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. The 2 types of compounds are IONIC and COVALENT.

4. Ionic bonds form between a metal + nonmetal. The metal transfers electrons to the nonmetal, forming cations and anions, which are wildly attracted together because of opposite charges. This electron transfer must be perfect.

   A covalent bonds form when 2 or more nonmetals share electrons, providing all with a stable octet (or a full baby sized shell if hydrogen). Atoms share electrons, they don't transfer them.

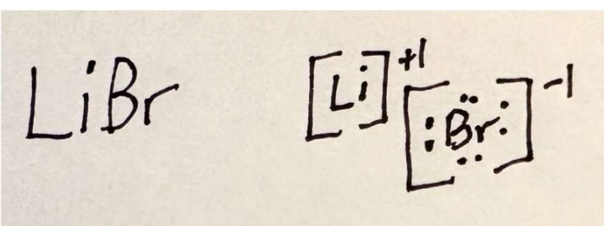
   A metallic bond forms only within a metal element or metal alloy. It's explained as the valence electrons become "loose and mobile" and are shared by the "packed cations". This explains metallic properties such as malleability, ductility, and electrical conduction.

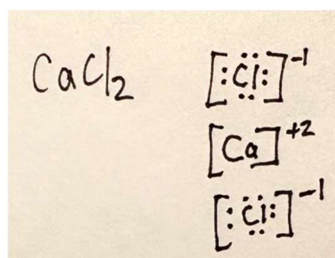
5. Ionic bonds form by the transfer of valence electrons between metals to the nonmetals. Covalent bonds form when nonmetals share valence electrons to share full valence orbitals.

6. In methane (CH_4) carbon and hydrogen share valence electrons. Carbon ends up with a full octet, and the hydrogen atoms get 2 electrons in their (baby sized) valence shells. In water, both H atoms share a valence electron with oxygen, so O atoms get an octet, and the H atoms both get full valence shells as well.

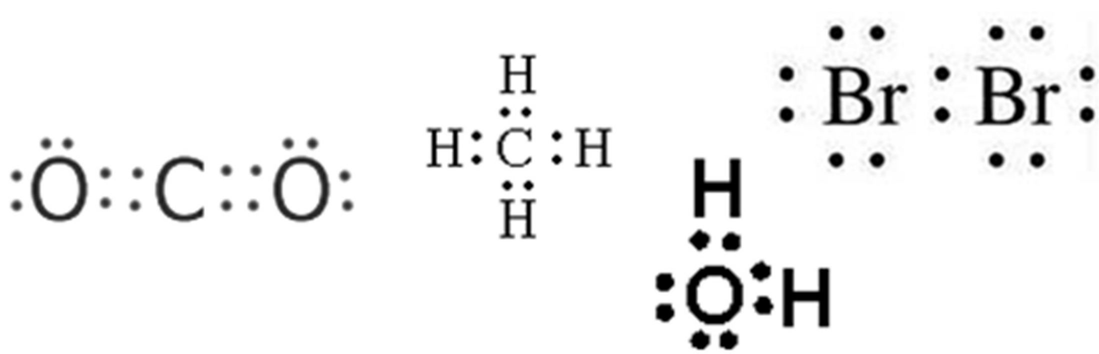
7. In HCl the bonding is via shared electrons, covalent bonding. In NaCl the bonding is ionic, sodium transfers a valence electron to chlorine, they bond because of opposite charges.

Draw Lewis dot diagrams to represent lithium bromide + calcium chloride.

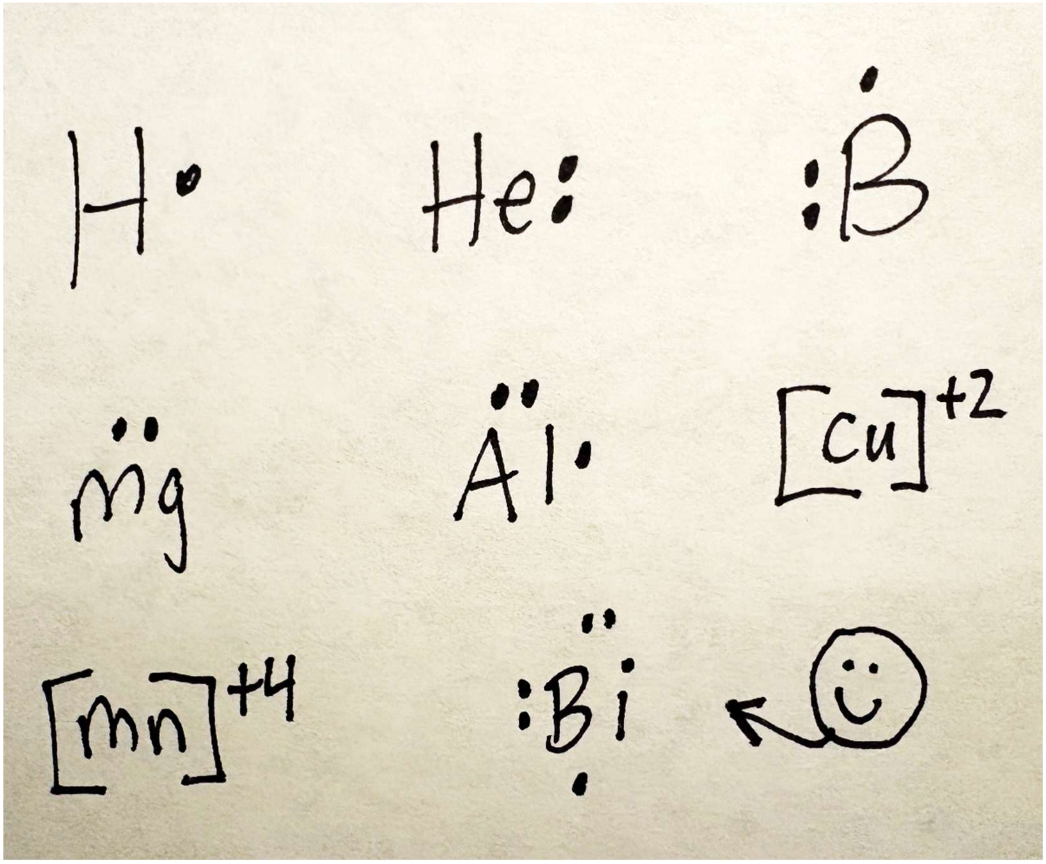




7. I can draw a Lewis dot diagram to represent molecular (covalently bonded) compounds like carbon dioxide, methane, water and bromine.



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 + HF
Double covalent bond	4	2	O_2 + CO_2
Triple covalent bond	6	3	N_2 + 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 can have covalent bonding (in NO_2^{-1} - sharing electrons) or ionic bonding (in CrO_4^{-2}). When forming compounds, the compound might have BOTH ionic and covalent bonds (like NaOH).

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: $N + N \rightarrow N_2$ Here, a bond is formed and 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 electronegativity values share electrons in a bond (like NBr_3).

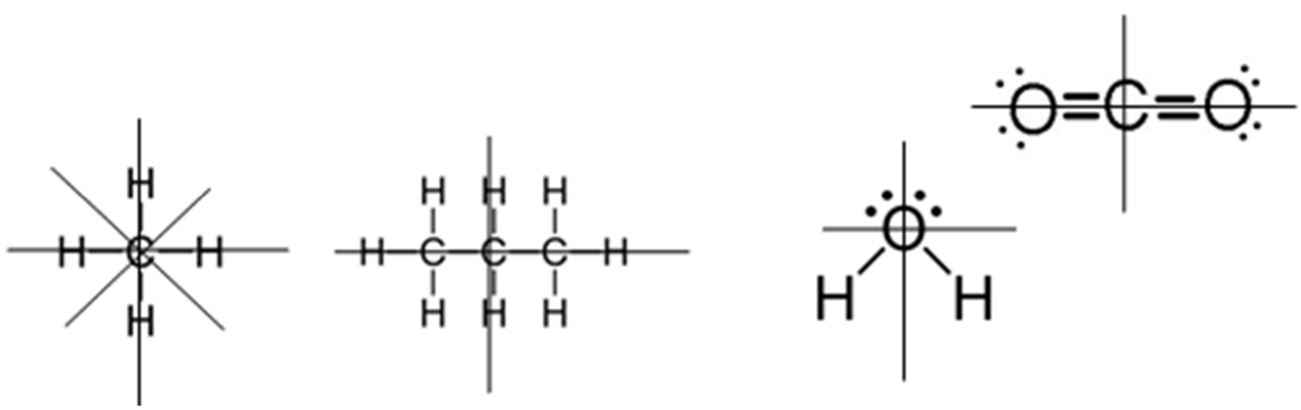
20. The greater the difference in electronegativity between the atoms, the greater polarity of the bond. If there is NO difference in EN value, the bond is non-polar.

21. In CO_2, the electronegativity difference is 0.8 (3.4 - 2.6 = 0.8) in water, the difference is 1.2 (3.4 - 2.2 = 1.2). The greater the difference in electronegativity, 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, as a gingerbread cookie or human has). If you can cut the molecule in any direction and get identical parts, then the molecule is nonpolar. 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. Oil is nonpolar. Oil cannot dissolve into polar water. Oil will 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. Intermolecular forces are attractions between nearby atoms or molecules. Single polar covalent bonds in water are INTRA-molecular.
Water molecules attracted to each other by hydrogen bonding are INTER-molecular bonds.

30. Ionic bonds are the strongest intramolecular bonds. Covalent bonds are weaker than ionic bonds.

31. Strongest intermolecular bonding are hydrogen bonds, followed by dipole interaction. The weakest of the intermolecular bonding is 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 106 electrons, its 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. Centigrade boiling points that are negative are fuzzy looking. In Kelvin, it's clear that ammonia has a much higher BP. those numbers look weird. Methane BP = 145 K. Ammonia BP = 240 Kelvin.

35. Hydrogen bonding is caused by polar bonds 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 the compound tends to evaporate easily, like gasoline or rubbing alcohol.
Nonvolatile means the compounds tend 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. The vapor pressure of ethanol at 53°C? Approx 33 kPa.

39. As the strength of IMF INCREASES, 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. Solute lowers the FP.

41. Adding solute to pure water causes the boiling point of the water to INCREASE. Solutes increase the BP.

42. Ionic substances have these properties:
HIGH melting points as compared to covalent substances,
HIGH boiling points,
LOW VAPOR PRESSURES, stronger intermolecular attractions,
CONDUCT ELECTRICITY when LIQUID (melted salts) or when they are AQUEOUS solutions (some ionic compounds, like AgCl, are not soluble and do not conduct electricity since they have no loose mobile ions. AgCl can still conduct electricity when MELTED into $AgCl_{(L)}$.

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. Covalent, or molecular substances have these properties:
LOW melting points (compared to ionic compounds),
LOW boiling points,
HIGHER vapor pressures (they have less intermolecular attraction than ionic compounds,
DO NOT CONDUCT electricity - even if melted - because they contain NO IONS.

46. 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	Nonconductor

47. Which terms describe a substance that has a low melting point and has 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.