

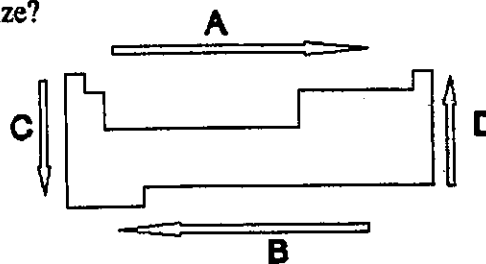
Project Advance Chemistry 106 Sample Questions
on Material in *General Chemistry*, Brown, LeMay, and Bursten, 6th ed.

Chapter 7. Periodic Properties of the Elements

1. Which scientist was responsible for showing that the periodic table was arranged most logically by atomic number?
 - (a) Bohr
 - (b) Mendeleev
 - (c) Meyer
 - (d) Moseley
 - (e) Rutherford
2. The $1s$ subshell is much closer to the nucleus in argon than in helium due to
 - (a) nuclear charge
 - (b) paramagnetism
 - (c) diamagnetism
 - (d) Hund's rule
 - (e) the azimuthal quantum number, l
3. Screening by valence electrons for representative elements is
 - (a) less efficient than that by core electrons.
 - (b) more efficient than that by core electrons.
 - (c) essentially identical to that by core electrons.
 - (d) responsible for a general increase in atomic radius going across a period.
 - (e) *both* more efficient than that by core electrons *and* responsible for a general increase in atomic radius going across a period.
4. Atomic radius for the main-group elements generally increases down a group because
 - (a) the effective nuclear charge increases down a group.
 - (b) the effective nuclear charge decreases down a group.
 - (c) the effective nuclear charge zigzags down a group.
 - (d) the principal quantum number of the valence orbitals increases.
 - (e) *both* the effective nuclear charge increases down a group *and* the principal quantum number of the valence orbitals increases.
5. Which one of the following atoms has the largest radius?
 - (a) oxygen
 - (b) fluorine
 - (c) sulfur
 - (d) chlorine
 - (e) none of these.

6. Which set of arrows corresponds to increasing atomic size?

- (a) A,D (b) C,B
 (c) C,B (d) B,D
 (e) not enough information to determine answer.

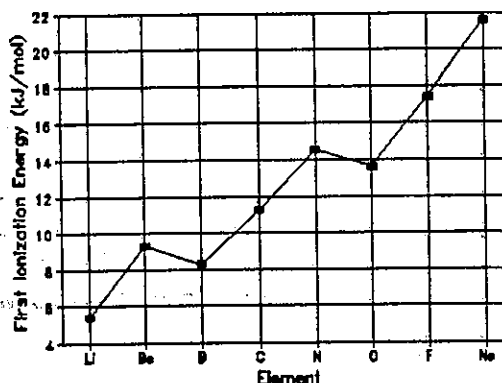


7. At which value n of ionization energy I_n does a graph of I_n plotted as a function of n suddenly get very large for carbon?

- (a) 1 (b) 2
 (c) 3 (d) 4
 (e) 5

8. The graph of $I_1 = f(\text{element})$ below shows $I_1(\text{Boron}) < I_1(\text{Beryllium})$. The key concept explaining why is

- (a) paramagnetism.
 (b) $2p$ electrons penetrate the $1s^2$ core less than do $2s$ electrons.
 (c) degeneracy.
 (d) repulsion of paired electrons in the p^4 configuration.
 (e) effective nuclear charge.



9. The first ionization energies of the elements _____ as you go from left to right across a period of the periodic table, and _____ as you go from the bottom to the top of a group in the table.

- (a) increase, increase
 (b) increase, decrease
 (c) decrease, increase
 (d) decrease, decrease
 (e) remain the same.

10. Which one of the following elements has the largest *first* ionization energy?
- (a) Na (b) Al
(c) Se (d) Cl
(e) Cs
11. Which one of the following elements has the largest *second* ionization energy?
- (a) K (b) Rb
(c) Sr (d) Ca
(e) H
12. Which one of the following elements has the largest *third* ionization energy?
- (a) As (b) Sc
(c) Ti (d) Ca
13. The trend for electron affinity going from left to right across a period of main group elements is best described as
- (a) becoming linearly more exothermic.
(b) becoming linearly less exothermic.
(c) becoming generally more exothermic, but with considerable interruptions due to electron-configuration effects.
(d) becoming generally less exothermic, but with considerable interruptions due to electron-configuration effects.
(e) remaining essentially constant.
14. Which one of the following elements has the largest (most exothermic) electron affinity?
- (a) S (b) Cl
(c) Se (d) Br
(e) Na
15. In general, as one goes across a period from left to right in the periodic table, the atomic radius _____, the exothermicity of the electron affinity _____, and the first ionization energy _____.
- (a) decreases, decreases, increases
(b) increases, increases, decreases
(c) increases, increases, increases
(d) decreases, increases, increases
(e) decreases, decreases, decreases

16. The expected formula of germanium fluoride is

- (a) GeF_2
- (b) Ge_2F
- (c) Ge_4F
- (d) GeF_4
- (e) GeF_7

17. Which one of the following is a transition metal?

- (a) V
- (b) Rb
- (c) Al
- (d) Be
- (e) Te

18. Which one of the following is a metalloid?

- (a) Ge
- (b) S
- (c) Br
- (d) Pb
- (e) Cs

19. Which one of the following is most metallic?

- (a) Na
- (b) Mg
- (c) Al
- (d) K
- (e) At

20. In the following list, the element with the *highest* melting point is

- (a) Ca
- (b) K
- (c) Sc
- (d) Na
- (e) H

21. All of the following are ionic compounds except

- (a) K_2O
- (b) Na_2SO_4
- (c) SiO_2
- (d) Li_3N
- (e) CsCl

22. Which one of these oxides is most basic?

- (a) K_2O
- (b) Al_2O_3
- (c) CO_2
- (d) MgO
- (e) SO_3

23. Which one of the following metal oxides has both acidic and basic properties?

- (a) Na_2O
- (b) Al_2O_3
- (c) CaO
- (d) MgO
- (e) RaO

24. Which of the following oxides is most acidic?

- (a) CO_2
- (b) SiO_2
- (c) Al_2O_3
- (d) SO_2
- (e) Rb_2O

25. Which of the following traits characterizes the alkali metals?

- (a) very high melting point
- (b) existence as diatomic molecules
- (c) common formation of dianions
- (d) the lowest I_1 values of the elements in each period
- (e) the smallest atom in each period

26. Which one of the following substances is *always* produced when an active metal reacts with water?

- (a) H_2O
- (b) H_2
- (c) CO_2
- (d) NaOH
- (e) O_2

27. Which Group 6A element is most metallic in character?

- (a) oxygen
- (b) sulfur
- (c) selenium
- (d) tellurium
- (e) polonium

28. Which one of the following elements has an allotropic form that is produced in the upper atmosphere by lightning?

- (a) nitrogen
- (b) hydrogen
- (c) oxygen
- (d) sulfur
- (e) chlorine

29. Which element is expected to be chemically *most* similar to phosphorus?

- (a) S
(b) As
(c) Se
(d) Sb
(e) Si

30. Which of the following statements is correct?

- (a) Na is an alkali earth metal.
(b) Ti is a representative element.
(c) Sn is a transition element.
(d) Ba is an alkali metal.
(e) Br is a halogen.

31. The most probable arrangement of the *valence* electrons in the ground state electronic configurations of several Lanthanide (inner transition) elements are shown below. Which two of these elements would be expected to have the most stable +2 oxidation states. [Hint: For the cations of the Lanthanide elements the 4*f* orbitals are of lower energy than the 6*s* orbital.]

Lanthanum	La:	$6s^2 5d^1$
Cerium	Ce:	$6s^2 4f^2$
Praesodymium	Pr:	$6s^2 4f^3$
Europium	Eu:	$6s^2 4f^7$
Gadolinium	Gd:	$6s^2 4f^7 5d^1$
Dysprosium	Dy:	$6s^2 4f^{10}$
Erbium	Er:	$6s^2 4f^{12}$
Thulium	Tm:	$6s^2 4f^{13}$
Ytterbium	Yb:	$6s^2 4f^{14}$
Lutetium	Lu:	$6s^2 4f^{14} 5d^1$

- (a) La and Lu
(b) Ce and Tm
(c) Pr and Er
(d) Eu and Yb
(e) Gd and Dy

Project Advance Chemistry 106 Study Questions
on Material in *General Chemistry*, Brown, LeMay, and Bursten

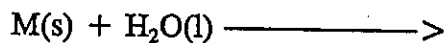
Chapter 7. Periodic Properties of the Elements.

Fall Semester 1996

1. If Na reacts with element X to form an ionic compound with the formula Na_3X , then Ca will react with X to form

- (a) CaX_2
- (b) CaX
- (c) Ca_2X_3
- (d) Ca_3X_2
- (e) Ca_3X

2. What is the coefficient of M when the following equation is completed and balanced if M is an alkali metal?



- (a) 1
- (b) 2
- (c) 3
- (d) 4
- (e) $\frac{1}{2}$

3. What is the valence shell electron configuration of the halogens?

- (a) ns^2np^6
- (b) ns^1
- (c) ns^2
- (d) ns^2np^5
- (e) ns^2np^3

4. Which one of the following contains no 3d electrons?

- (a) Ca
- (b) Sn
- (c) Ge
- (d) Pb
- (e) Ru

5. Which one of the following atoms has the largest radius?
- (a) O
 - (b) F
 - (c) S
 - (d) Cl
 - (e) He
6. Which one of the following atoms has the largest radius?
- (a) Sr
 - (b) Ca
 - (c) K
 - (d) Rb
 - (e) H
7. Which one of the following elements has the largest atomic radius?
- (a) O
 - (b) F
 - (c) Al
 - (d) P
 - (e) N
8. In which choice below are the elements ranked in order of increasing first ionization energy.
- (a) P, Cl, S, Al, Ar, Si
 - (b) Ar, Cl, S, P, Si, Al
 - (c) Al, Si, P, S, Cl, Ar
 - (d) Al, Si, S, P, Cl, Ar
 - (e) Ar, Si, S, P, Cl, Al
9. Which one of the following elements has the largest first ionization energy?
- (a) K
 - (b) Rb
 - (c) Sr
 - (d) Ca
 - (e) Cs

10. Which one of the following elements has the largest second ionization energy?
- (a) K
 - (b) Rb
 - (c) Sr
 - (d) Ca
 - (e) Ba
11. Which one of the following elements has the largest third ionization energy?
- (a) As
 - (b) Sc
 - (c) Ti
 - (d) Ca
 - (e) V
12. The _____ have the most negative electron affinities.
- (a) alkaline earth metals
 - (b) alkali metals
 - (c) halogens
 - (d) transition metals
13. The trend for electron affinity going left to right across a period of main-group elements is best described as
- (a) becoming linearly more exothermic
 - (b) becoming linearly less exothermic
 - (c) becoming generally more exothermic, but with considerable interruptions due to electron-configuration effects
 - (d) becoming generally less exothermic, but with considerable interruptions due to electron-configuration effects
 - (e) remaining essentially constant
14. Which one of the following elements has the largest (most exothermic) electron affinity?
- (a) S
 - (b) Cl
 - (c) Se
 - (d) Br
 - (e) Be

15. The oxide of which element below can react with hydrochloric acid?
- (a) sulfur
 - (b) selenium
 - (c) nitrogen
 - (d) sodium
 - (e) carbon
16. Which one of the following pairs contains a halogen and an alkaline earth element?
- (a) S, Na
 - (b) Cl, Mg
 - (c) O, Ca
 - (d) F, Cs
 - (e) Co, Fe
17. Which of these is an inner transition element?
- (a) Sc
 - (b) U
 - (c) Zn
 - (d) Ga
 - (e) Ge
18. Which one of the following elements is the most metallic?
- (a) Mg
 - (b) Na
 - (c) K
 - (d) Al
 - (e) At
19. Which of these oxides is most acidic?
- (a) CO_2
 - (b) SiO_2
 - (c) Al_2O_3
 - (d) SO_2
 - (e) K_2O
20. Which one of the following compounds would produce a basic solution when dissolved in water?
- (a) SO_2
 - (b) Na_2O
 - (c) CO_2
 - (d) OF_2
 - (e) NO_2

21. Which one of the following metals is most likely to form several different positive ions?
- (a) Al
 - (b) Cs
 - (c) V
 - (d) Ca
 - (e) Mg
22. This element is more reactive than lithium and magnesium but less reactive than potassium. This element is
- (a) Na
 - (b) Rb
 - (c) Ca
 - (d) Be
23. Which one of the following is not true about oxygen?
- (a) the most stable allotrope is O₂
 - (b) ozone is toxic whereas O₂ is not
 - (c) dry air is about 80% oxygen
 - (d) it forms two unstable ions, peroxide and superoxide
24. Which one of the following groups contains only nonmetals?
- (a) 1A
 - (b) 2A
 - (c) 6A
 - (d) 7A
 - (e) 5A
25. Which one of the following elements has an allotropic form that is produced in the upper atmosphere by lightning?
- (a) N
 - (b) O
 - (c) S
 - (d) Cl
 - (e) He

