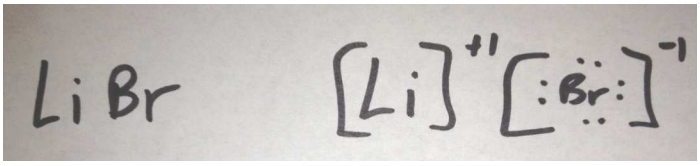
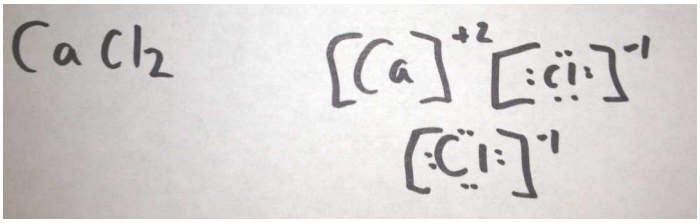
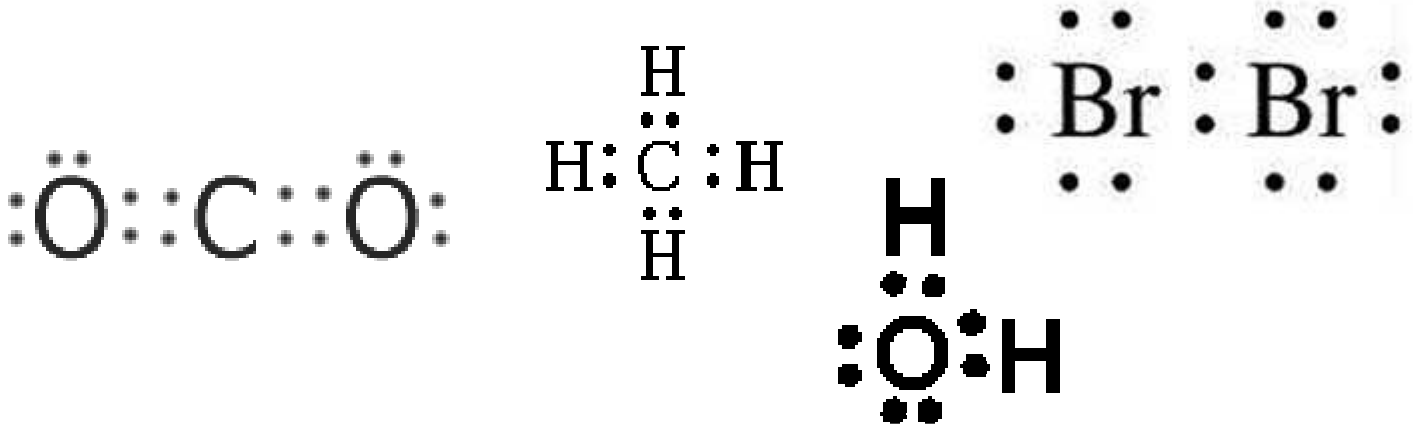
When it comes to Chemical Bonding , I can… ANSWERS

1. The 3 types of chemical bonds are IONIC, COVALENT, and METALLIC bonds.
2. When atoms have 8 valence electrons they are most stable. (exception 2 for H + He they're too small)
3. 2 types of compounds are IONIC and COVALENT.
4. An ionic bond is a bond that forms between a metal and nonmetal when the metal transfers electrons to the nonmetal (forming cations and anions) which are wildly attracted together because of opposite charges. This transfer must be exact.
   A covalent bond is a bond formed when 2 or more nonmetals share electrons, providing all with a stable octet (or 2 if hydrogen, it's too small for 8) The atoms share electrons (they do not transfer them).
   A metallic bond is formed within a metal, whereby it's explained as the valence electrons become "Loose" and run around the "packed cations". This explains many metallic properties such as malleability, ductility, and electrical conduction.
5. Ionic bonds form upon the transfer of valence electrons between metals to the nonmetals. Covalent bonds form when nonmetals share valence electrons to share full valence orbitals.
6. In methane (CH_4) carbon and hydrogen share valence electrons to give carbon an octet, and the hydrogen atoms get 2 electrons in their valence orbitals. All are shared and all are full orbitals. In water, both hydrogen atoms share valence electrons with oxygen, so oxygen gets an octet, and the hydrogen atoms both get full valence orbitals as well.
7. In HCl the bonding is via shared electrons, covalent bonding. In NaCl the bonding is ionic, sodium transfers a valence electron to chlorine, they bond because of opposite charges.
8. I can draw a Lewis dot diagram to represent an ionic compound, like lithium bromide + calcium chloride. The cations end up with NO electrons showing, and brackets with +1 for lithium, +2 for calcium. The anions end up with full octets, and brackets showing -1 for the bromide and the chloride.

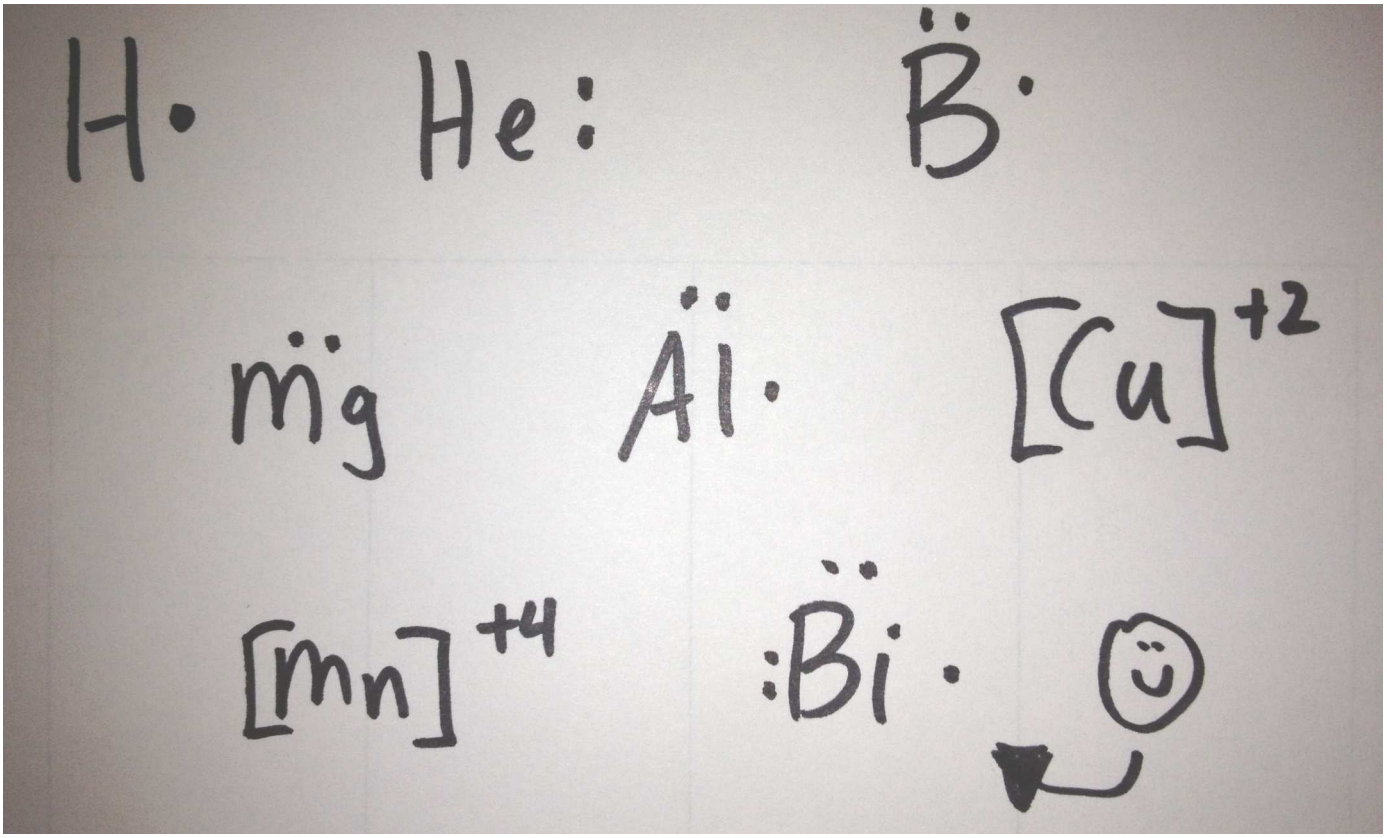




9. I can draw a Lewis dot diagram to represent a molecular (covalently bonded) compound, like water, methane, carbon dioxide and bromine.



10. I can draw a Lewis dot diagram to represent atoms on the periodic table, or ions they form into, such as H, He, B, Mg, Al, Cu^{+2}, Mn^{+4}, or Bi



11. I can state the number of electrons that are shared in single and multiple covalent bonds. I can also state the number of pairs of electrons that are shared. I know the difference

	# electrons shared	# pairs of electrons shared	Provide 2 examples
Single covalent bond	2	1	HCl and HF
Double covalent bond	4	2	O_2 and CO_2
Triple covalent bond	6	3	$N_2$and C_2H_2 (between the carbon atoms only)

12. Lewis dot diagrams for ionic compounds have brackets because the ions have charges, and their valence electron orbitals have changed. Brackets indicate this. Lewis dot diagrams for molecular compounds do NOT have brackets because the atoms SHARE electrons, they "keep" their own and don't transfer them.

13. skip

14. Polyatomic ions have covalent bonding (like in NO_2^{-1} - sharing electrons) + sometimes they have ionic (like in CrO_4^{-2}). When forming into compounds, the compound might have BOTH ionic and covalent.

15. NaCl has only ionic bonds, Hg has only metallic bonding, CO_2 has two double polar covalent bonds, and Na_3PO_4 has both ionic and polar covalent.

16. When bonds form energy is released.

17. When bonds are broken energy is absorbed.

18. Given the balanced equation: $N + N \rightarrow N_2$ B. A bond is formed as energy is released.

19. Polar covalent bonds are formed when nonmetals atoms with different electronegativity values share electrons unevenly. Nonpolar covalent bonds form when identical atoms (like O_2) or different atoms with the SAME EN Values share electrons in a bond.

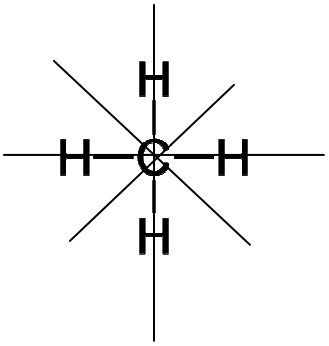
20. The greater the difference in electronegativity between the atoms, the grater polarity of the bond. If there is NO difference in EN value, the bond is non-polar.

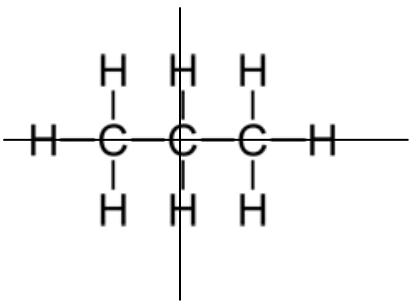
21. In CO_2, the EN value difference is 0.8 (3.4 - 2.6 =) while the EN value difference is water is 1.2 (3.4 - 2.2 =) The greater the difference in EN values, the greater the bond polarity.

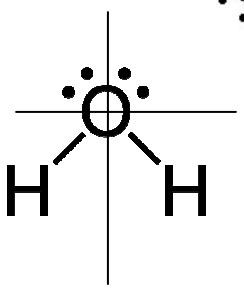
22. Symmetry means having similar features in different directions. In chemistry, molecular polarity depends only if the molecule has RADIAL SYMMETRY. That's pizza pie symmetry (not like bilateral symmetry, such as a gingerbread cookie or a human). If you can cut the molecule in any direction and get equal sides, then the molecule is nonpolar. No exceptions.
If the molecule does not have radial symmetry, it's polar.

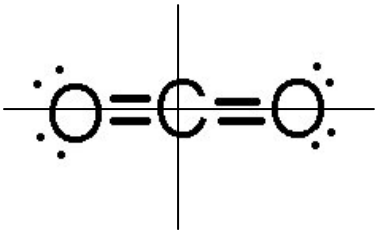
23. Below you can see that water does not have radial symmetry, it's a polar molecule. The other three molecules do have radial symmetry, they are nonpolar molecules.

A note: do not get fooled by water, it has bilateral symmetry, it's balanced one way, but not the other way. Molecules need radial (pizza pie) symmetry to be nonpolar.









24. A molecule of CH_4 is nonpolar even though the bonds between the C + H are polar because
A. The shape of the CH_4 molecule is symmetrical. It has RADIAL SYMMETRY.

25. Explain, in terms of charge distribution, why a molecule of water (H_2O) is polar. The hydrogen atoms become positive because they "lose" their electrons to oxygen most of the time because oxygen has a much greater electronegativity value. The oxygen becomes negative most of the time for this reason as well. The molecule DOES NOT have radial symmetry, so this charge differential is not balanced (as it is in CH_4)

26. This is a sort of repeat question, three of these are drawn on the previous page. To draw a fluorine molecule with a structural diagram instead of dots, it looks like this: F – F This has radial symmetry and it's nonpolar. The water is polar, the CO_2 and CH_4 are nonpolar.

27. Like dissolves like is part of solvation. As a solute dissolves (or does not dissolve) in a solvent, the general rule of thumb is that polar or ionic compounds tend to dissolve into polar solvents; nonpolar solutes dissolve into nonpolar solvents. Polar ammonia (NH_3) dissolves readily into polar water. Nonpolar oil does not dissolve into polar water, but oil does dissolve into nonpolar gasoline.

28. NH_3 is polar and dissolves easily into polar water (at most temperatures) while methane is a nonpolar molecule, the water can't "catch it" and it will bubble out immediately, dissolving practically not at all.

29. Intramolecular forces are bonds inside molecules (or ionic compounds), Intermolecular forces are bonds between adjacent molecules. Single polar covalent bonds in water are INTRAmolecular. Water molecules attracted to each other by hydrogen bonding are INTERmolecular bonds.

30. Strongest intramolecular bonds are ionic bonds, the weaker are the covalent bonds.

31. Strongest intermolecular bonds are hydrogen bonds, followed by dipole interaction. The weakest of the intermolecular bonds are electron dispersion forces (AKA London dispersion forces).

32. I can state the relationship between polarity and intermolecular forces (IMF) strength. As the polarity of the molecule <u>INCREASES</u> the strength of the intermolecular forces <u>INCREASES</u>.

33. F_2 is a gas at STP because the number of electrons in this molecule is just 18, and the only attraction between molecules is the (weakest) electron dispersion forces. There are just NOT THAT MANY electrons to disperse, the attraction is weak. In Br_2 the number of electrons is so much greater, 70 electrons, that their instantaneous dispersion creates enough intermolecular attraction that at STP it's a liquid. (with I_2, and its 106 electrons, this intermolecular attraction is enough to make it a solid at STP!!!)

34. Ammonia clearly has a greater IMF because it has hydrogen bonding, methane is nonpolar, it has almost no intermolecular attraction. The ammonia BOILS at a much higher temperature. In centigrade those numbers look weird. Methane boils at about 145 Kelvin, ammonia boils at 240 Kelvin. Those numbers are "easier to see".

35. Hydrogen bonding is caused by polar bonding containing hydrogen in a polar molecule. This bond polarity in a polar molecule makes the molecules almost magnetically attracted together. The greater the bond polarity, the greater the magnetic attraction, the stronger the molecules stick together. CO_2 has no hydrogen, the bonds are slightly polar, but the molecule has radial symmetry, so the molecule is "balanced" and there is very little IMF.

36. normal boiling point is the boiling point at NORMAL PRESSURE.
vapor pressure is the extra pressure in a closed system caused by the evaporation of a liquid in that system. It's based upon the IMF and the temperature
volatile means tends to evaporate easily (like gasoline or rubbing alcohol)
nonvolatile means tends to NOT evaporate easily like water or ethanoic acid (vinegar)

37. The strongest IMF belong to ethanoic acid, the weakest to propanone. You can tell because propanone has the lowest BP (at any pressure) compared to the ethanoic acid with the highest BP.

38. What is the vapor pressure of ethanol at 53°C? Approx 33 kPa.

39. As the strength of IMF INCREASES the vapor pressure will BE LOWER. (it's harder for it to evaporate)

40. As you add solute to pure water the freezing point of the water is DEPRESSED (it requires a colder temperature to freeze.

41. Adding solute to pure water causes the boiling point of the water to INCREASE. (it requires a hotter temperature to boil the solution than pure water)

42. Five physical properties of ionic substances include: They have ionic bonding (duh, I know), have HIGH melting points as compared to covalent substances, have HIGH boiling points too, and LOW VAPOR PRESSURE because they have more intermolecular attractions, and conduct electricity as LIQUIDS (melted salts) or in AQUEOUS solutions. Ionic compounds like AgCl that are NOT SOLUBLE in water can still conduct electricity when MELTED into the liquid phase.

43. Any solid substance that dissolves in water, it is an electrolyte, and it has a high melting point must be IONIC. The only ionic choice here is gold (I) chloride, choice B. AuCl

44. The compound that has the highest melting point will probably be the IONIC COMPOUND: C. NaCl

45. Five physical properties of molecular substances include: they have covalent bonding (duh, I know), have low melting points (compared to ionic compounds), have low boiling points too, have higher vapor pressures (they don't have as much intermolecular inward attraction as the ionic compounds, and do not conduct electricity even if melted because they contain NO IONS.

46. I can identify a substance as "molecular" based on its properties.
The results suggest that: D. Solid A contains only ionic bonds, + solid B contains only covalent bonds.

	Solid A	Solid B
Melting point	High, 801°C	Low, decomposes at 186°C
Solubility in water (g/100.0g water at 0°C)	35.7	3.2
Electrical conductivity in aqueous solution	Good conductor	Non-conductor

47. Which terms describe a substance that has a low melting point and poor electrical conductivity?
B. covalent and molecular
Electrical is the big one here, metals and ionic compounds conduct, it's easy to see I hope.