

Even if we resolve all matter into one kind, that kind will need explaining. And so on for ever and ever deeper into the pit at whose bottom truth lies, without ever reaching it. For the pit is bottomless.--O. Heaviside

Unit 4 Sample Test

The test will be similar in format to previous tests with five multiple choice questions, two required problems, a choice of one out of two smaller problems, a choice of two out of four chemical reactions to write and one essay question. *Remember that on this test the first three solubility rules will be missing.* Values for the speed of light (c) and Planck's constant (h) will also be given.

The following are representative of typical multiple choice questions but do not necessarily indicate topics to be addressed on your actual test.

- _____ 1. The correct electron configuration for Mg is
a. $1s^2 2s^2 2p^8$ b. $1s^2 2s^4 2p^6$ c. $1s^2 2s^2 2p^4 3s^4$ d. $1s^2 2s^2 2p^6 3s^2$
2. As one moves down the periodic table, which of the following properties increase? Which decrease?
a. metallic character
b. ionization energy
c. electron affinity
d. atomic radius
3. Which of the following statements are true? Which are false?
a. There are fewer metallic elements than non-metallic
b. metals tend to have low electron affinities
c. metalloids lie along a diagonal line in the periodic table which runs from upper right to lower left
d. non-metals are located toward the upper right corner of the table
- _____ 4. Atoms form bright-line spectra when some of their electrons
a. are expelled from the atom
b. move from ground to excited states
c. fall from higher energy levels to lower energy levels
d. travel in stationary orbits
- _____ 5. Francium would be the most reactive element in group IA. This is so because
a. francium is rare
b. francium has the lowest ionization energy
c. francium ions are unstable
d. francium has the largest atomic mass

The next section consists of representative problems which might be found in the required section. All students are expected to work on both of the required problems.

6. In the Pfund series of lines for the excited hydrogen atom, a transition from $n = 6$ to a lower energy level has a frequency (ν) of 4.02×10^{13} Hz. Determine the wavelength (λ) of this EMR, and calculate the energy of the transition.

On the diagram below, indicate with a properly oriented arrow the transition described above.



7. The following information concerning four *consecutive*--by atomic number-- (not necessarily in the same row) elements in the periodic table was collected as a result of laboratory experiments. The letters have been assigned arbitrarily:

Element A reacts vigorously with water producing hydrogen gas and forms a compound with oxygen, A_2O

Element B is very unreactive and is monoatomic and gaseous at room temperature

Element C exists as a diatomic gas at room temperature; reacts with A to form AC

Element D reacts with C to form a compound DC_2 . It reacts slowly with water to form hydrogen gas.

_____ a. Assuming that not all these elements are in the same row, but are consecutive, put them in order from lowest to highest atomic number.

_____ b. Which of these elements is a *halogen*?

_____ c. Which of these elements is an *alkaline earth metal*?

The next section consists of representative problems such as might be found in the "options" section. Each student is expected to select one problem from this section to work on.

8. Write out the electron configurations for these elements: (you may abbreviate)

Tc

Ge

V

P

9. Given: Element A is in the second period, Group I
Element E is in the same row, Group V
Elements J, D, M, and R are in period 3, in (respectively) Groups I, IV, VI, VIII
Element L and G are in period 4, in Groups (respectively) III and VII

_____ a. What would be the most probable formula for a compound of L and M?

_____ b. Select the element with the highest ionization energy.

_____ c. Select the element with the most metallic character.

10. When synthesized, the halogen in period 7 will have $Z =$ _____.

At room temperature, this element will probably exist in the _____ (solid, liquid, gas) state.

It will most likely have _____ (high, low) reactivity compared to other elements in its family.

The next section consists of representative reactions to complete and write balanced net-ionic equations for. Note that some reactions do not occur in aqueous solution and thus molecular equations are all that would be needed. Each student is expected to choose two from this section. Recall that an additional solubility rule will be missing from the list this time.

11. For each of the following, complete the word equation, write a balanced net-ionic reaction, and tell what type of reaction it is. (reactions b and c do not occur in aqueous solution)

a. potassium metal + water \rightarrow _____

[more on next page]

b. chlorine + lithium → _____

c. calcium + oxygen gas → _____

*d. chloride ions and nitrate ions are combined in an acidic solution; nitrogen dioxide gas and chlorine gas are among the products

The final section of the test will consist of one essay question selected from the following topics:

- atomic models of Bohr and Schrödinger
- limitations on observations in the spectrum lab experiment
- predictions based on periodic trends
- electron configuration and periodic properties

[Answers](#)