Chemistry 11

Stoichiometry I

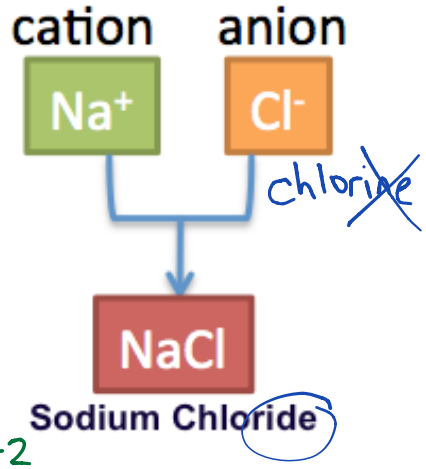
Name:
Date:
Block:

1. **Naming and Writing Formulas**
2. **Writing Chemical Equations**
3. **Balancing Reactions**

Naming and Writing Formulas

Key Points for naming **ionic compounds**:

- Cations (metals) are positively charged and are written first
- Anions (non-metals) are negatively charged and are written last
  - Change the ending of the anion to "ide"
- Don't forget: When naming compounds that have multivalent ions, use roman numerals
  - Example: iron (III) oxide



Name the following *ionic* compounds:

1) NaBr Sodium bromide

2) CaO Calcium oxide

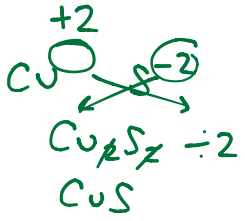
3) * CuS Copper (II) sulphide

4) $MgBr_2$ Magnesium bromide

5) * $Be(OH)_2$ Beryllium hydroxide

* family 3-12 multivalent

* polyatomic



Write the formulas for the following *ionic* compounds:

6) potassium iodide KI

7) tin (IV) oxide SnO_2

8) aluminum chloride $AlCl_3$

9) sodium nitrate $NaNO_3$

10) calcium carbonate $CaCO_3$

11) lithium sulfate Li_2SO_4

12) beryllium phosphide Be_3P_2

13) * magnesium hydroxide $Mg(OH)_2$

14) sodium phosphate Na_3PO_4

15) aluminum carbonate $Al_2(CO_3)_3$

16) nickel (II) chloride $NiCl_2$

17) * sodium cyanide $NaCN$

18) aluminum oxide Al_2O_3

19) magnesium acetate $Mg(CH_3COO)_2$

20) * ammonium chloride NH_4Cl

* Put brackets around your polyatomic ions if there is a subscript outside!

Key Points for naming **covalent compounds**:

- Covalent compounds form between two non-metals (anions)
- Use prefixes to indicate the number of atoms
  - Change the ending of the 2nd non-metal to "ide"
  - Exception: don't use mono- for the first atom
- Exceptions: water (H_2O), ammonia (NH_3), methane (CH_4)

Prefixes

1	Mono
2	Di
3	Tri
4	Tetra
5	Penta
6	Hexa
7	Hepta
8	Octa

Write the names of the following *covalent* compounds:

21) SO_3 sulfur trioxide

22) N_2S dinitrogen monosulfide

23) PH_3 phosphorus trihydride

24) BF_3 boron trifluoride

25) P_2Br_4 diphosphorus tetrabromide

26) CO Carbon monoxide

27) SiO_2 Silicon dioxide

28) SF_6 sulfur hexafluoride

29) NH_3 ammonia

30) NO_2 nitrogen dioxide

Write the formulas of the following *covalent* compounds:

31) nitrogen trichloride NCl_3

32) disilicon hexaiodide Si_2I_6

33) dinitrogen trioxide N_2O_3

34) phosphorus pentafluoride PF_5

35) methane CH_4

36) sulfur dibromide SBr_2

37) diboron tetrahydride B_2H_4

38) oxygen difluoride OF_2

39) carbon disulfide CS_2

40) nitrogen monoxide NO

* Don't reduce covalent compounds

Reaction Types

Synthesis

General Formula: $A + B \rightarrow AB$

Things you need to remember:

- When elements are by themselves, they are neutral
- H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2 P_4 S_8
- When they partner up and form a molecule, you need to remember their charge!

Examples:

$H_2 + O_2 \rightarrow H_2O$

$Al + O_2 \rightarrow Al_2O_3$

Decomposition

General Formula: $AB \rightarrow A + B$

Things you need to remember:

- Breaks down into its elements
- When elements are by themselves, they are neutral
- H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2 P_4 S_8
- When they partner up and form a molecule, you need to remember their charge!

Examples:

$Al_2O_3 \rightarrow Al + O_2$

$FeSO_4 \rightarrow Fe + S_8 + O_2$

Single Replacement

General Formula: $AB + C \rightarrow AC + B$

<OR> $AB + D \rightarrow DB + A$

- C = will form a negative charge → will replace B
- D = will form a positive charge → will replace A

Things you need to remember:

- The "incoming" element's charge is important because it determines whether "A" or "B" is replaced
- When they partner up and form a molecule, you need to remember their charge!

Examples:

$NaCl + I_2 \rightarrow NaI + Cl_2$

$NaCl + Li \rightarrow LiCl + Na$

Double Replacement

General Formula: $AB + CD \rightarrow AD + CB$

Things you need to remember:

- The ions switch partners!
- The positive ion is written first!
- When they partner up and form a molecule, you need to remember their charge!

Examples:

$PbCl_2 + KNO_3 \rightarrow Pb(NO_3)_2 + KCl$

$LiOH + KMnO_4 \rightarrow LiMnO_4 + KOH$

Neutralization

General Formula: Acid + Base → Salt + Water

Things you need to remember:

- Acid = Usually starts with "H–" (ex. HCl, H_2SO_4, H_3PO_4)
- Base = Ends with "–OH" (ex. NaOH, $Ca(OH)_2$)
- Products are always a salt (has a positive and negative ion) and water
- It is essentially a double replacement

Examples:

$HCl + NaOH \rightarrow NaCl + H_2O$

$H_2SO_4 + LiOH \rightarrow Li_2SO_4 + H_2O$

Combustion

General Formula:

$HYDROCARBON + O_2 \rightarrow H_2O + CO_2$

Things you need to remember:

- Hydrocarbon = contains carbon and hydrogen and sometimes oxygen
- Key word: BURN → means to react with oxygen!
- Products are always carbon dioxide (CO_2) and water (H_2O)

Examples:

$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

Writing Chemical Equations

Write the type chemical reaction on the line—synthesis, decomposition, combustion, single replacement, or double replacement. It is not necessary to balance the equations.

$KClO_3 \rightarrow KCl + O_2$	D
$KBr + F_2 \rightarrow KF + Br_2$	SR
$S_8 + F_2 \rightarrow SF_6$	S
$Na_2SO_4 + Pb(NO_3)_2 \rightarrow NaNO_3 + PbSO_4$	DR
$C_3H_8 + O_2 \rightarrow CO_2 + H_2O$	C
$Zn + HCl \rightarrow ZnCl_2 + H_2$	SR
$FeCl_3 + Na_2CO_3 \rightarrow Fe_2(CO_3)_3 + NaCl$	DR
$Na + H_2O \rightarrow NaOH + H_2$	SR
$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$	C
$HgO \rightarrow Hg + O_2$	D

Balancing Reactions

Methods:

1. **Inspection**
   - Quick & easy; good for simple equations

$2\,H_2 + O_2 \rightarrow 2\,H_2O$

H: 2 x 2 = 4 ✓ H: 2 x 2 = 4 ✓

O: 2 ✓ O: 1 x 2 = 2 ✓

2. **Algebraic**
   - Longer & more involved; good for equations that cannot be solved by inspection

Steps:

1. Balance C
2. Balance H
3. Balance O (.5)

x2

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

$2\,C_4H_{10} + 13\,O_2 \rightarrow 8\,CO_2 + 10\,H_2O$

8 + 5 = 13

1. Place coefficients in front of each molecule in the equation (w, x, y, z)

   $x\,C_4H_{10} + y\,O_2 \rightarrow z\,CO_2 + w\,H_2O$

2. For each atom, write out an equation using the unknowns

   For carbon: $4x = z$

   For hydrogen: $10x = 2w$

   For oxygen: $2y = 2z + w$

3. Let one of your coefficients be equal to 1, and solve for the remaining coefficients

   Let x = 1

   If x=1, z=4, w=5 and y=6.5

   Can't have 0.5's, so multiply everything by 2

   $2\,C_4H_{10} + 13\,O_2 \rightarrow 8\,CO_2 + 10\,H_2O$

   x y z w

x = 1 → 2

4x = z

4(1) = z

z = 4 → 8

10x = 2w

10(1) = 2w

w = 5 → 10

x2

2y = 2z + w

2y = 2(4) + 5

2y = 13

y = 6.5 → 13

Balance these equations!

1) ___ $AlBr_3$ + 3 K → 3 KBr + ___ Al

2) ___ FeO + ___ PdF_2 → ___ FeF_2 + ___ PdO

3) ___ P_4 + 6 Br_2 → 4 PBr_3

4) 2 LiCl + ___ Br_2 → 2 LiBr + ___ Cl_2

5) ___ $PbBr_2$ + 2 HCl → 2 HBr + ___ $PbCl_2$

* 6) 2 $CoBr_3$ + 3 $CaSO_4$ → 3 $CaBr_2$ + ___ $Co_2(SO_4)_3$

$2CoBr_3 + 3CaSO_4 \rightarrow 3CaBr_2 + \_Co_2(SO_4)_3$

Co: 1 x 2 = 2 ✓ | Co: 2 ✓

Br: 3 x 2 = 6 ✓ | Br: 2 x 3 = 6 ✓

Ca: 1 x 3 = 3 ✓ | Ca: 1 x 3 = 3 ✓

SO_4: 1 x 3 = 3 ✓ | SO_4: 3 ✓

7) 2 Na_3P + 3 CaF_2 → 6 NaF + ___ Ca_3P_2

8) 2 Mn + 6 HI → 3 H_2 + 2 MnI_3

9) ___ Li_3PO_4 + 3 NaBr → ___ Na_3PO_4 + 3 LiBr

10) ___ CaF_2 + ___ Li_2SO_4 → ___ $CaSO_4$ + 2 LiF

11) 2 HBr + ___ $Mg(OH)_2$ → ___ $MgBr_2$ + 2 H_2O

12) 2 $LiNO_3$ + ___ $CaBr_2$ → ___ $Ca(NO_3)_2$ + 2 LiBr

13) ___ $AgNO_3$ + ___ Li → ___ $LiNO_3$ + ___ Ag

14) ___ $Si(OH)_4$ + 4 NaBr → ___ $SiBr_4$ + 4 NaOH

15) 2 NaCN + ___ $CuCO_3$ → ___ Na_2CO_3 + ___ $Cu(CN)_2$

Predict the products for the following reactions. Then balance the reactions.

D 2 NaCl → 2 Na + Cl_2 ← diatomic!

SR CuF_2 + Mg → Cu + MgF_2

(Cu is the metal; Mg is the metal)

S Lithium + oxygen →

4 Li + O_2 → 2 Li_2O

DR $SrCl_2 + Pb(NO_3)_2 \rightarrow Sr(NO_3)_2 + PbCl_2$

DR $2\,Na_3PO_4 + 3\,MgI_2 \rightarrow 6\,NaI + Mg_3(PO_4)_2$

D Aluminum oxide →

$2\,Al_2O_3 \longrightarrow 4\,Al + 3O_2$

C $2\,C_4H_{10} + 13\,O_2 \rightarrow 8\,CO_2 + 10\,H_2O$

SR. Tin + gold (III) nitrate →

$3\,Sn + 2\,Au(NO_3)_3 \rightarrow 3\,Sn(NO_3)_2 + 2\,Au$

Sn	$1 \times 3 = 3$	$1 \times 3 = 3$
Au	$1 \times 2 = 2$	$1 \times 2 = 2$
NO_3	$3 \times 2 = 6$	$2 \times 3 = 2$

S $6\,Mg + P_4 \rightarrow 2\,Mg_3P_2$

C. Glycerine ($C_3H_8O_3$) + oxygen →

$2\,C_3H_8O_3 + 7\,O_2 \rightarrow 6\,CO_2 + 8\,H_2O$

N. $Ca(OH)_2 + H_2SO_4 \rightarrow 2\,H_2O + CaSO_4$

S Nitrogen + oxygen →

$2\,N_2 + 3O_2 \longrightarrow 2\,N_2O_3$

DR Barium hydroxide + lead (IV) bromide →

$2\,Ba(OH)_2 + PbBr_4 \longrightarrow 2\,BaBr_2 + Pb(OH)_4$