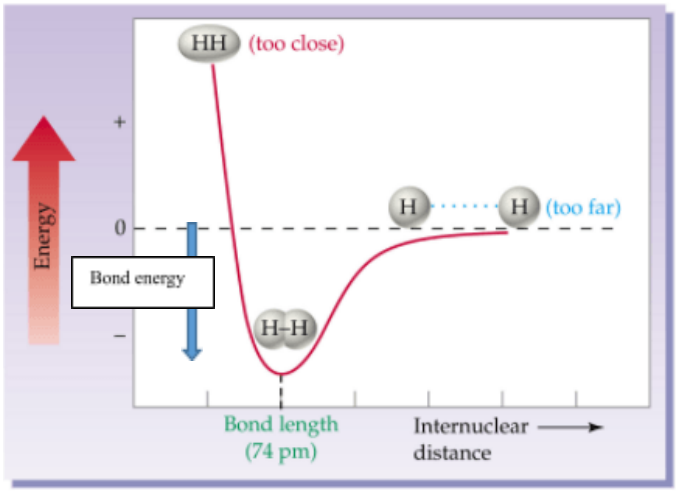
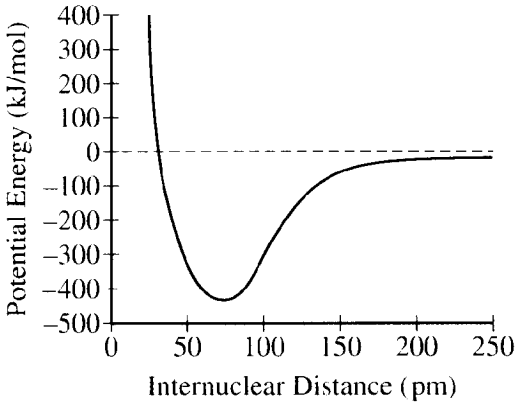
Name_____ **Approximately 10% of the AP exam**

AP Chemistry Exam Practice Part 6: Bonding, Alloys

When bond is formed, 2 atoms rest at a distance of **minimum** potential energy. This gives the typical bond length of the molecule.



- If 2 atoms are too close together, repulsive forces between the nuclei are too great! (PE is high)
- If the 2 atoms are too far apart, the attractive forces (between the ions in ionic, between the nuclei and shared electrons for covalent) are too weak. (PE is near 0)



1.
Which of the following can be inferred from the diagram above that shows the dependence of potential energy on the internuclear distance between two atoms?
a. The atoms form a bond with a bond length of 25 pm
b. The atoms form a bond with a bond length of 75 pm.
c. The net force between the atoms is attractive at 25 pm.
d. The net force between the atoms is attractive at 75 pm.

Drawing Lewis Structures for COVALENT compounds:

1. The atom with lowest EN is the central atom (farthest from F).
2. Count the total number of valence electrons. **MAGIC NUMBER!** (adjust for ions)
3. Place one sigma bond (a pair of electrons) between each pair of bonded atoms.
4. Subtract the total number of valence electrons used for bonds from the **MAGIC NUMBER**.
5. Place lone pairs about each terminal atom except for hydrogen atoms. Subtract the number of lone pairs from the sum.
6. If e^- are still left at this point, assign them to the central atom. If the central atom is from the third period or higher, it can accommodate more than four pairs of electrons.
7. If the central atom is not yet surrounded by four electron pairs, convert one or more terminal atom lone pairs to pi bond pairs.
8. ALWAYS show resonance, if there is resonance.

2. a.) Draw the Lewis structure for SiO_2

b.) Draw the Lewis structure for XeF_4

c.) Draw the Lewis structure for CH_3COOH

Label the ionizable hydrogen above.

d.) Draw the Lewis structure for octanol: (an alcohol, has –OH group)

b. Is this molecule acidic?

Resonance Structures

If the double bond in a molecule (or, rarely, a triple bond) can be towards one exterior atom or another exterior atom, then the double bond will seem to alternate between the 2 or 3 possibilities.

In fact, the true resonance structure is the average of the possibilities.

For bond order in resonance, take the average of a **given** bond from each resonance structure.

3. a.) Example: Draw O_3 and calculate the bond order of each bond.

b.) Draw HNO_3 and calculate the bond order of each bond. ***(Tip: There are 2 resonance structures)*** ***(Tip: The hydrogen in oxyacids is always on an O)***

Formal charge = # of valence electrons - # of lone pairs – ½ # of bonding electrons

Formal charge is used to evaluate which structure (often resonance) is best.

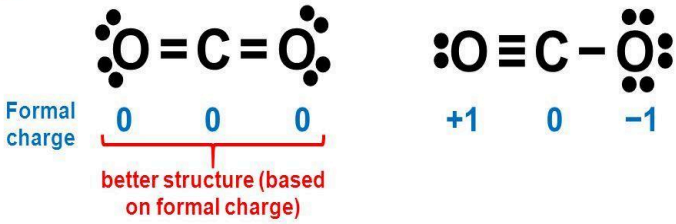
Lewis Structures and Formal Charge

When there is more than one possible structure, the best arrangement is determined by the following guidelines:

1) A Lewis structure in which all formal charges are zero is preferred.

2) Small formal charges are preferred to large formal charges.

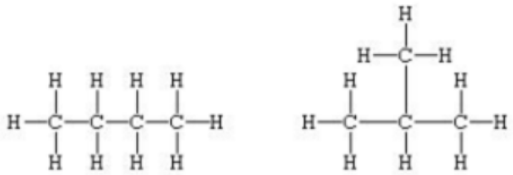
3) Formal charges should be consistent with electronegativities.



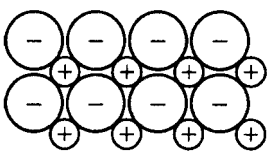
4. Two possible structure for fulminic acid, HCNO, are shown below.

Explain why the diagram on the left is the better representation for the bonding in fulminic acid. Justify your choice based on formal charges. Be sure to give the formal charge of each atom on both structures.

Isomers – Molecules with same chemical formula, but different chemical structures. May result in different properties such as boiling point, melting point, enthalpy of vaporization, etc, due to different strengths of IMFs.



5. Draw two isomers of C_2H_6O.

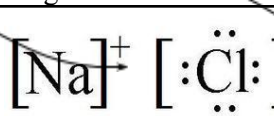
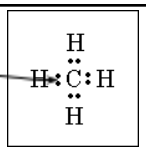
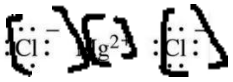
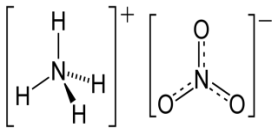
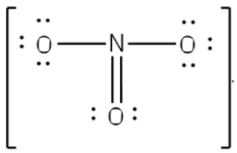


6. Which of the following most likely describes the solid represented in the diagram above?

a. It is soft and is a poor thermal and electrical conductor.
b. It has a low melting point and is a poor thermal and electrical conductor as a solid.
c. It is a brittle, water soluble electrolyte that is a poor thermal and electrical conductor as a solid.

d. It is malleable and is an excellent thermal and electrical conductor as a solid

IONIC	COVALENT
Metal + nonmetal Metal +polyatomic ion Poly ion + nonmetal Poly ion + poly ion	Nonmetal + nonmetal Within poly ion
Strongest type of bond	Weaker bond
Electrostatic attraction between oppositely charged ions	**Electrostatic attraction between nuclei and shared electrons**
Electrons transferred, creating ions	Electrons shared – NO IONS!
Forms crystal lattice And thus crystals	A few form covalent networks (SiO_2, , most form individual molecules
Formula units	molecules
Higher MP, Higher BP (must break bond to change phase)	Lower MP, lower BP (only break IMFS **NOT** bonds to change phase)
Lattice Energy	Bond energy
Higher charge, smaller size= stronger bond	Higher bond order, smaller atom = stronger bond
	Forms polar and nonpolar bonds

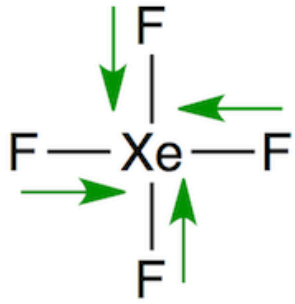
IONIC	COVALENT
Large EN difference	Medium (polar) or Small (nonpolar) EN difference
If soluble, forms electrolytes when dissolved	Nonelectrolytes, may dissolve but won't ionize!
Electrolytic when molten, not solid	Nonelectrolyte
High % ionic character	Low % ionic character
	
	
	 Show resonance!

Total number of sigma bonds and lone pairs on central atom	Shape	Atoms bonded to central atom (# of sigma bonds)	Lone pairs on central atom	Type of molecule (A= central atom E=lone pairs)	Formula Example	Hybridization
2	Linear	2	0	AB_2	BeF_2	sp
3	Triangular Planar	3	0	AB_3	BF_3	sp^2
3	Bent	2	1	AB_2E	$SnCl_2$	sp^2
4	Tetrahedral	4	0	AB_4	CH_4	sp^3
4	Triangular pyramidal	3	1	AB_3E	NH_3	sp^3
4	Bent	2	2	AB_2E_2	H_2O	sp^3
5	Trigonal bipyramidal	5	0	AB_5	PF_5	sp^3d
5	Unsymmetrical tetrahedron (see saw)	4	1	AB_4E	SF_4	sp^3d
5	T-shaped	3	2	AB_3E_2	ClF_3	sp^3d
5	Linear	2	3	AB_2E_3	XeF_2	sp^3d
6	Octahedral	6	0	AB_6	SF_6	sp^3d^2
6	Square pyramidal	5	1	AB_5E	BrF_5	sp^3d^2

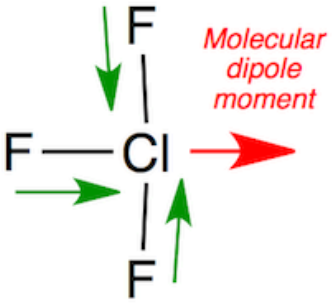
6	Square planar	4	2	AB_4E_2	XeF_4	sp^3d^2

A molecule is polar <u>if both conditions are met</u>:

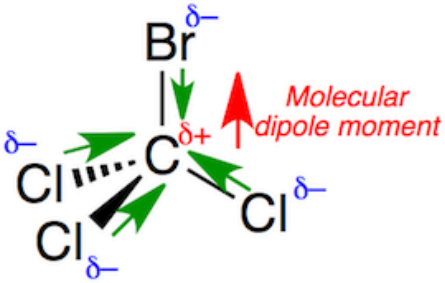
- It contains at least 1 polar bond
- AND, the polar bonds are arranged unsymmetrically (therefore, there is a net pull of unequally shared electrons in one direction, resulting in a net dipole)



The four dipoles within the square planar molecule cancel each other out
XeF_4 is non-polar



The three dipoles within the T-shaped molecule do not cancel each other out
ClF_3 is polar



The C–Br bond is less polar than the C–Cl bonds
CCl_3Br has a small dipole

Tips:

- Having different atoms attached to the central atom results in a net dipole
- The following shapes are symmetrical in 3d space: linear, trigonal planar, tetrahedral, trigonal bipytramidal, octahedral, square planar

7. For the following molecules, draw the Lewis structure, name the shape, give the bond angles, and tell if the molecule is polar or nonpolar.

a. SF_4

b. SF_6

c. SO_2

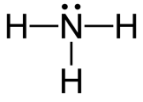
d. XeF_2

e. ClF_3

f. NCl_3

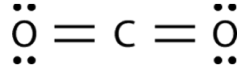
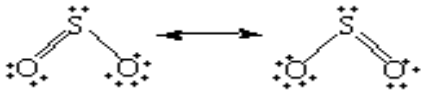
WHY …?	ONLY Reasons you will use
Does …… make a given shape? Have a given bond angle?	**VSEPR THEORY!!!** Electron domains and ions of like charges (bond or a lone pair) experience ***repulsion*** with each other so they spread out in 3d space as far as possible; ***Lone pair electrons induce greater repulsion and cause angles between bonding electrons to be smaller than expected.***
Is ... polar?	Electronegativity difference (polar or nonpolar bonds?) **AND** Symmetrical or Unsymmetrical shape (discuss whether the bond dipoles cancel or do not cancel)

Why is the bond angle in ammonia a little less than 109.5°?



The Lewis structure is . Since there are 4 electron domains (3 bonds and 1 lone pair) around the nitrogen, they will arrange themselves as far away as possible from each other due to repulsion. Thus, the shape of the domains will be tetrahedral and the expected bond angle is 109.5°. Because lone pairs cause more repulsion than bonds, then the bond angle is slightly less than 109.5°.

Which is more polar, CO_2 or SO_2? Justify.

Carbon dioxide is represented by  . Sulfur dioxide is represented by  .
Both molecules have polar bonds because the electronegativity difference between C and O and S and O are both high. However, CO_2 is linear and SO_2 is bent. So CO_2 is nonpolar because the polar bonds are pulling in equal and opposite directions. SO_2 is polar since there is a net pull of electrons downward towards the oxygens.

8. Why is SF_4 more polar than SF_6 but less polar than SCl_4? (Always justify with Lewis structures and words)

Types of crystalline solids:

Types of Crystals	How are particles connected	Melting point	Properties	Example
Ionic	Ionic bonds	Very high	Brittle, nonconducting in solid, conductive of electricity in liquid/molten phase and when dissolved in water	Salt, any ionic compounds!
Network	Covalent Bonds	Very high	Very Hard, Nonconducting always	diamond (C), glass (SiO_2), quartz (SiO_2)
Molecular	IMFs	Low	Weak, deformable - Formed from the regular arrangement of IMFs	snow, rock candy, iodine crystals
Metallic	Metallic bonds	High	Conducts electricity in solid phase	Any metal or alloy

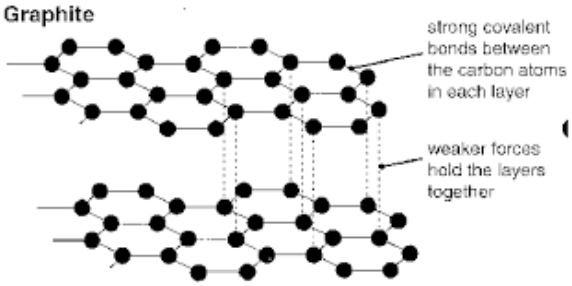
9. What type of crystalline solid is each of the following?

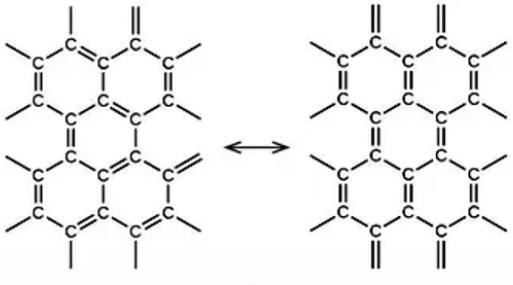
A. Silvery, malleable solid that conducts electricity as a solid and in molten phase, m.p. = 660°C

B. Very hard solid that cannot conduct electricity in any phase, m.p. = 1600°C

C. Brittle white solid that conducts electricity when dissolved, m.p. = 801°C
D. Soft white solid that doesn't conduct electricity in any phase, m.p. = 0°C

Graphite is a unique **network** solid made only of carbon atoms. They are bonded together in sheets. The sheets are attracted to each other by weak London dispersion forces (rubs off easily). Within the sheets, there is resonance throughout, allowing graphite (a nonmetal) to conduct electricity!





metallic bonding--a chemical bond resulting from the attraction between positive ions and surrounding mobile electrons.

These surrounding mobile electrons are referred to as the **sea of electrons**.

10. Metallic bonding is different from most ionic and covalent bonding in that the electrons are _____ - they are not tied to a specific atom or a between 2 electrons. (Although these electrons can also be found in some covalent compounds that exhibit resonance). These electrons create a "sea" of electrons that allow metals to bend, be _____, and conduct heat and _____

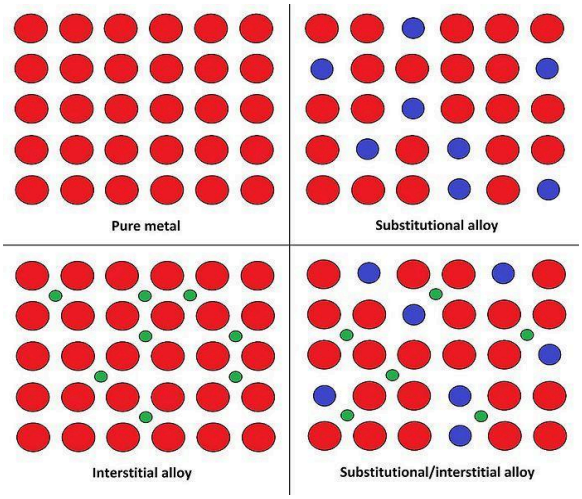
Alloys are metal solutions. (homogeneous mixtures)

Substitutional alloy: formed by 2 metals of similar radii; **mp** or **ability to resist corrosion** or **conductivity** might be affected. Hardness/malleability is NOT.

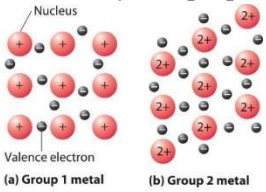
Interstitial alloy: formed by 2 metals of different radii; adding in smaller metals into larger metals tends to make the alloy **harder (less malleable)**.

mp or **ability to resist corrosion** might be affected depending on metal added.

For both alloys, adding metals with more valence electrons increases **conductivity**.



11. a) An alloy is a mixture metals developed to increase properties of the alloy. If a metal with more valence electrons is chosen for alloy, the purpose is to improve on what property?



b) If a metal that is smaller in atomic radius than another metal that it is alloyed with, the point is to increase strength/hardness and decrease _____. This type of alloy is a _____ alloy.

c) If 2 or more metals are combined with similar radii, a/an _____ alloy is produced. The point of making such an alloy may be to change the _____ point, or reduce _____ (the process of reacting with oxygen in the air), or reduce cost!

Optional multiple choice practice: 2013

23. Lewis electron dot diagrams for CO_2 and SO_2 are given above. The molecular geometry and polarity of the two substances are

a. the same because the molecular formulas are similar
b. the same because C and S have similar electronegativity values
c. different because the lone pair of electrons on the S atom make it the negative end of a dipole.
d. different because S has a greater number of electron domains (regions of electron density) surrounding it than C has

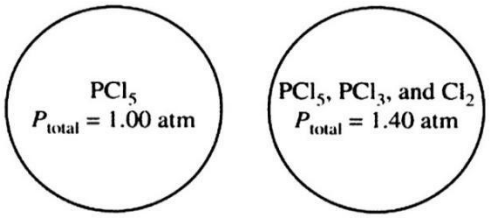


Figure 1: Initial Figure 2: Equilibrium

29. Which of the following is the most likely cause for the increase in pressure observed in the container as the reaction reaches equilibrium?

a. A decrease in the strength of intermolecular attractions among molecules in the flask
b. An increase in the strength of intermolecular attractions among molecules in the flask
c. An increase in the number of molecules, which increase the frequency of collisions with the walls of the container.
d. An increase in the speed of the molecules than then collide with the walls of the container with greater force.

40. Silicon crystals are semiconductors. Which of the following is a correct reason for the increase in the conductivity of Si crystals when a small fraction of Si atoms are replaced with those of a different element?

a. P atoms introduce additional mobile negative charges.
b. P atoms introduce additional mobile positive charges.
c. Ge atoms have more electrons than Si atoms have.
d. Ge atoms are much smaller than Si atoms.

From the 1984 AP Exam:

Questions 8–9

(A) A network solid with covalent bonding
(B) A molecular solid with zero dipole moment
(C) A molecular solid with hydrogen bonding
(D) An ionic solid
(E) A metallic solid

8. Solid ethyl alcohol, C_2H_5OH
9. Silicon dioxide, SiO_2

40. The geometry of the SO_3 molecule is best described as
(A) trigonal planar (D) bent
(B) trigonal pyramidal (E) tetrahedral
(C) square pyramidal

41. Which of the following molecules has the shortest bond length?
(A) N_2 (C) Cl_2 (E) I_2
(B) O_2 (D) Br_2

51. Pi (π) bonding occurs in each of the following species EXCEPT
(A) CO_2 (C) CN^- (E) CH_4
(B) C_2H_4 (D) C_6H_6

60. Which of the following has a zero dipole moment?

(A) HCN (C) SO_2 (E) PF_5
(B) NH_3 (D) NO_2

80. For which of the following molecules are resonance structures necessary to describe the bonding satisfactorily?
(A) H_2S (C) CO_2 (E) PF_3
(B) SO_2 (D) OF_2

From the 1989 AP Exam:

Questions 11–14

Tip: Not all the choices below are related to bonding, some are related to intermolecular forces. DON'T confuse the 2!!!!!!

a. hydrogen bonding
b. hybridization
c. ionic bonding
d. resonance
e. van der Waals forces (London dispersion forces)

11. Is used to explain why iodine molecules are held together in the solid state
12. Is used to explain why the boiling point of HF is greater than the boiling point of HBr
13. Is used to explain the fact that the four bonds in methane are equivalent
14. Is used to explain the fact that the carbon-to-carbon bonds in benzene, C_6H_6, are identical

17. The Lewis dot structure of which of the following molecules shows only one unshared pair of valence electrons?
a. Cl_2 c. NH_3 e. H_2O_2
b. N_2 d. CCl_4

31. The structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values for which of the following? (Assume ideal behavior.)
a. Gaseous densities at the same temperature and pressure
b. Vapor pressures at the same temperature
c. Boiling points
d. Melting points
e. Heats of vaporization

42. The $SbCl_5$ molecule has trigonal bipyramid structure. Therefore, the hybridization of Sb orbitals should be
a. sp^2 c. dsp^2 e. d^2sp^3
b. sp^3 d. dsp^3

47. CCl_4, CO_2, PCl_3, PCl_5, SF_6
Which of the following does not describe any of the molecules above?
a. Linear d. Tetrahedral
b. Octahedral e. Trigonal pyramidal
c. Square planar

59. Which of the following compounds is ionic and contains both sigma and pi covalent bonds?
a. $Fe(OH)_3$ c. H_2S e. NaCN
b. HClO d. NO_2

From the 1994 AP Exam:

Questions 8–10 refer to the following diatomic species.
(A) Li_2 (B) B_2 (C) N_2
(D) O_2 (E) F_2

8. Has the largest bond–dissociation energy
9. Has a bond order of 2
10. Contains 1 sigma *(s)* and 2 pi (π) bonds

15. In a molecule in which the central atom exhibits sp^3d^2 hybrid orbitals, the electron pairs are directed toward the corners of
(A) a tetrahedron
(B) a square-based pyramid
(C) a trigonal bipyramid
(D) a square
(E) an octahedron

43. Which of the following pairs of compounds are isomers?
(A) $CH_3—CH_2—CH_2—CH_3$ and $CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{CH}}}—CH_3$
(B) $CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{CH}}}—CH_3$ and $CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}=CH_2$
(C) $CH_3—O—CH_3$ and $CH_3—\overset{\displaystyle O}{\overset{\displaystyle \|}{C}}—CH_3$
(D) $CH_3—OH$ and $CH_3—CH_2—OH$
(E) CH_4 and $CH_2=CH_2$

57. Molecules that have planar configurations include which of the following?
I. BCl_3 II. $CHCl_3$ III. NCl_3
(A) I only (B) III only
(C) I and II only (D) II and III only
(E) I, II, and III

62. The electron–dot structure (Lewis structure) for which of the following molecules would have two unshared pairs of electrons on the central atom?
(A) H_2S (B) NH_3 (C) CH_4
(D) HCN (E) CO_2

68. Which of the following molecules has a dipole moment of zero?
(A) C_6H_6 (benzene) (B) NO
(C) SO_2 (D) NH_3
(E) H_2S

2012

Questions 1 - 3 refer to the following gaseous molecules.

(A) $BeCl_2$
(B) SO_2
(C) N_2
(D) O_2
(E) F2

1. Is a polar molecule
2. Is best represented by two or more resonance forms
3. Is the molecule in which the intramolecular forces are strongest
4. Has the highest melting point

17. A certain crystalline substance that has a low melting point does not conduct electricity in solution or when melted. This substance is likely to be
(A) a covalent network solid
(B) a metallic solid
(C) a polymer
(D) an ionic solid
(E) a molecular solid

55. Which of the molecules represented below contains carbon with sp^2 hybridization?
(A) CH_4
(B) CH_2Cl_2
(C) C_2H_6
(D) $C_2H_2Cl_2$
(E) $C_2H_4Cl_2$

71. Which of the following compounds contains both ionic and covalent bonds?
(A) SO_3
(B) C_2H_5OH
(C) MgF_2
(D) H_2S
(E) NH_4Cl

74. Which of the following molecules is nonpolar but has polar bonds?
(A) N_2
(B) H_2O_2
(C) H_2O
(D) CCl_4
(E) CH_2Cl_2

2008

Questions 7-9 refer to the following pure substances, which are gases at 25 °C and 1 atmosphere

(A) $NH_3(g)$
(B) $BH_3(g)$
(C) $H_2(g)$
(D) $H_2S(g)$
(E) HBr(g)

7. Has molecules with a pyramidal shape
8. Is a strong electrolyte in aqueous solution
9. Is the slowest to effuse through a small opening at 25 °C and 1 atm

20. In solid methane, the forces between neighboring CH_4 molecules are best characterized as
(A) ionic bonds
(B) covalent bonds
(C) hydrogen bonds
(D) ion-dipole forces
(E) London (dispersion) forces

22. Which of the following is a nonpolar molecule that contains polar bonds?
(A) F_2
(B) CHF_3
(C) CO_2
(D) HCl
(E) NH_3

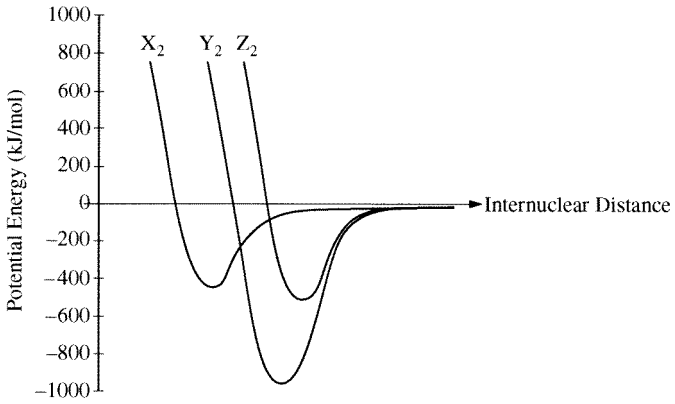
28. Which of the following molecules contains only single bonds?
(A) CH_3COOH
(B) $CH_3CH_2COOCH_3$
(C) C_2H_6
(D) C_6H_6
(E) HCN

H – C ≡ C – H

57. What is the hybridization of the carbon atoms in a molecule of ethyne, represented above?
(A) *sp*
(B) sp^2
(C) sp^3
(D) dsp^3
(E) d^2sp^3

75. Which of the following molecules has an angular (bent) geometry that is commonly represented as a resonance hybrid of two or more electron-dot structures?
(A) CO_2
(B) O_3
(C) CH_4
(D) BeF_2
(E) OF_2

2014



17. The potential energy as a function of internuclear distance for three diatomic molecules, X_2, Y_2, and Z_2, is shown in the graph above. Based on the data in the graph, which of the following correctly identifies the diatomic molecules, X_2, Y_2, and Z_2?

	X_2	Y_2	Z_2
a.	H_2	N_2	O_2
b.	H_2	O_2	N_2
c.	N_2	O_2	H_2
d.	O_2	H_2	N_2

$CO(g) + 2\ H_2(g) \rightleftharpoons CH_3OH(g) \quad \Delta H < 0$

The synthesis of $CH_3OH(g)$ from $CO(g)$ and $H_2(g)$ is represented by the equation above. The value of K_c for the reaction at 483 K is 14.5.

24. Which of the following statements is true about bond energies in this reaction?

a. The energy absorbed as the bonds in the reactants are broken is greater than the energy released as the bonds in the product are formed.

b. The energy released as the bonds in the reactants are broken is greater than the energy absorbed as the bonds in the product are formed.

c. The energy absorbed as the bonds in the reactants are broken is less than the energy released as the bonds in the product are formed.

d. The energy released as the bonds in the reactants are broken is less than the energy absorbed as the bonds in the product are formed.

35. The BF_3 molecule is nonpolar, whereas the NF_3 molecule is polar. Which of the following statements accounts for the difference in polarity of the two molecules?

a. In NF_3, each F is joined to N with multiple bonds, whereas in BF_3, each F is joined to B with single bonds.

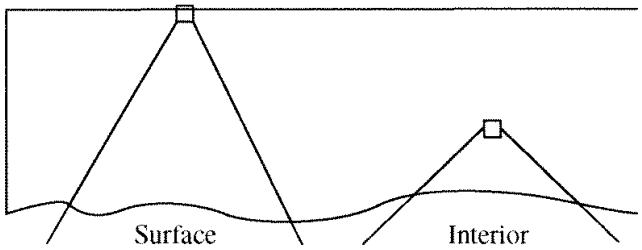
b. N – F bonds are polar, whereas B – F bonds are nonpolar.

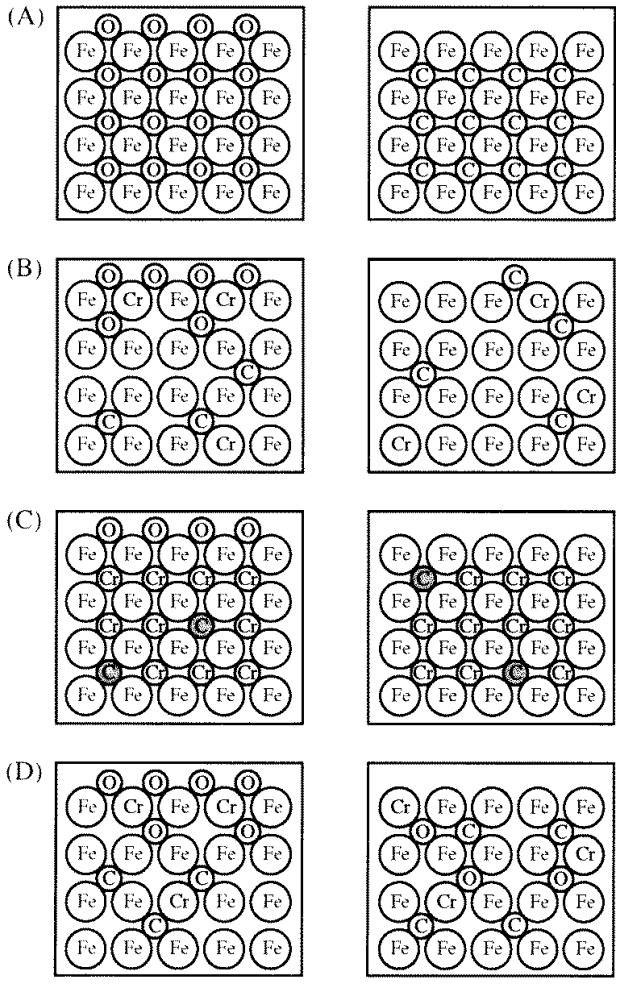
c. NF_3 is an ionic compound, whereas BF_3 is a molecular compound.

d. Unlike BF_3, NF_3 has a nonplanar geometry due to an unshared pair of electrons on the N atom.

42. Steel is an alloy consisting of Fe with a small amount of C. Elemental Cr can be added to steel to make the steel less likely to rust; Cr atoms react with oxygen in the air for form a nonreactive layer of chromium oxide on the surface of the steel, preventing the oxidation of underlying Fe atoms. A sample of steel – chromium alloy contains 15 percent Cr by mass. Which of the following diagrams best show a particle level view of a surface section and an interior section of the alloy represent below at the left? (The atomic radii of the atoms involved are given in the table below at the right.)

Element	Molar mass (g / mol)	Atomic Radius (pm)
Fe	55.85	125
Cr	52.00	127
C	12.01	77
O	16.00	73



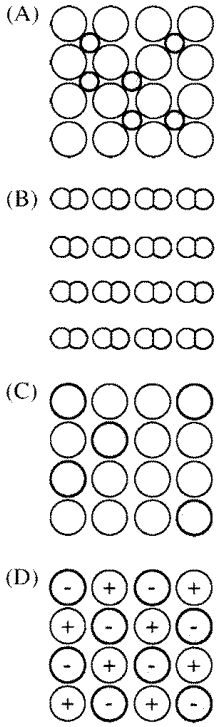


2015

2. The lattice energy of a salt is related to the energy required to separate the ions. For which of the following pairs of ions is the energy that is required to separate the ions largest? (Assume that the distance between the ions in each pair is equal to the sum of the ionic radii.)

a. $Na^+(g)$ and $Cl^-(g)$
b. $Cs^+(g)$ and $Br^-(g)$
c. $Mg^{2+}(g)$ and $O^{2-}(g)$
d. $Ca^{2+}(g)$ and $O^{2-}(g)$

4. Which of the following diagrams best depicts an alloy of Ni and B?



Questions 25-29 refer to the following information:
$2\ H_2O_2(aq) \rightarrow 2\ H_2O(l) + O_2(g)$ $\Delta H^o = -196$ kJ / mol_{rxn}

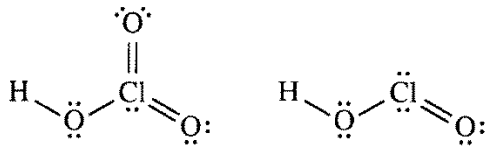
29. Assume that the bond enthalpies of the oxygen – hydrogen bonds in H_2O are not significantly different from those in H_2O_2. Based on the value of ΔH^o of the reaction, which of the following could be the bond enthalpies (in kJ / mol) for the bonds broken and formed in the reaction?

	O – O In H_2O_2	O = O in O_2	O – H
a.	300	500	500
b.	150	500	500
c.	500	300	150
d.	250	300	150

Questions 34 – 36 refer to the reactions represented below, which are involved in the demonstration commonly known as "underwater fireworks".
Reaction 1: $CaC_2(s) + 2\ H_2O(l) \rightarrow C_2H_2(g) + Ca(OH)_2(s)$
Reaction 2: $NaOCl(aq) + 2\ HCl(aq) \rightarrow Cl_2(g) + NaCl(aq) + H_2O(l)$
Reaction 3: $C_2H_2(g) + Cl_2(g) \rightarrow C_2H_2Cl_2(g)$

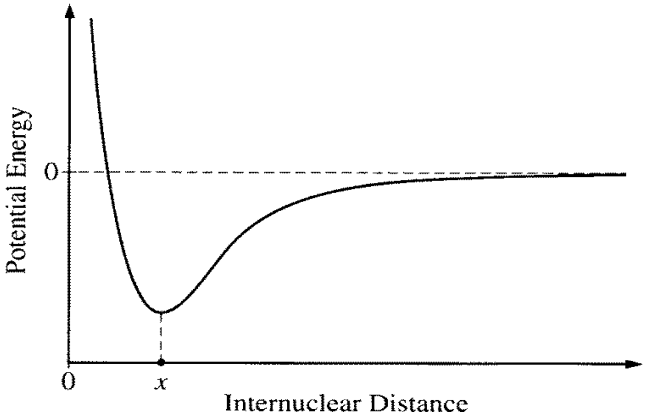
36. When Reaction 3 occurs, does the hybridization of the carbon atoms change?

a. Yes; it changes from *sp* to sp^2
b. Yes; it changes from *sp* to sp^3
c. Yes; it changes from sp^2 to sp^3
d. No; it does not change.



38. The Lewis electron-dot diagrams of the $HClO_3$ molecule and the $HClO_2$ molecule are shown above at the left and right, respectively. Which of the following statements identified the stronger acid and correctly identifies a factor that contributes to its being the stronger acid?

a. $HClO_3(aq)$ is the stronger acid because its molecules experience stronger London dispersion forces.
b. $HClO_3(aq)$ is the stronger acid because the additional electronegative oxygen atom on the chlorine atom stabilizes the conjugate base.
c. $HClO_2(aq)$ is the stronger acid because its molecules experience weaker London dispersion forces.
d. $HClO_2(aq)$ is the stronger acid because the lone pairs of electrons on the chlorine atom stabilize the conjugate base.



47. The potential energy of a system of two atoms as a function of the internuclear distance is shown in the diagram above. Which of the following is true regarding the forces between the atoms when their internuclear distance is x?

a. The attractive and repulsive forces are balanced, so the atoms will maintain an average internuclear distance x.
b. There is a net repulsive force pushing the atoms apart, so the atoms will move further apart.
c. There is a net attractive force pulling the atoms together, so the atoms will move closer together.
d. It cannot be determined whether the forces between atoms are balanced, attractive, or repulsive, because the diagram show only the potential energy.

Answers:

FRQ:

4. Oxygen is the most electronegative in the compound it is preferred to have a negative formal charge **6.** C **8.** Be sure to draw the Lewis structure of all 3. SF_4 is more polar than SF_6 because in SF_4 the polar bonds' dipoles pull more in one direction, creating an overall dipole moment. This is because SF_4 is a see-saw shape. SF_6 is not polar, despite its bonds being polar, because of its trigonal bipyramidal shape which means that all of its bonds' dipoles cancel out creating a net zero dipole moment. SCl_4 if less electronegative than SF_4 because although it is the same shape as SF_4, its bonds are less polar due to a smaller electronegativity difference between S and Cl than S and F**. 9.** A. metallic solid (actually aluminum) b. covalent network solid (actually diamond) c. ionic crystal (actually NaCl) d. molecular crystal (actually H_2O) **10.** dispersed, malleable, electricity **11.** (a) conductivity (b) malleability, interstitial (c) substitutional, melting, oxidation

MCQ:

2013: C 23 D 29 C 40 A
1984: 8 C 9 A 39 C 40 A 41 A 51 E 60 E 77 D 80 B
1989: 11 E 12 A 13 B 14 D 17 C 31 A 42 D 47 C 59 E 44 E 63 B 64 E 73 A 69 A
1994: 8 C 9 D 10 C 15 E 32 D 34 E 43 A 57 A 62 A 68 A
2012: 1 B 2 B 3 C 4 A 14 C 15 D 16 A 17 E 55 D 61 D 65 D 66 D 68 E 74 D
2008: 7A 8 E 9. E 20 E 22C 28 C 57 A 65 C 69 A 75 B
2014: 17 A 24 C 35 D 42 B
2015: 2C 4A 29 B 36 A 38 B