

## AP Chemistry: Atomic Structure

### Multiple Choice

22.  $1s^2 2s^2 2p^6 3s^2 3p^3$

Atoms of an element, X, have the electronic configuration shown above. The compound most likely formed with magnesium, Mg, is...

- (A)  $MgX$  (B)  $Mg_2X$  (C)  $MgX_2$  (D)  $MgX_3$  (E)  $Mg_3X_2$

43. The elements in which of the following have most nearly the same atomic radius?

- (A) Be, B, C, N (B) Ne, Ar, Kr, Xe (C) Mg, Ca, Sr, Ba  
(D) C, P, Se, I (E) Cr, Mn, Fe, Co

58. Which of the following represents the ground state electron configuration for the  $Mn^{3+}$  ion?  
(Atomic number Mn = 25)

- (A)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$  (B)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$  (C)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$   
(D)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$  (E)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^1$

Use the following answers for questions 1 - 3.

- (A) F (B) S (C) Mg (D) Ar (E) Mn

1. Forms monatomic ions with  $2^-$  charge in solutions
2. Forms a compound having the formula  $KXO_4$
3. Forms oxides that are common air pollutants and that yield acidic solution in water

33. Which of the following conclusions can be drawn from J. J. Thomson's cathode ray experiments?

- (A) Atoms contain electrons.  
(B) Practically all the mass of an atom is contained in its nucleus.  
(C) Atoms contain protons, neutrons, and electrons.  
(D) Atoms have a positively charged nucleus surrounded by an electron cloud.  
(E) No two electrons in one atom can have the same four quantum numbers.

1. Use these answers for questions 1 - 3.

- (A) O (B) La (C) Rb (D) Mg (E) N

1. What is the most electronegative element of the above?
2. Which element exhibits the greatest number of different oxidation states?
3. Which of the elements above has the smallest ionic radius for its most commonly found ion?

50. In the periodic table, as the atomic number increases from 11 to 17, what happens to the atomic radius?

- (A) It remains constant. (B) It increases only.  
(C) It increases, then decreases. (D) It decreases only.  
(E) It decreases, then increases.

4. Use these answers for questions 4 - 7.

- (A)  $1s^2 2s^2 2p^5 3s^2 3p^5$  (B)  $1s^2 2s^2 2p^6 3s^2 3p^6$  (C)  $1s^2 2s^2 2p^6 2d^{10} 3s^2 3p^6$   
(D)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$  (E)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$

4. An impossible electronic configuration

5. The ground-state configuration for the atoms of a transition element

6. The ground-state configuration of a negative ion of a halogen

7. The ground-state configuration of a common ion of an alkaline earth element

1. Use these answers for questions 1-4

(A) Heisenberg uncertainty principle (B) Pauli exclusion principle (C) Hund's rule

(D) Shielding effect (E) Wave nature of matter

1. Can be used to predict that a gaseous carbon atom in its ground state is paramagnetic

2. Explains the experimental phenomenon of electron diffraction

3. Indicates that an atomic orbital can hold no more than two electrons

4. Predicts that it is impossible to determine simultaneously the exact position and the exact velocity of an electron

54. All of the following statements concerning the characteristics of the halogens are true EXCEPT...

(A) The first ionization energies (potentials) decrease as the atomic numbers of the halogens increase.

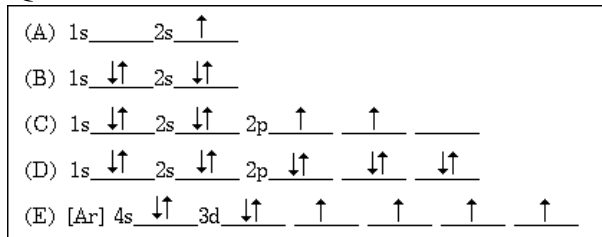
(B) Fluorine is the best oxidizing agent.

(C) Fluorine atoms have the smallest radii.

(D) Iodine liberates free bromine from a solution of bromide ion.

(E) Fluorine is the most electronegative of the halogens.

5. Questions 5-8 refer to atoms for which the occupied atomic orbitals are shown below:



5. Represents an atom that is chemically unreactive

6. Represents an atom in an excited state

7. Represents an atom that has four valence electrons.

8. Represents an atom of a transition metal.

51. Which of the following is a correct interpretation of the results of Rutherford's experiments in which gold atoms were bombarded with alpha particles?

(A) Atoms have equal numbers of positive and negative charges.

(B) Electrons in atoms are arranged in shells.

(C) Neutrons are at the center of an atom.

(D) Neutrons and protons in atoms have nearly equal mass.

(E) The positive charge of an atom is concentrated in a small region.

Ionization Energies for element X ( $\text{kJ mol}^{-1}$ )				
First	Second	Third	Fourth	Five
580	1815	2740	11600	14800

37. The ionization energies for element X are listed in the table above. On the basis of the data, element X is most likely to be...

(A) Na    (B) Mg    (C) Al    (D) Si    (E) P

19. Which of the following represents a pair of isotopes?

		Atomic Number	Mass Number
(A)	I.	6	14
	II.	7	14
(B)	I.	6	7
	II.	14	14
(C)	I.	6	14
	II.	14	28
(D)	I.	7	13
	II.	7	14
(E)	I.	8	16
	II.	16	20

### Questions 1-2

Consider atoms of the following elements. Assume that the atoms are in the ground state.

- (A) S  
(B) Ca  
(C) Ga  
(D) Sb  
(E) Br

- The atom that contains exactly two unpaired electrons.
- The atom that contains only one electron in the highest occupied energy sublevel.

17. In which of the following groups are the three species isoelectronic, i.e. have the same number of... electrons?

- (A)  $\text{S}^{2-}$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$   
(B) Sc, Ti,  $\text{V}^{2+}$   
(C)  $\text{O}^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Cl}^-$   
(D)  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$   
(E) Cs,  $\text{Ba}^{2+}$ ,  $\text{La}^{3+}$

44. Which of the following properties generally decreases across the periodic table from sodium to chlorine?

- (A) First ionization energy
- (B) Atomic mass
- (C) Electronegativity
- (D) Maximum value of oxidation number
- (E) Atomic radius

46. The effective nuclear charge experienced by the outermost electron of Na is different than the effective nuclear charge experienced by the outermost electron of Ne. This difference best accounts for which of the following?

- (A) Na has a greater density at standard conditions than Ne.
- (B) Na has a lower first ionization energy than Ne.
- (C) Na has a higher melting point than Ne.
- (D) Na has a higher neutron-to-proton ratio than Ne.
- (E) Na has fewer naturally occurring isotopes than Ne.