Periodic Trends: Ionization Energy Worksheet

1. What is the ionization energy of an element?

2. Predict the following trends you expect to see in ionization energy:
   a) As you move across a period? Why?

   b) As you move down a group? Why?

3. What factors influence the ease of removing an electron from an element?

4. Choose an orbital where an electron would experience the highest $Z_{eff,}$ effective nuclear charge (least shielded), and the highest first ionization energy. Circle the correct answer.

   Na (3s) Mg (3s) Al (3p) P (3p) S (3p)

5. Match the following electron configuration with the appropriate ionization energy.

   a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1$ i) 1356 kJ/mol

   b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$ ii) 595 kJ/mol

   c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$ iii) 409 kJ/mol

6. Which one of the following has the largest first ionization energy? Circle the correct answer.

   Na K Li Cs

7. The first ionization energies values (kJ/mol) for sequential elements in period 3 are shown below. Assign elements to these values based on the periodic trends.

   740 578 786 1012 999

8. Choose the element with the greatest first ionization energy. Circle the correct answer.

   a) Carbon or aluminum b) Calcium or strontium

   c) Helium or lithium d) Chlorine or argon

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Answers

1. What is the ionization energy of an element?

   It is the minimum energy needed to remove an electron from the outer shell of a neutral atom in a gaseous state.

2. Predict the following trends you expect to see in ionization energy:

   a) As you move across a period? Why?

   It will increase because of the increased positive charge of the nucleus pulling on the electrons

   b) As you move down a group? Why?

   It will decrease because the outer electrons are farther away from the positively charged nucleus and the inner electrons shield the outer electrons, decreasing the attraction

3. What factors influence the ease of removing an electron from an element?

   - the effective charge of a nucleus on the specific electron
   - the electron configuration
   - the size of the element

4. Choose an orbital where an electron would experience the highest $Z_{eff,}$ effective nuclear charge (least shielded), and the highest first ionization energy. Circle the correct answer.

   Na (3s) ↑ | Mg (3s) ↑↓ | Al (3p) ↑ | **P (3p) ↑↑↑** | S (3p) ↑↓↑↑

5. Match the following electron configuration with the appropriate ionization energy.

   a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1$ — i) 1356 kJ/mol — c)

   b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$ — ii) 595 kJ/mol — b)

   c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$ — iii) 409 kJ/mol — a)

6. Which one of the following has the largest first ionization energy? Circle the correct answer.

   Na K **Li** Cs

7. The first ionization energies values (kJ/mol) for sequential elements in period 3 are shown below. Assign elements to these values based on the periodic trends.

740	578	786	1012	999
Mg	Al	Si	P	S

8. Choose the element with the greatest first ionization energy. Circle the correct answer.

   a) **Carbon** or aluminum

   b) **Calcium** or strontium

   c) **Helium** or lithium

   d) Chlorine or **argon**

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