3. These are the electrons that are in the outermost energy level of the atom.

Plan Your Strategy
The Lewis structure is a diagram of the chemical symbol surrounded by its valence electrons, indicated by dots. The dots are usually in a north, south, east, west position around the symbol, and are paired in increasing sequence according to the increase in valence electrons. From the diagrams in Practice Problem 3, the number of electrons in the outermost energy level of the atom is the number of dots you should place around the symbol.

Act on Your Strategy

Check your Solution
For the elements after atomic number 8, the group A numbers on the periodic table indicate the number of valence electrons in the atom. Your diagram should show the same number of valence electrons as the group A number under which the element falls.

5. Problem
Identify the number of valence electrons in the outer energy levels of the following elements.

(a) chlorine      (b) helium      (c) indium
(e) rubidium      (f) lead        (g) antinomy
(i) arsenic       (j) xenon      (d) strontium
(h) selenium
What Is Required?
You need to give the number of valence electrons in the elements listed.

What Is Given?
You have access to a periodic table.

Plan Your Strategy
For the elements after atomic number 8, the group A numbers on top of the periodic table columns can be used as an indication of the number of valence electrons in the atom. Look up under which group A number the element falls.

Act on Your Strategy
(a) chlorine – 7   (b) helium – 2   (c) indium – 3   (d) strontium – 2
(e) rubidium – 1   (f) lead – 4   (g) antimony – 5   (h) selenium – 6
(i) arsenic – 5   (j) xenon – 8

Check your Solution
Work with Bohr-Rutherford diagrams and fill in the number of electrons into energy shells. The valence electrons are those in the outermost shell.

6. Problem
Use the periodic table to draw Lewis structures for the following elements: barium (Ba), gallium (Ga), tin (Sn), bismuth (Bi), iodine (I), cesium (Cs), krypton (Kr), xenon (Xe).

What Is Required?
You need to draw Lewis structures for the elements listed.

What Is Given?
You have the chemical names and symbols. You have access to a periodic table.

Plan Your Strategy
The Lewis structure is a diagram of the chemical symbol surrounded by its valence electrons, indicated by dots. The dots are usually in a north, south, east, west position around the symbol, and are paired in increasing sequence according to the increase in valence electrons, the maximum of which is 8 electrons. For the elements after atomic number 8, the group A numbers on the periodic table can be used as an indication of the number of valence electrons in the atom. Look up under which group A number the element falls. The group number indicates the number of dots to draw in the Lewis structure.

Act on Your Strategy

Check Your Solution
Work with Bohr-Rutherford diagrams and fill in the number of electrons into energy shells. The valence electrons are those in the outermost shell. It should be the same number as the number of dots surrounding the symbol in your Lewis structures. For example, tin falls under group IVA. It has four electrons in its outermost shell. It has four dots in the Lewis structure, one at each of the poles.

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7. Problem
Using only their location in the periodic table, rank the atoms in each set by decreasing atomic size. Explain your answer.
(a) Mg, Be, Ba  (b) Ca, Se, Ga  (c) Br, Rb, Kr  (d) Se, Br, Ca  
(e) Ba, Sr, Cs  (f) Se, Br, Cl  (g) Mg, Ca, Li  (h) Sr, Te, Se  
(i) In, Br, I  (j) S, Se, O

**What Is Required?**
You have to reorder the 3 elements in each group according to decreasing atomic size.

**What Is Given?**
The chemical symbols are given. You have access to a periodic table.

**Plan Your Strategy**
As a general trend, atomic sizes increase in the direction from the top of the table to the bottom of the table. Atomic sizes generally decrease in the direction going from the left of the table to the right of the table. The elements can be compared depending on how they sit relative to one another on the periodic table.

**Act on Your Strategy**
(a) Ba, Mg, Be – decrease in size as you go up a group  
(b) Ca, Ga, Se – decrease in size as you go across a period  
(c) Rb, Br, Kr – decrease in size as you go up a group and across a period  
(d) Ca, Se, Br – decrease in size as you go across a period  
(e) Cs, Ba, Sr – decrease in size as you go across a period and up a group  
(f) Se, Br, and Cl – decrease in size as you go across and up a group  
(g) Ca, Mg, Li – decrease in size as you go up a group  
(h) Sr, Te, Se – decrease in size as you go across a period and up a group  
(i) In, I, Br – decrease in size as you go across a period and up a group  
(j) Se, S, O – decrease in size as you go up a group

**Check Your Solution**
Look up various periodic tables, in books or online. Some tables give the atomic radii of the elements. You can check and compare these sizes to verify your results. For example, the following are the atomic radii of the elements listed in problem (h), given in angstrom units. Sr = 2.15; Te = 1.60; Se = 1.40. The atomic sizes decrease from Sr to Te to Se. The results match.

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8. Problem
Using only a periodic table, rank the elements in each set by increasing ionization energy. Explain your answers.

(a) Xe, He, Ar  (b) Sn, In, Sb  (c) Sr, Ca, Ba  
(d) Kr, Br, K  (e) K, Ca, Rb  (f) Kr, Br, Rb

**What Is Required?**
You have to reorder the 3 elements in each group according to increasing ionization energy.

**What Is Given?**
The chemical symbols are given. You have access to a periodic table.

**Plan Your Strategy**
As a general trend, ionization energies increase in the direction from the bottom of the table to the top of the table. Ionization energies generally increase in the direction going from the left of the table to the right of the table. The elements can be compared depending on how they sit relative to one another on the periodic table.
Act on Your Strategy
(a) Xe, Ar, He – increase in ionization energy as you go up a group
(b) In, Sn, Sb – increase in ionization energy as you go across a period
(c) Ba, Sr, Ca – increase in ionization energy as you go up a group
(d) K, Br, Kr – increase in ionization energy as you go across a period
(e) Rb, K, Ca – increase in ionization energy as you go up a group and across a period
(f) Rb, Br, Kr – increase in ionization energy as you go up a group and across a period

Check Your Solution
Look up various periodic tables, in books or online. Some tables give the ionization energies of the elements. You can check and compare these values to verify your results. For example, the following are the first ionization energies of the elements listed in problem (a), given in kcal/g·mol. Xe = 280; Ar = 363; He = 567. The ionization energy increases from Xe to Ar to He. The results match.

9. Problem
Using only a periodic table, identify the atom in each of the following pairs with the lower first ionization energy.

(a) B, O
(b) B, In
(c) I, F
(d) F, N
(e) Ca, K
(f) B, Tl

What Is Required?
You have to identify the element with the lower first ionization energy.

What Is Given?
The chemical symbols are given. You have access to a periodic table.

Plan Your Strategy
As a general trend, ionization energies increase in the direction from the bottom of the table to the top of the table. Ionization energies generally increase in the direction going from the left of the table to the right of the table. The elements can be compared depending on how they sit relative to one another on the periodic table.

Act on Your Strategy
(a) B
(b) In
(c) I
(d) N
(e) K
(f) Tl

Check Your Solution
Look up various periodic tables, in books or online. Some tables give the ionization energies of the elements. You can check and compare these values to verify your results. For example, the following are the first ionization energies of the elements listed in problem (a), given in kcal/g·mol. B = 191; O = 314. Boron has the lower first ionization energy. The result is consistent.