



- \_\_\_\_\_ 8. The outermost electron in a ground state potassium atom can be described by which of the following sets of four quantum numbers?
- a. (4, 0, 0, +1/2)
  - b. (4, 1, 0, +1/2)
  - c. (4, 1, 1, +1/2)
  - d. (5, 0, 0, +1/2)
  - e. (5, 1, 0, +1/2)
- \_\_\_\_\_ 9. Gaseous atoms of which of the following elements are paramagnetic in their ground states?
- I. Na
  - II. Mg
  - III. Al
  - IV. P
- a. I, II, III, IV.
  - b. I, II, III only.
  - c. I, III, IV only.
  - d. II only.
  - e. III, IV only.
- \_\_\_\_\_ 10. Which set of quantum numbers is not allowed?
- a. (2, 2, 1, +1/2)
  - b. (3, 2, 0, -1/2)
  - c. (4, 3, -3, +1/2)
  - d. (5, 4, 4, +1/2)
  - e. (6, 2, -1, +1/2)

*Free Response Questions*

1. A line having a wavelength of 656 nm exists in the atomic emission spectrum of hydrogen.
  - a. For the line, calculate the following values and specify their units:
    - i. frequency
    - ii. energy of a photon
    - iii. energy of a mole of photons
  - b. What color is the line? Explain your reasoning.
  - c. Discuss the origin of the line in terms of the Bohr theory of the atom. Specify any energy transitions that are applicable.
2. Molecules of oxygen are converted to atomic oxygen in the upper atmosphere by absorbing photons having wavelengths of 240 nm and shorter.
  - a. Write the electron configuration of oxygen and tell why atomic oxygen is diamagnetic or paramagnetic.
  - b. Write the electron configuration of the oxide ion. Assign a set of four quantum numbers to each of the electrons in the oxide ion. Correlate the sets to the electron configuration.
  - c. Calculate the energy equivalent of a photon of wavelength 240 nm in units of kJ/mol.