



1. How many electrons do metal atoms have in their outer ring?

- (A) 1, 2, or 3
- (B) 3, 4, or 5
- (C) 4, 5, or 6
- (D) 5, 6, or 7

The correct answer is A. Metal atoms are different from other atoms because metal atoms only have 1, 2, or 3 electrons in their outer ring. While they can give or share their electrons with atoms needing 1, 2, or 3 electrons, they cannot do that with each other because that won't fill up their outer rings. Metal atoms have to bond to each other a different way.

2. Metal atoms bond together by _____.

- (A) giving and taking electrons
- (B) sharing electrons equally
- (C) sharing electrons unequally
- (D) **dumping their electrons into a sea of electrons**

The correct answer is D. Metal atoms have too few electrons in their outer rings to fill up their outer rings by giving away or sharing their outer electrons with another atom. So instead, they dump the 1, 2, or 3 electrons in their outer ring into a sea of electrons.

3. Why does dumping their outer electrons into a sea of electrons cause metal atoms to pull together?

- (A) When metal atoms dump their electrons, they become positive metal ions which are attracted to other positive metal ions.
- (B) When metal atoms dump their electrons, they become positive metal ions which are attracted to the electrons still circling the nuclei of other metal atoms.
- (C) **When metal atoms dump their electrons, they become positive metal ions which are attracted to all the released electrons.**
- (D) When metal atoms dump their electrons, they become positive metal ions which are repelling each other and forcing each closer together.

The correct answer is C. When metal atoms dump their electrons and become positive metal ions, those positive metal ions are attracted to all the loose electrons roaming around all the metal atoms and gravitate toward the electrons until they sense another positive metal ion lurking in the cloud of electrons.

4. How do metal ions arrange themselves?

- (A) alternating rows of positive and negative metal ions.
- (B) groups of positive metal ions clustered around a small cloud of electrons
- (C) rows and columns of positive metal ions**
- (D) rows and columns of neutral metal atoms

The correct answer is C. When metal atoms dump their electrons and become positive metal ions, they move toward the swarming electrons but stop when they sense another positive metal ion, resulting in equally spaced metal ions in rows and columns.

5. Why do metals bend instead cracking when hammered?

- (A) Because rows of positive metal ions are still lying next to positive metal ions after they've been shifted over by the hammer.**
- (B) Because the metallic bond holding positive metal ions together is extremely strong.
- (C) Because positive metal ions are able to repel the positive metal ions in the hammer.
- (D) Because metals are able to transfer mechanical force into the metal before the force can split the surface metal ions.

The correct answer is A. In a metal, rows of positive metal ions are lying atop each other. While a hammer may shift a rows of positive metal ions, rows of positive metal ions are still lying on rows of positive metal ions.

6. Why are metals such good conductors of electricity?

- (A) Because free-floating electrons in the sea of electrons are readily able to leap from positive metal ion to positive metal ion.
- (B) Because free-floating electrons in the sea of electrons are readily able to shoot down the aisles between rows and columns of metal ions.**
- (C) Because electrical charges are able to avoid the center of the sea of electrons by speeding along the surface of the sea of electrons.
- (D) Because there are so many electrons in the sea of electrons to carry the electrical charges.

The correct answer is B. The aisles between the rows and columns of positive metal ions allow electrons to carry electrical charges quickly through a metal.

7. Why do metals feel cold?

- (A) Because the positive metal ions in a metal are being rigidly held and cannot jiggle in place.
- (B) Because positive metal ions do not conduct heat very well.
- (C) Because electrons prevent heat from being transferred out of the metal bonds.
- (D) Because metals rapidly conduct heat away from the skin.**

The correct answer is D. The brain judges the heat of an object by sensing the temperature of the skin touching the object. Since metals conduct heat so well away from the skin, the brain is fooled into thinking the metal is cold.

8. How is heat conduction different in a metal from most other substances?

- (A) Heat is conducted through the jiggling of positive metal atoms being held rigidly together.
- (B) Heat is conducted by electrons shooting down the aisles between positive metal ions.**
- (C) Heat is conducted by the transfer of heat waves between rigidly held metal ions.
- (D) Heat is conducted by negative electrons rapidly leaping from one positive ion to the next.

The correct answer is B. Unlike other substances that express heat through the jiggling of their atoms, metals conduct heat through their electrons, which are able to rapidly shoot down the aisles between rows and columns of positive metal ions.

9. What is an alloy?

- (A) An alloy is a mixture of two metals.**
- (B) An alloy is rearrangement of metal ions into interlocking clusters.
- (C) An alloy is a metal made harder by hammering and heating it.
- (D) An alloy is a metal with interconnecting bonds between the rows and columns of positive metal ions.

The correct answer is A. An alloy is made by sprinkling in atoms of a second metal. Nestled between the rows and column of positive metal ions, the atoms prevent the rows and columns from rolling over one another and thereby strengthen the metal.

10. Which of the following metals are not alloys?

- (A) bronze
- (B) iron**
- (C) pewter
- (D) brass

The correct answer is B. Iron is a pure metal. Bronze is a mixture of copper and tin. Pewter is a mixture of tin with copper. Brass is an a mixture of copper with zinc.