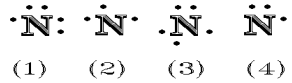
Test Review № 7

Bonding. The electrons of one atom are attracted to the protons of another. When atoms combine, there is a tug of war over the valence electrons. The combining atoms either lose, gain, or share electrons in such a way that they complete their outer shells. Whether atoms gain, lose, or share electrons depends how tightly they hold onto their own electrons and how strongly they pull on the electrons of another atom.
Ionic Bonds. Ionic bonds are caused by the attraction between oppositely charged ions. Ions form as follows: The electrons of one atom are attracted to the protons of another. Metals hold onto electrons loosely while nonmetals hold onto electrons tightly. As a result, metals lose electrons and nonmetals gain electrons in such a way that they complete their outer shells. Atoms that gain or lose electrons become electrically charged. Metals become positively charged ions by losing electrons. Nonmetals become negatively charged ions by gaining electrons. Metal cations and nonmetal anions become ionically bonded because they are oppositely charged. Atoms gain or lose electrons in such a way that they complete their outer shells. This gives them the same electron configuration as a noble gas. For example, potassium, with an electron configuration of 2-8-8-1 loses an electron to become K^+ with an electron configuration of 2-8-8, the same as argon. Chlorine, with an electron configuration of 2-8-7, gains an electron to become Cl^-, with an electron configuration also of 2-8-8.
Covalent Bonds. Covalent bonds are bonds formed by sharing electrons. The electrons of one atom are attracted to the protons of another, but neither atom pulls strongly enough to remove an electron from the other. Covalent bonds form when the electronegativity difference between the elements is less than 1.7 (see the Electronegativity table on the back of the Periodic Table) or when hydrogen behaves like a metal. When a covalent bond forms, no valence electrons are transferred, rather, they are shared. During covalent bonding, unpaired electrons pair up in such a way that the atoms complete their outer shells. This can be illustrated with electron dot diagrams.
Bond Type and Polarity. When the electronegativity difference is greater than or equal to 1.7, the atom with the greater electronegativity gains the electron, and an **ionic bond** is formed. Electronegativity differences below 1.7 result in covalent bonds or sharing. If the electronegativity difference is close to zero (<0.4), the atoms share equally and a **nonpolar bond** forms. Higher electronegativity differences (still below 1.7) result in unequal sharing or **polar bonds**.
Electron Dot Diagrams. Electron dot diagrams show valence electrons as dots at 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock, and the rest of the atom, known as the kernel, as a symbol. Electrons will move into the *s* orbital first. Once the *s* is filled, additional electrons will go into each of the three *p* orbitals without pairing until each *p* orbital has one electron. During bonding, however, the outer shell of the atom is composed of four equal orbitals. Electrons do not pair up until each orbital contains an electron.
Polar Molecules. Electronegativity differences between 0.4 and 1.7 are found in molecules with polar bonds. These molecules can be polar depending on their shapes. Molecules with polar bonds distributed symmetrically are nonpolar. Asymmetrical molecules with polar bonds are polar. Water is polar. An imaginary line can be drawn through a water molecule separating the positive pole from the negative pole. This is because the charges are distributed asymmetrically. Carbon dioxide is nonpolar because the electronegative oxygens are distributed symmetrically around the carbon. (O=C=O)

Answer the questions below by circling the number of the correct response

1. Which of the following is the correct electron dot diagram for nitrogen?



2. Barium combines by (1) gaining two electrons, (2) losing two electrons, (3) sharing two electrons, (4) sharing 3 electrons.

3. In water, the bond between hydrogen and oxygen is (1) ionic, (2) polar covalent, (3) nonpolar covalent, (4) nonpolar noncovalent.

4. Which of the following occurs during covalent bonding? (1) Electrons are lost. (2) Electrons are gained. (3) Valence electrons fall from the excited state to the ground state. (4) Unpaired electrons form pairs.

5. Which of the following is an example of a substance with a nonpolar covalent bond? (1) HCl (2) Cl_2 (3) $HClO_2$ (4) NaCl

6. The electronegativity of sulfur is (1) 16, (2) 239, (3) 2.6, (4) 32.

7. Which of the following elements has the highest electronegativity? (1) fluorine (2) chlorine (3) barium (4) hydrogen

8. When calcium combines, it usually (1) loses two electrons, (2) gains six electrons, (3) shares two electrons, (4) shares six electrons.

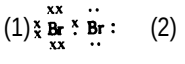
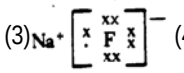
9. Which compound contains a bond with the *least,* ionic character? (1) CO (2) K_2O (3) CaO (4) Li_2O

10. Which type of bond is contained in a water molecule? (1) nonpolar covalent (2) ionic (3) polar covalent (4) electrovalent

11. The bonding in NH_3 most similar to the bonding in (1) H_2O (2) MgO (3) NaCl (4) KF

12. The electronegativity difference in hydrogen chloride (HCl) is (1) 2.1, (2) 3.2, (3) 1.1, (4) 5.3.

13. Which electron dot formula represents a molecule that contains a nonpolar covalent bond?

(1)  (2)  (3)  (4) 

14. When a reaction occurs between atoms with ground state electron configurations 2–1 and 2–7, the predominant type of bond formed is (1) polar covalent, (2) ionic, (3) nonpolar covalent, (4) metallic.

15. The P—Cl bond in a molecule of PCl_3 is (1) nonpolar covalent, (2) coordinate covalent, (3) polar covalent, (4) electrovalent.

16. A Ca^{2+} ion differs from a Ca atom in that the Ca^{2+} ion has (1) more protons, (2) more electrons, (3) fewer protons, (4) fewer electrons.

17. Which of the following compounds has the most ionic character? (1) KI (2) NO (3) HCl (4) MgS

18. Which atom has the strongest attraction for electrons? (1) Cl (2) F (3) Br (4) I

19. Which compound is ionic? (1) HCl (2) $CaCl_2$ (3) SO_2 (4) H_2O

20. Two atoms of element A unite to form a molecule with the formula A_2. The bond between the atoms in the molecule is (1) electrovalent, (2) nonpolar covalent, (3) ionic, (4) polar covalent.

21. When an ionic bond is formed, the atom that transfers its valence electron is the atom that has the (1) higher electronegativity value, (2) lower atomic number. (3) higher atomic mass, (4) lower ionization energy.

22. When an ionic bond is formed, the atom that transfers its valence electron becomes an ion with (1) positive charge and more protons, (2) positive charge and no change in the number of protons, (3) negative charge and more protons, (4) negative charge and no change in the number of protons.

23. Which compound best illustrates ionic bonding? (1) CCl_4 (2) $MgCl_2$ (3) H_2O (4) CO_2

24. An atom that loses or gains one or more electrons becomes (1) an ion, (2) an isotope, (3) a molecule, (4) an electrolyte

25. Which kind of bond is formed when two atoms share electrons to form a molecule? (1) ionic (2) metallic (3) electrovalent (4) covalent

26. Which type of bonding is usually exhibited when the electronegativity difference between two atoms is 1.2? (1) ionic (2) metallic (3) network (4) covalent

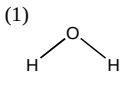
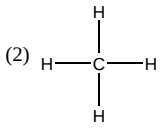
27. Which molecule is nonpolar and has a symmetrical shape? (1) HCl (2) CH_4 (3) H_2O (4) NH_3

28. Which formula represents a polar molecule? (1) CH_4 (2) Cl_2 (3) NH_3 (4) N_2

29. Which substance contains a polar covalent bond? (1) Na_2O (2) Mg_3N_2 (3) CO_2 (4) N_2

30. Which molecule is nonpolar and contains a nonpolar covalent bond? (1) CCl_4 (2) F_2 (3) HF (4) HCl

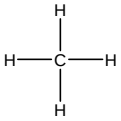
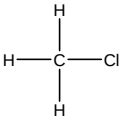
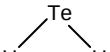
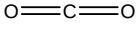
31. Which structural formula represents a nonpolar symmetrical molecule?

(1)  (2)  (3) (4) 

32. Why is NH_3 classified as a polar molecule? (1) It is a gas at STP. (2) H—H bonds are nonpolar. (3) Nitrogen and hydrogen are both nonmetals. (4) NH_3 molecules have asymmetrical charge distributions.

33. Which statement best explains why carbon tetrachloride (CCl_4) is nonpolar? (1) Each carbon-chloride bond is polar. (2) Carbon and chlorine are both nonmetals. (3) Carbon tetrachloride is an organic compound. (4) The carbon tetrachloride molecule is symmetrical.

34. Which of the following is a polar compound?

(1)  (2)  (3)  (4) 

Answers

1. 3	8. 1	15. 3	22. 2	29. 3
2. 2	9. 1	16. 4	23. 2	30. 2
3. 2	10. 3	17. 1	24. 1	31. 2
4. 4	11. 1	18. 2	25. 4	32. 4
5. 2	12. 3	19. 2	26. 4	33. 4
6. 3	13. 1	20. 2	27. 2	34. 2
7. 1	14. 2	21. 4	28. 3	