

CHEM 281. Winter 2002. Homework 1. Chapter 1 & 2.

Chapter 1.

1. Define the following terms, (a) nodal surface b) Pauli exclusion principle (c) paramagnetism
2. Define the following terms: (a) orbitals (b) degeneracy (c) Hund's rule.
3. Construct a quantum number tree for the principal quantum number $n = 4$ similar to that depicted for $n = 3$ in Figure 1,5.
4. Determine the lowest value of n for which m_l can have a value of $+4$
5. Identify the orbital that has $n = 6$ and $l = 0$,
6. Explain concisely why carbon has two electrons in different p orbitals with parallel spins rather than the other possible arrangements.
7. Write noble gas core ground state electron configuration for atoms of (a) sodium; (b) nickel; (c) copper.
8. Write noble gas core ground state electron configuration for atoms of (a) potassium; (b) scandium $3+$; (c) copper $2+$.
9. Predict the common charge of the silver ion. Explain your reasoning in terms of electron configurations.
10. Use diagrams similar to Figure 1.14 to determine the number of unpaired electrons in atoms of (a) oxygen; (b) magnesium; (c) chromium.
11. Write the electron configuration expected for element 113 and the configurations for the two cations that it is most likely to form.
12. In the text set of orbitals after the f orbitals are g orbitals. How many g orbitals would there be? What would be the lowest principle quantum number n that would possess g orbitals? Deduce the atomic number of the first element at which g orbitals would begin to be filled on the basis of the patterns of the d and f orbitals.

Chapter 2.

13. Define the following terms; (a) rare earth metals; (b) Van der Waals radius; (c) effective nuclear charge.
14. Define the following terms; (a) second, ionization energy; (b) electron affinity; (c) Bertrand's rule.
15. Why is iron the highest atomic number element formed in stellar

processes?

16. Identify
 - (a) the highest atomic number element for which stable isotopes exist;
 - (b) the only transition metal for which no stable isotopes are known;
 - (c) the only liquid nonmetal at SATP (standard ambient temperature and pressure).
17. Identify the only two radioactive elements to exist in significant quantities on Earth. Explain why they are still present.
18. Suggest the number of neutrons in the most common isotope of calcium.
19. Suggest why polonium-210 and astatine-211 are the isotopes of those elements with the longest half-lives.
20. Which atom should have the larger covalent radius, potassium or calcium? Give your reasoning.
21. Suggest a reason why the covalent radius of germanium (122 pm) is almost the same as that of silicon (117 pm), even though germanium has 18 more electrons than silicon.
22. Using Slater's rules, calculate the effective nuclear charge on an electron in each of the orbitals in an atom of potassium.
23. Which element should have the higher ionization energy, silicon or phosphorus?
24. An element has the following first through fourth ionization energies in $\text{MJ}\cdot\text{mol}^{-1}$: 0.7, 1.5, 7.7, 10.5. Deduce to which group in the periodic table it probably belongs. Give your reasoning.
25. When element 117 is synthesized, what would you expect qualitatively in terms of its physical and chemical properties?