AP Chemistry Test Periodic Functions Unit 8

MULTIPLE CHOICE QUESTIONS 1pt each

1. Mendeleev proposed the existence of an unknown element that he called eka-aluminum. This element is now called

   A. magnesium.
   B. silicon.
   C. gallium.
   D. boron.
   E. germanium.

2. The alkali metal elements are found in _____ of the periodic table.

   A. Group 1A
   B. Group 2A
   C. Group 3A
   D. Period 7
   E. Period 1

3. Which of the following is the general electron configuration for the outermost electrons of elements in the alkaline earth group?

   A. ns1
   B. ns^2
   C. ns^2np^4
   D. ns^2np^5
   E. $ns^2np^6(n - 1)d^6$

4. Consider an element with the following electron configuration. How would you classify this element?

   $[Kr]\,5s^2 4d^{10} 5p^5$

   A. a representative element
   B. a transition metal
   C. an alkali metal
   D. an actinide element
   E. a noble gas

5. The representative elements are those with unfilled energy levels in which the "last electron" was added to

   A. an s orbital.
   B. an s or p orbital.
   C. a d orbital.
   D. a p or d orbital.
   E. an f orbital.

6. How many valence electrons does a tin (Sn) atom have?

   A. 2
   B. 4
   C. 14
   D. 36
   E. 50

7. What is the charge on the monatomic ion of nitrogen, the nitride ion?

   A. +2
   B. +1
   C. -1
   D. -2
   E. -3

8. Which element forms stable +2 cations?

   A. Kr
   B. I
   C. Se
   D. Al
   E. Ba

9. Which two electron configurations represent elements that would have similar chemical properties?
   1. $1s^2 2s^2 2p^4$ 2. $1s^2 2s^2 2p^5$ 3. $[Ar]\,4s^2 3d^{10} 4p^3$ 4. $[Ar]\,4s^2 3d^{10} 4p^4$

   A. 1, 2
   B. 1, 3
   C. 1, 4
   D. 2, 4
   E. 2, 3

10. Which of the following make an isoelectronic pair: Cl^-, O^{2-}, F, Ca^{2+}, Fe^{3+}?

    A. Ca^{2+} and Fe^{3+}
    B. O^{2-} and F
    C. F and Cl^-
    D. Cl^- and Ca^{2+}
    E. none of the above

11. The cobalt(III) ion, Co^{3+}, has how many 3d electrons?

    A. 0
    B. 7
    C. 6
    D. 5
    E. 4

12. How many 3d electrons does an Fe^{3+} ion have?

    A. 9
    B. 65
    C. 5
    D. 4
    E. 3

13. Which atom will have the largest radius?

A. B
B. Ga
C. Br
D. Si
E. Cl

14. Which one of the following elements should have the lowest ionization energy?

A. Cl
B. Na
C. Be
D. K
E. As

15. Successive ionization energies, first, second, third, and so on, provide evidence for the shell structure of the atom. For silicon atoms, which ionization energy value will show an exceptionally large increase over the preceding ionization energy value?

A. 2nd
B. 3rd
C. 4th
D. 5th
E. 6th

16. Which of the following elements has the greatest electron affinity (largest positive value)?

A. Mg
B. Al
C. Si
D. P
E. S

17. Which of the following elements has the greatest metallic character?

A. Br
B. Se
C. Ni
D. As
E. Si

18. Which of the following is an acidic oxide?

A. P_4O_{10}
B. MgO
C. Fe_2O_3
D. K_2O
E. Cr_2O_3

19. Which of the following is a basic oxide?

A. NO_2
B. H_2O
C. Na_2O
D. SnO
E. SO_2

20. Which of the following element(s) behave chemically similar to oxygen?

A. magnesium
B. sodium
C. sulfur
D. chlorine
E. iron
F. beryllium

TRUE-FALSE QUESTIONS 1 pt each

21. The radii of ions are always smaller than the radii of the corresponding atoms of the same element.

22. Electron affinity is always a positive quantity.

23. The electron configuration of the outermost electrons of atoms of the halogen group is ns^2np^7.

24. Amphoteric oxides exhibit both acidic and basic properties.

25. For Mg atoms a very large jump in the magnitudes of the ionization energies will occur between the second and the third ionization energies.

OPEN-ENDED QUESTIONS

26. Many physical properties have periodic characteristics. Given the following data, what is a reasonable estimate of the melting point of potassium. 1pt

Lithium	180 °C
Sodium	98 °C
Rubidium	39 °C
Cesium	29 °C

27. Why is the Mg^{2+} ion smaller than F^-, even though they are isoelectronic? 2pts

28. Write the electron configurations for the following ions: (Do not use the core method) 2½pts
    a. S^{2-} _____
    b. Ca^{2+} _____
    c. Cr^{3+} _____
    d. Ni^{2+} _____
    e. Br^- _____

29. Consider the following reaction $3Li + Z \rightarrow Li_3Z$. 1½pts

    a. What is the formula for the compound if we substitute sodium for lithium?
    b. What is the formula for the compound if we substitute magnesium for lithium?
    c. What is a reasonable guess for element Z?

30. The second ionization energy of Mg is (greater, less) than its first ionization energy, and is (greater, less) than the second ionization energy of Na. Explain your answer. 3pts

31. Properties of the chemical elements often show regular variation with respect to their positions in the periodic table.
    (a) Describe the general trend in acid–base character of the oxides of the elements in the third period (Na to Ar). Give examples of one acidic oxide and one basic oxide and show with equations how these oxides react with water. 1pt
    (b) How does the tendency of the halogen elements to form anions vary down the group? Account for this trend. 1pt
    (c) How does the tendency of the alkali metals to form cations vary down the group? Account for this trend. 1pt

32. Although nitrogen usually forms covalent bonds it is capable of producing ionic bonds.
    (a) Indicate the formula charge and name of the anion nitrogen can form.
    (b) Write the formula for the compound that nitrogen's anion will form when it reacts with magnesium. 2pts

33. Predict the possible compounds that the following elements will have with oxygen.
    a. Lithium b. Boron c. Magnesium d. Aluminum e. Rubidium f. Si 3pts
    (There might be more than one compound or none at all for some of these elements)

34. Compare the chloride salts of beryllium and magnesium and relate this to the metallic trends of their group. 1pt

35. Predict the possible reactions that the following elements will have with water at room temperature. 2pts
    a. potassium b. aluminum c. magnesium d. barium

36. If element 120 were discovered predict two chemical properties it might have. 1pt

37. Why will thallium tend to more stable as a +1 ion than +3 ? 1pt.

38. For the set of elements Be, B, C, and N which element has the smallest ionization energy? Explain your answer. 2pts

39. Answer the following related to the properties element 117 (symbol Fb if Mr. Bernardo discovered it)
    a. What will be its core electron configuration?
    b. What element would it most resemble chemically and physically?
    c. What will be the formula of the neutral binary compounds it would form with sodium, magnesium, carbon and oxygen? 4pts
    d. What oxyanions would you expect Fb to form? (hint oxyanions like chlorate or sulfate etc....)

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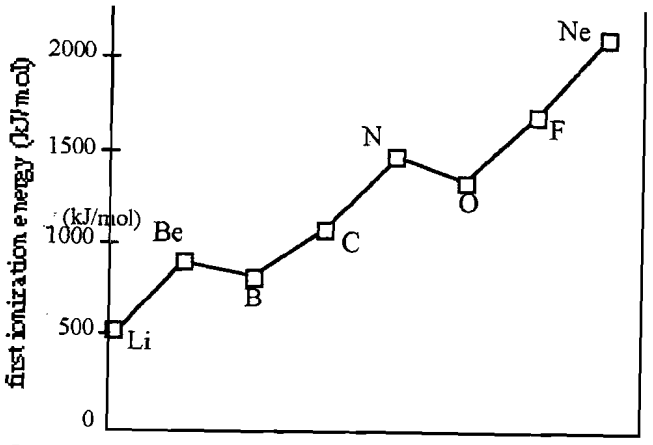

The diagram shows the first ionization energies for the elements from Li to Ne. Briefly (in one to three sentences) explain each of the following in terms of atomic structure.

(a) In general, there is an increase in the first ionization energy from Li to Ne.
(b) The first ionization energy of B is lower than that of Be.
(c) The first ionization energy of O is lower than that of N.
(d) Predict how the first ionization energy of Na compares to those of Li and of Ne. Explain.

1 pt each

	First Ionization Energy (kJ mor^{1})	Second Ionization Energy (kJ mor^{1})	Third Ionization Energy (kJ mor^{1})
Element 1	1,251	2,300	3,820
Element 2	496	4,560	6,910
Element 3	738	1,450	7,730
Element 4	1,000	2,250	3,360

41. The table above shows the first three ionization energies for atoms of four elements from the third period of the periodic table. The elements are numbered randomly. Use the information in the table to answer the following questions.

(a) Which element is most metallic in character? Explain your reasoning.

(b) Identify element 3. Explain your reasoning.

(c) Write the complete electron configuration for an atom of element 3.

1pt each

(d) What is the expected oxidation state for the most common ion of element 2 ?

(e) What is the chemical symbol for element 2 ?

(f) A neutral atom of which of the four elements has the smallest radius?