

Recitation
 Week 5
 Ionic Compounds

KEY

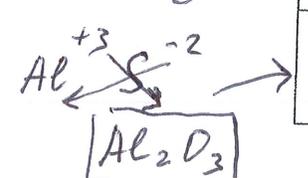
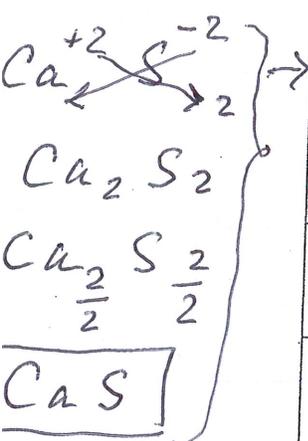
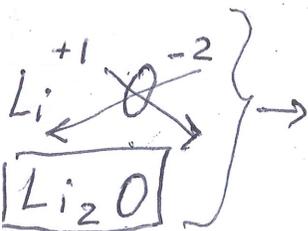
Problem 1: Write full electron configuration (spdf- notation, box-notation, noble gas notation), for the following:

- a) Mg and Mg^{+2}
- b) P and P^{-3}
- c) Fe and Fe^{+3}

See the answer on the last page.

Problem 2: Use the principle of neutrality to determine the formulas for Type I binary ionic compounds.

Combination of Ions	# Cations needed	# Anions Needed	Empirical Formula	Name of Ionic Compound
Na^+ with Cl^-	1	1	$NaCl$	Sodium Chloride
Li^+ with O^{2-}	2	1	Li_2O	Lithium Oxide
K^+ with P^{3-}	3	1	K_3P	Potassium Phosphide
Mg^{2+} with F^-	1	2	MgF_2	Magnesium Fluoride
Ca^{2+} with S^{2-}	1	1	CaS	Calcium Sulfide
Be^{2+} with N^{3-}	3	2	Be_3N_2	Beryllium Nitride
Al^{3+} with Cl^-	1	3	$AlCl_3$	Aluminum Chloride
Ga^{3+} with O^{2-}	2	3	Ga_2O_3	Gallium Oxide
Al^{3+} with S^{2-}	2	3	Al_2O_3	Aluminum Sulfide



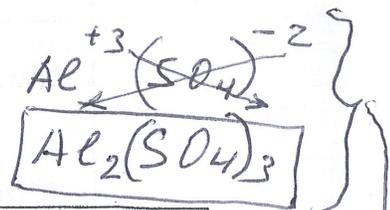
Problem 3:

Formulas and Names for ionic compounds containing ions of **variable-charge** metals

Combination of Ions	# Cations needed	# Anions Needed	Empirical Formula	Name of Ionic Compound
Cu^+ with Cl^-	1	1	CuCl	Copper (I) chloride
Cu^{2+} with Cl^-	1	2	CuCl_2	Copper (II) chloride
Fe^{2+} with S^{2-}	1	1	FeS	Iron (II) sulfide
Fe^{3+} with S^{2-}	2	3	Fe_2S_3	Iron (III) sulfide
Mn^{2+} with F^-	1	2	MnF_2	manganese (II) fluoride
Mn^{3+} with F^-	1	3	MnF_3	manganese (III) fluoride

Problem 4:

Formulas and Names for ionic compounds containing **polyatomic ions**



Combination of Ions	# Cations needed	# Anions Needed	Empirical Formula	Name of Ionic Compound
K^+ with PO_4^{3-}	3	1	K_3PO_4	Potassium phosphate
Mg^{2+} with NO_3^-	1	2	$\text{Mg}(\text{NO}_3)_2$	Magnesium Nitrate
Al^{3+} with SO_4^{2-}	2	3	$\text{Al}_2(\text{SO}_4)_3$	Aluminium sulfate
Na^+ with CO_3^{2-}	2	1	Na_2CO_3	Sodium Carbonate
Na^+ with HCO_3^-	1	1	NaHCO_3	Sodium Bicarbonate
NH_4^+ with Cl^-	1	1	NH_4Cl	Ammonium chloride

Problem 5:

Putting it all together

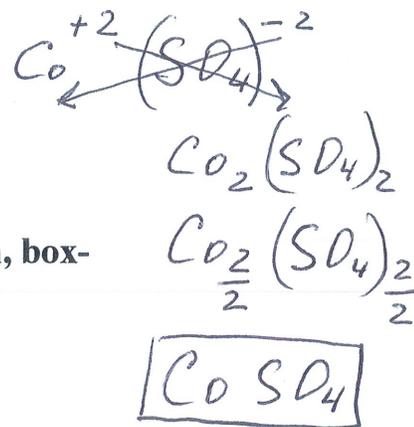
Combination	Formula	Name
Sodium with fluorine	NaF	Sodium fluoride
Magnesium with Nitrogen	Mg_3N_2	magnesium nitride
Ba with Cl	$BaCl_2$	Barium chloride
Potassium with oxygen	K_2O	Potassium oxide
Al with Br	$AlBr_3$	Aluminum bromide
Potassium with phosphate	K_3PO_4	Potassium phosphate
Na^+ and SO_4^{2-}	Na_2SO_4	Sodium sulfate
Iron (3+) with chlorine	$FeCl_3$	Iron(III) chloride
Copper (2+) with chlorine	$CuCl_2$	Copper (II) chloride
Ammonium with sulfur	$(NH_4)_2S$	Ammonium sulfide
Vanadium (3+) with oxygen	V_2O_3	Vanadium (III) oxide
Iron (3+) with oxygen	Fe_2O_3	Iron(III) oxide
K^+ with hydroxide	KOH	Potassium hydroxide
Copper (1+) with sulfate	Cu_2SO_4	Copper(I) sulfate

Problem 6:

- a. Copper (II) chloride - CuCl_2
- b. Calcium fluoride - CaF_2
- c. Iron (II) phosphate - $\text{Fe}_3(\text{PO}_4)_2$
- d. Potassium hydroxide - KOH
- e. Ammonium sulfate - $(\text{NH}_4)_2\text{SO}_4$

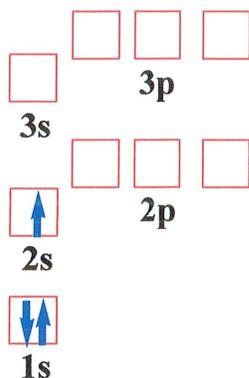
Problem 7: Name each of the following ionic compounds:

- 1. KF - Potassium fluoride
- 2. Na_2O - Sodium oxide
- 3. MgCl_2 - Magnesium chloride
- 4. FeCl_3 - Iron(III) chloride
- 5. CoSO_4 - Cobalt(II) sulfate
- 6. $\text{Ba}(\text{NO}_3)_2$ - Barium nitrate
- 7. $(\text{NH}_4)_2\text{CO}_3$ - Ammonium carbonate



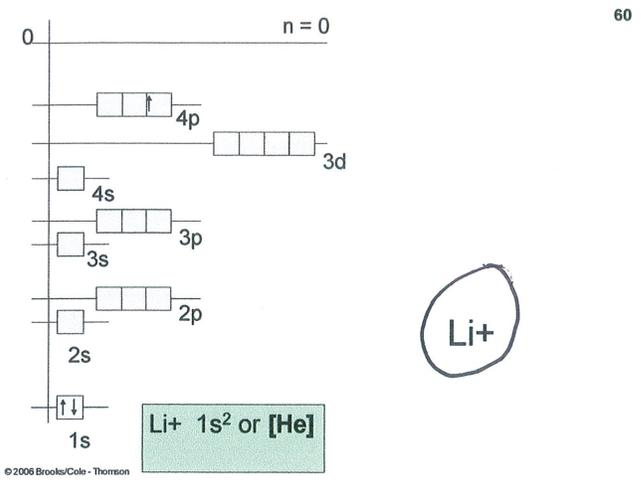
Problem 1: Write full electron configuration (spdf- notation, box-notation, noble gas notation), for the following:

- a) Li and Li^+
- b) Cl and Cl^-
- c) Fe and Fe^{+3}
- d) Mg and Mg^{+2}
- e) P and P^{-3}





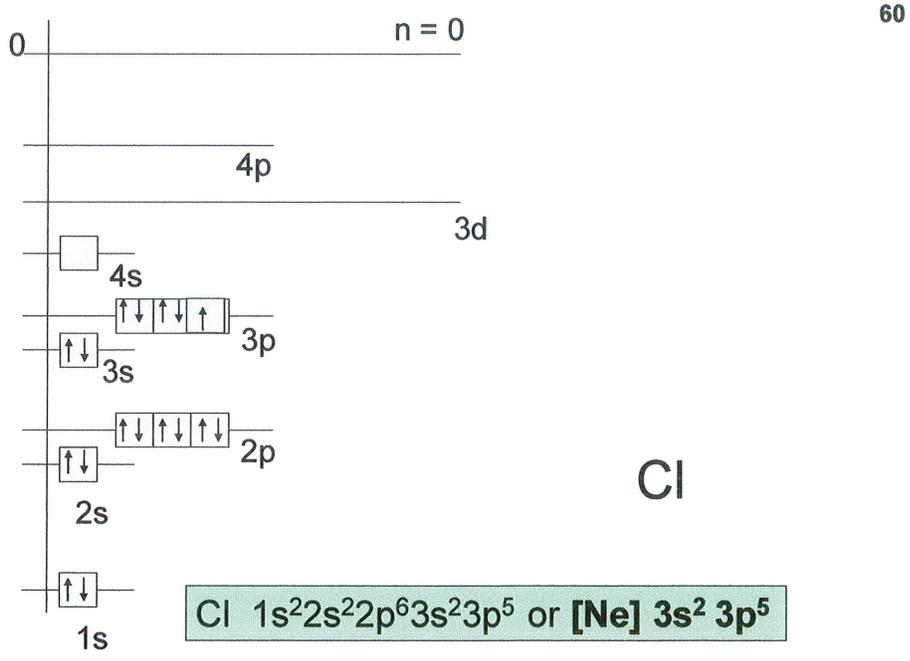
$1s^2 \rightarrow$ 2 total electrons or **[He]**



b)



$1s^2 2s^2 2p^6 3s^2 3p^5$ - 17 total electrons; 7 valence electrons

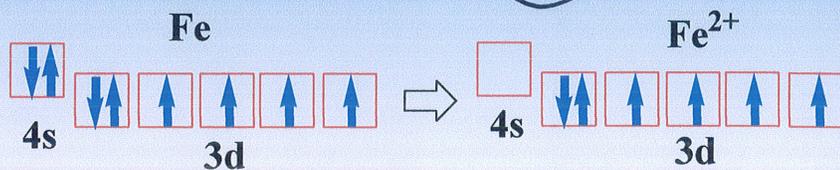


$1s^2 2s^2 2p^6 3s^2 3p^6$ - 18 total electrons; or **[Ar]**

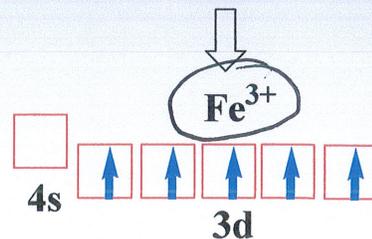
c)

Ion Configurations

For transition metals, remove ns electrons and then (n - 1) electrons.



To form cations, always remove electrons of highest n value first!



d)

33

Phosphorus **P**

Group 5A
 Atomic number = 15
 $1s^2 2s^2 2p^6 3s^2 3p^3$
 $[\text{Ne}] 3s^2 3p^3$



$\uparrow\downarrow$
3s

$\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$
3p

$\uparrow\downarrow$
2s

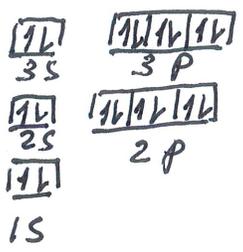
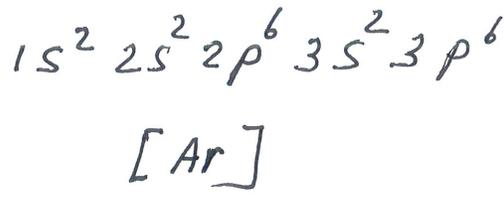
$\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$
2p

$\uparrow\downarrow$
1s

All Group 5A elements have [core] $ns^2 np^3$ configurations where n is the period number.

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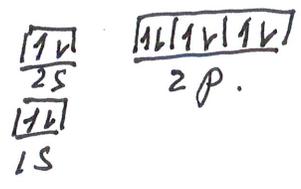
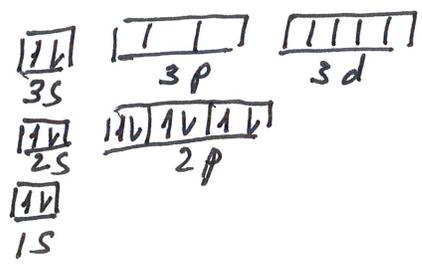
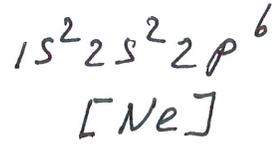
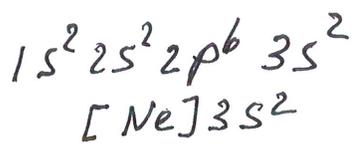
P gains 3 electrons to form anion =
 = argon electron configuration



e)



Loses 2 electrons → **Mg²⁺**
 = Neon electron configuration



	Alkali metals (except H)		Alkaline earth metals		Atomic number		Group designation										Halogens		Noble gases					
	IA (1)	IIA (2)		I H (1.00794)		Atomic mass		IIIA (13)	IVA (14)	VA (15)	VIA (16)	VIIA (17)	VIIIA (18)											
1	1 H 1.00794												2 He 4.002602											
2	3 Li 6.941	4 Be 9.012182							5 B 10.811	6 C 12.0107	7 N 14.0067	8 O 15.9994	9 F 18.99840	10 Ne 20.1797										
3	11 Na 22.98977	12 Mg 24.3050	IIIB (3)	IVB (4)	VB (5)	VIB (6)	VIIB (7)	VIII B (8) (9) (10)			IB (11)	IIB (12)	13 Al 26.98154	14 Si 28.0855	15 P 30.97376	16 S 32.065	17 Cl 35.453	18 Ar 39.948						
4	19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.93320	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.409	31 Ga 69.723	32 Ge 72.64	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.798						
5	37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc 98.9072	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.293						
6	55 Cs 132.90545	56 Ba 137.327	57 *La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96654	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98037	84 Po 208.9824	85 At 209.9871	86 Rn 222.0175						
7	87 Fr 223.0197	88 Ra 226.0254	89 †Ac 227.0277	104 Rf 261.1089	105 Db 262.1144	106 Sg 263.118	107 Bh 262.12	108 Hs 265.1306	109 Mt (268)	110 Ds (271)	111 Uuu (272)	112 Uub (285)	114 Uuq (289)											

* 58 Ce 140.116	59 Pr 140.90765	60 Nd 144.24	61 Pm 144.9127	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04
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† 90 Th 232.0381	91 Pa 231.0369	92 U 238.0289	93 Np 237.0482	94 Pu 244.0642	95 Am 243.0614	96 Cm 247.07003	97 Bk 247.0703	98 Cf 251.0796	99 Es 252.083	100 Fm 257.0951	101 Md 258.0984	102 No 259.1011
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