

Worksheet "Electron Configurations and Periodicity": KEY

2. Write electron configuration of Calcium (Z= 20) [Ar] 4s²

Which of the following equations represents the first ionization energy of calcium?

- a. $\text{Ca}(s) \longrightarrow \text{Ca}^+(s) + e^-$
- b. $\text{Ca}(s) + e^- \longrightarrow \text{Ca}^-(s)$
- *c. $\text{Ca}(g) \longrightarrow \text{Ca}^+(g) + e^-$
- d. $\text{Ca}(s) \longrightarrow \text{Ca}^+(g) + e^-$
- e. $\text{Ca}(g) \longrightarrow \text{Ca}^{2+}(g) + 2e^-$

Write electron configuration of calcium ion with +1 charge [Ar] 4s¹

Write electron configuration of calcium ion with +2 charge [Ar] 4s⁰

Discuss ionization energy trends in period and in group. Explain from the point of view of Z_{eff} and changing principle quantum number. SECOND ionization energy is always bigger/ (or smaller?) than FIRST, then THIRD, etc. Remember that the ionization energy from noble gas core is expected to be very large.

3. Which **ONE** of the following atoms (electron configurations shown below) should have the most negative value for the **ELECTRON AFFINITY** of the free atom? Atoms are designated by electronic configuration. [DISCUSS DEFINITION OF ELECTRON AFFINITY first: $M + e \rightarrow M^-$, trends for EA and WHICH GROUP THIS ELEMENT IS LIKELY TO BE IN if EA is very negative, i.e. when formation of anion is favorable]!!!

- a. $1s^2 2s^2 2p^6 3s^1$ (Na)
- *b. $1s^2 2s^2 2p^5$ (F)
- c. $1s^2 2s^2 2p^6 3s^2 3p^2$ (Si)
- d. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$ (Mn)
- e. $1s^2 2s^2 2p^6$ (Ne)

Identify which element is described in each configuration above. (Hint – total number of electrons should equal Z. Another hint – the last electrons configuration gives you a clue where to look for the element!)

1. Which of the following properties, in general, increase as we move left to right across a period in the periodic table?

- 1. atomic radius
 - 2. ionization energy
 - 3. metallic character
- a. 1 only
 - *b. 2 only
 - c. 3 only
 - d. 1 and 2 only
 - e. 2 and 3 only

4. Which of the following atoms has the most negative electron affinity (EA)?

- a. Na
- * b. Cl
- c. Br
- d. S
- e. As

5. Question on CHEMICAL periodicity. (Explain the similarity of behavior in the GROUPS and gradual change across the PERIODS!):

Arsenic is an element in the same family as phosphorus. Which of the following would be the formula of arsenic acid?

*d. H_3AsO_4

6. Consider the ions of S^{2-} , O^{2-} , F^- , Na^+ , Mg^{2+} . Order the ions with ionic radius from largest to smallest?

*a. S^{2-} , O^{2-} , F^- , Na^+ , Mg^{2+}

7. Extra question if you have time:

An unknown element, Y, reacts with oxygen to form an oxide with the general formula Y_2O_5 . The pure element is strongly paramagnetic and the oxide, when added to water, forms an acidic solution. Which of the following elements could be described by these characteristics?

a. Na

*b. N, HNO_3 from reaction $\text{N}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{N}_2\text{O}_{(5+1)}$, i.e. $\text{H}_2\text{N}_2\text{O}_6 = 2 \text{HNO}_3$ nitric acid

c. Sc

d. S

e. Bi



8.38 A periodic law based on atomic masses would necessitate $_{52}\text{Te}$ and $_{53}\text{I}$ changing places in the periodic table. This was not done in the early periodic table because

a. it was thought that the atomic masses may be in error.

b. iodine contains one naturally occurring isotope, whereas tellurium consists of several isotopes.

c. a periodic law based on atomic masses is not valid.

d. the tellurium samples could contain a heavy impurity.

*e. iodine behaves chemically like chlorine and bromine.