PAL Worksheet – Chem 6A

Ionic compounds

Principle: Cations and anions combine to give compounds with no net charge.

I. Ionic compounds with representative metals and anions.

The ions formed by representative elements have fixed charges that reflect the octet rule, which we demonstrated in a previous worksheet. Na always forms Na^+ (not Na^{2+} or Na^-). S always forms S^{2-} (not S^- or S^+). In the table below, combine cations and anions to give the ionic compound. Total plus charges must equal total minus charges. In the name, the cation has the same name as the metal, the anion ends in -ide.

Example: Na and S. Na forms Na^+, S forms S^{2-}. We will need two sodium ions to match the negative 2 charge of the sulfide: Na_2S, sodium sulfide.

Element	Ion (include charge)	Element	Ion (include charge	Ionic compound	Compound name
Na		Cl			
K		S			
Ca		F			
Mg		O			
Al		Se			
Ba		P			
Be		I			
Sr		S			

II. Ionic compounds with transition metals.

Transition metals are metals that have variable charge. We can always determine what that charge is from either the ionic compound formula or the the compound name. If we have the formula, we can use the charge on the anion to determine the charge on the transition metal. For example, given the compound formula $FeCl_3$, we know that each Cl in the formula has a -1 charge. Since we have three of them, we have a total of -3 charge. We need to balance this with the Fe which must therefore be Fe^{3+}. The compound name is then iron (III) chloride, where the roman numeral tells us the charge on the transition metal. If we start with the compound name for any ionic compound containing a transition metal, we always know the charge on the metal. We can then figure out what amount of anion is needed to balance the charge on the metal. For example, given cobalt (VI) fluoride, we know that the VI means Co^{6+}. To balance the +6 charge on one cobalt, we must combine it with six F- ions. The formula is therefore CoF_6. Note that there are a few transition metals that don't normally have variable charge. These include zinc (always Zn^{2+}) and silver (usually Ag^{+}).

Element	**Ion**	**Element**	**Ion (include charge)**	**Ionic compound**	**Compound name**
Fe	Fe^{2+}	O			
V		S			Vanadium (IV) sulfide
Mn	Mn^{2+}	F			
Cr		P		CrP_2	
Ti	Ti^{4+}	Br			
Mo		Cl			Molybdenum (VI) chloride
Cu	Cu^{2+}	N			
Cu		O		Cu_2O	

III. Ionic compounds with polyatomic ions

The charge on polyatomic ions is fixed. The polyatomic ion name is used unchanged in the ionic compound name. For example, the compound containing sodium ion, Na+, and

bicarbonate ion, HCO_3^-, is named sodium bicarbonate. Polyatomic ions can combine with either representative or transition metals to form ionic compounds. Ammonium ion, NH_4^+, is the only positively charged polyatomic ion and it combines with negatively charged representative elements to form ionic compounds.

Element	**Ion (include charge)**	**PA ion**	**Name of PA ion**	**Ionic compound**	**Compound name**
Mg		HCO_3^-			
Fe	Fe^{3+}	CO_3^{2-}			
	V^{4+}		chlorate		
Na		HPO_4^{2-}			
					Chromium (VI) sulfate
Cs		Nitrate			
					Rubidium phosphate
Zn		$H_2PO_4^-$			
	NH_4^+		chromate		
Y		SO_4^{2-}		$Y(SO_4)_2$	
Ca			nitrite		
Mg			oxalate		