

Chapter 7 Periodicity Test Questions:

Answer 3 of the following 5 questions. Submit to me jeff@szeryk.ca.

1) The electron affinities of five elements are given below.

$_{13}\text{Al}$ 12 kcal/mole

$_{14}\text{Si}$ 32 kcal/mole

$_{15}\text{P}$ 17 kcal/mole

$_{16}\text{S}$ 48 kcal/mole

$_{17}\text{Cl}$ 87 kcal/mole

Define the term “electron affinity” of an atom. For the elements listed above, explain the observed trend with the increase in atomic number. Account for the discontinuity that occurs at phosphorus.

2) Suppose that a stable element with atomic number 119, symbol Q, has been discovered.

- Write the ground-state electron configuration for Q, showing only the valence-shell electrons.
- Would Q be a metal or a nonmetal? Explain in terms of electron configuration.
- On the basis of periodic trends, would Q have the largest atomic radius in its group or would it have the smallest? Explain in terms of electronic structure.
- What would be the most likely charge of the Q ion in stable ionic compounds?
- Write a balanced equation that would represent the reaction of Q with water.
- Assume that Q reacts to form a carbonate compound.
 - Write the formula for the compound formed between Q and the carbonate ion, CO_3^{2-} .
 - Predict whether or not the compound would be soluble in water. Explain your reasoning.

3)
$$\text{M(s)} + \text{Cl}_2(\text{g}) \rightarrow \text{MCl}_2(\text{s})$$

The reaction of a metal with chlorine proceeds as indicated above. Indicate, with reasons for your answers, the effect of the following factors on the heat of reaction for this reaction.

- A large radius versus a small radius for M^{2+}
- A high ionization energy versus a low ionization energy for M.

4) Explain why in aqueous solution,

- Ti^{3+} is colored but Sc^{3+} is not.
- Ti^{2+} is a reducing agent but Ca^{2+} is not.

5) First ionization Energy

	<u>(kilocalories/mole)</u>	<u>Covalent Radii, Å</u>
Li	124	1.34
Be	215	0.90
B	191	0.82
C	260	0.77
N	336	0.75
O	314	0.73
F	402	0.72

The covalent radii decrease regularly from Li to F, whereas the first ionization energies do not. For the ionization energies, show how currently accepted theoretical concepts can be used to explain the general trend and the two discontinuities.