You know the trends. (Or you should know them from general chemistry.) But can you explain them? How do you deal with exceptions? Now that you're an inorganic student, you should be able to do all of these things!

**RADIUS**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **18** |
| H  37 | **2** |  |  |  |  |  |  |  |  |  |  | **13** | **14** | **15** | **16** | **17** | He  32 |
| Li  122 | Be  89 |  |  |  |  |  |  |  |  |  |  | B  90 | C  77 | N  75 | O  73 | F  71 | Ne  69 |
| Na  157 | Mg  136 | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | Al  130 | Si  118 | P  110 | S  102 | Cl  99 | Ar  97 |
| K  202 | Ca  174 | Sc  144 | Ti  132 | V  122 | Cr  119 | Mn  118 | Fe  117 | Co  116 | Ni  115 | Cu  118 | Zn  121 | Ga  120 | Ge  122 | As  122 | Se  117 | Br  114 | Kr  110 |
| Rb  216 | Sr  191 | Y  162 | Zr  156 | Nb  134 | Mo  130 | Tc  127 | Ru  125 | Rh  125 | Pd  128 | Ag  134 | Cd  138 | In  144 | Sn  140 | Sb  143 | Te  135 | I  133 | Xe  130 |
| Cs  235 | Ba  198 | Lu  156 | Hf  144 | Ta  134 | W  130 | Re  128 | Os  126 | Ir  126 | Pt  129 | Au  134 | Hg  139 | Tl  147 | Pb  146 | Bi  146 | Po | At | Rn  145 |

1. Generally, radius decreases as you go across a period. Provide the BEST explanation.
2. Generally, radius increases as you go down a group. Provide the BEST explanation.
3. Circle the elements aluminum, gallium, and indium.
   * Arrange them in order of increasing radius.
   * Provide the BEST explanation for this unusual ordering.
4. Circle the elements titanium, zirconium, and hafnium.
   * Arrange them in order of increasing radius.
   * Provide the BEST explanation for this unusual ordering.
5. What do these two exceptions to the periodic trends have in common?

**FIRST IONIZATION ENERGY**

PICTURE HAS BEEN REMOVED. This is a figure that plots first ionization energy as a function of atomic number. My favorite picture of IE vs. Z is from Shriver & Atkins’ Inorganic Chemistry. Most general and inorganic texts will have a version of this figure that you can use.

1. Generally, ionization energy increases as you go across a period. Provide the BEST explanation.
2. Generally, ionization energy decreases as you go down a group. Provide the BEST explanation.
3. Look at magnesium and aluminum.

* Arrange these elements in order of increasing ionization energy.
* Provide the BEST explanation for this unusual ordering.

1. Look at phosphorus and sulfur.

* Arrange them in order of increasing ionization energy.
* Provide the BEST explanation for this unusual ordering.

**SUCCESSIVE IONIZATION ENERGIES**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE (kJ) | Be | B | C | N |
| 1st | 899 | 902 | 1086 | 1400 |
| 2nd | 1757 | 2430 | 2350 | 2860 |
| 3rd | 14850 | 3660 | 4620 | 4580 |
| 4th | 21005 | 25000 | 6220 | 7500 |
| 5th |  | 32820 | 38000 | 9400 |
| 6th |  |  |  | 53000 |

1. Describe each ionization process with a balanced chemical equation representing a general element with the symbol A.
   1. First ionization
   2. Second ionization
   3. Third ionization
2. Calculate Z\* for the highest energy electron of
   1. Be
   2. Be+
   3. Be2+
   4. Be3+
3. Why is there a huge jump in energy between the second and third ionization energies for beryllium?
4. Generalize this phenomenon. When do you expect to see small jumps in ionization energy? …large jumps?