# Ionization Energies

Directions: Below is a table of the 1st, 2nd, and 3rd ionization energies for the first 20 elements. On the graph, plot the 1st ionization energy vs. atomic number. (The atomic number should be along the x-axis.) Then, on the same graph, plot the 2nd ionization energy vs. atomic number, and similarly for the third ionization energy. After completing your graph, answer the questions at the bottom of this page.

Atomic Number	Chemical Symbol	1st Ionization Energy (kJ/mol x 10⁻³)	2nd Ionization Energy (kJ/mol x 10⁻³)	3rd Ionization Energy (kJ/mol x 10⁻³)
1	H	1.3	----	----
2	He	2.4	5.2	----
3	Li	0.5	7.3	11.8
4	Be	0.9	1.8	14.8
5	B	0.8	2.4	3.7
6	C	1.1	2.4	4.6
7	N	1.4	2.9	4.6
8	O	1.3	3.4	5.3
9	F	1.7	3.4	6.0
10	Ne	2.1	4.0	6.3
11	Na	0.5	4.6	6.9
12	Mg	0.7	1.5	7.7
13	Al	0.6	1.8	2.7
14	Si	0.8	1.6	3.2
15	P	1.0	1.9	2.9
16	S	1.0	2.3	3.4
17	Cl	1.3	2.3	3.9
18	Ar	1.5	2.7	3.9
19	K	0.4	3.1	4.6
20	Ca	0.6	1.1	4.9

1. In general, what happens to the 1st ionization energy as you go across a period?

2. In general, what happens to the 1st ionization energy as you go down a group / family?

3. List the elements for which the 2nd ionization energy is significantly higher than the 1st .

4. Explain why the elements you listed in your answer to question three have such large 2nd ionization energies.

5. List the elements for which the 3rd ionization energy is significantly higher than the 2nd.

6. Explain why the elements you listed in your answer to question five have such large 3rd ionization energies.
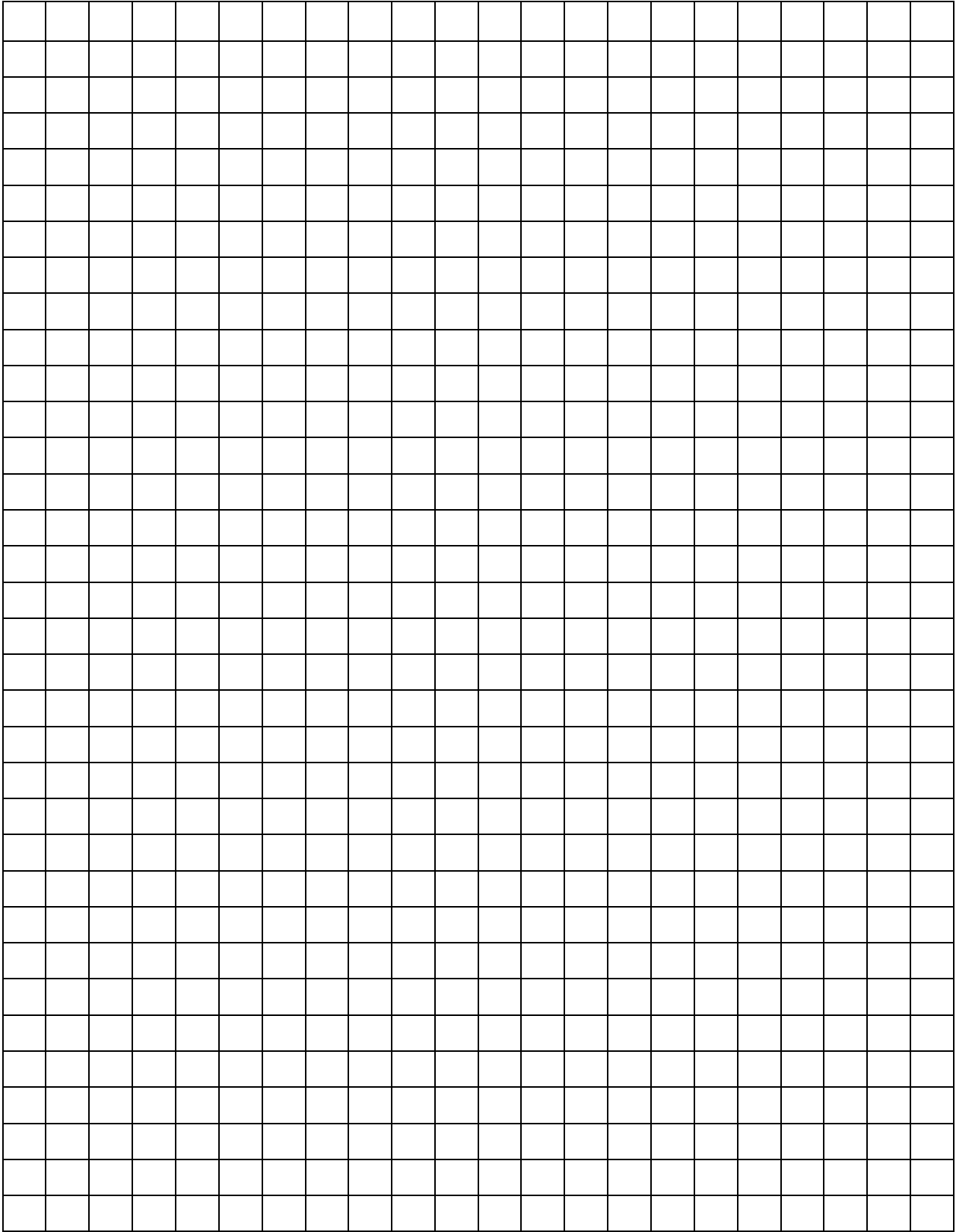
Graphing Technique

1. Remember that the x-axis goes across and the y-axis goes up and down.

2. Every graph should have a title ("Mass and Age of Pennies").

3. Every graph should have a heading (your name, date, etc.).

4. Some graphs may need a key (to explain use of colors or symbols).

5. The graph should fill the available space.

6. The axes should each be titled AND labeled to match the data table and should indicate unites of measurement ("mass of pennies, grams").

7. The range of each axis may be different. They should each be large enough to cover the needed range without lots of extra space. They do not need to start at zero.

8. The scale of each axis may be different, but each one must be consistent. If one box represents one year at the beginning of the graph, one box *always* represents one year.

9. The axes should be numbered to the same number of decimal places as the data was recorded. You don't need to number every box - usually every ten boxes will be adequate.

10. The independent variable always goes on the x-axis. If time is one of the measurements being graphed, it always goes on the x-axis.

11. Error bars may be used to indicate uncertainty in a measurement. The proper use depends on the graph and will be discussed as necessary.

12. Sometimes a line connecting points is OK. When this is true, it is usually best to draw the best smooth curve that goes near the data points. Look for general patterns rather than details.