Unit 05 Outcomes

LPT

Given name or formula of an element shown below, write the other

Element	Formula	Element	Formula
Aluminum	Al	Lead	Pb
Argon	Ar	Lithium	Li
Barium	Ba	Magnesium	Mg
Beryllium	Be	Manganese	Mn
Boron	B	Mercury	Hg
Bromine	Br_2	Neon	Ne
Calcium	Ca	Nickel	Ni
Carbon	C	Nitrogen	N_2
Chlorine	Cl_2	Oxygen	O_2
Chromium	Cr	Phosphorus	P
Cobalt	Co	Potassium	K
Copper	Cu	Silicon	Si
Fluorine	F_2	Silver	Ag
Helium	He	Sodium	Na
Hydrogen	H_2	Sulfur	S
Iodine	I_2	Tin	Sn
Iron	Fe	Zinc	Zn
Krypton	Kr		

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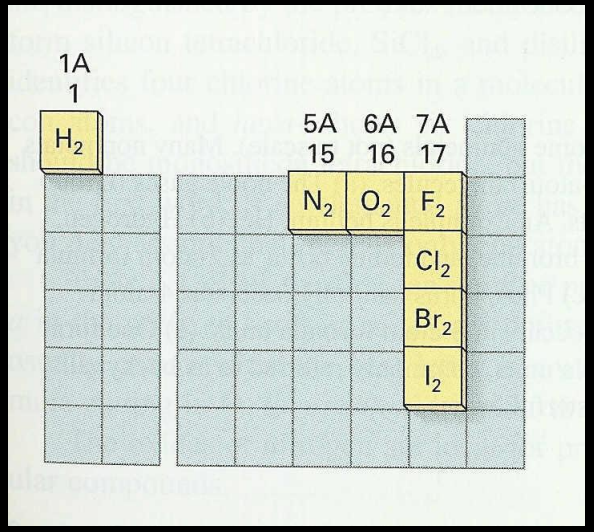
Elements which exist as diatomic molecules

H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2



Symbols are the elemental abbreviations found on the periodic table
Formulas are representations of the molecular species (use subscripts)

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Classify chemical formula as ionic or molecular

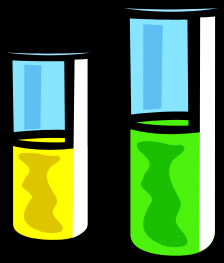
Ionic = cation + anion

most often metal plus non-metal

(far left + far right of periodic table)

conducts electricity (melt or solution)

transfer of electrons from cation to anion



Molecular = not ionic

mostly right of "staircase"

acids

noble halides

electrons shared (covalent bonding)

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Given the name or formula of a binary molecular compound, write the other

First Word

Name of the element appearing first in the formula

Include a prefix to indicate # atoms

Second Word

Name of the element appearing second in the formula, changed to end in –ide

Include prefix to indicate # atoms

N_2O	Dinitrogen Monoxide	CO	Carbon Monoxide
N_2O_3	Dinitrogen Trioxide	CO_2	Carbon Dioxide
Si_2Cl_6	Disilicon Hexachloride	P_2O_5	Diphosphorus Pentoxide

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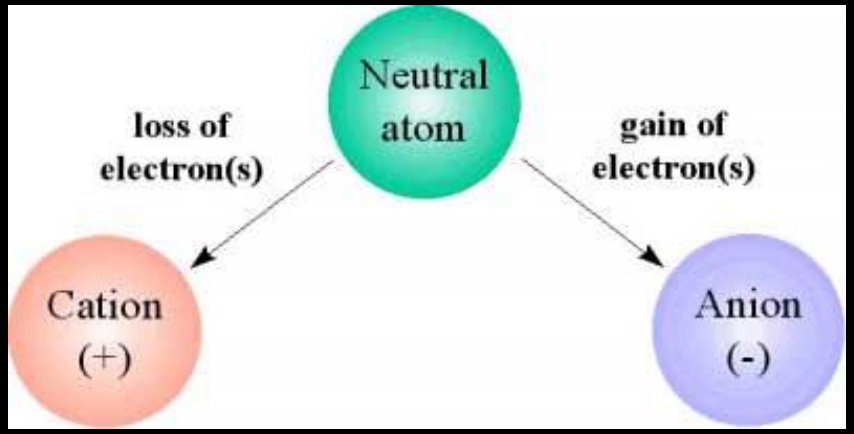
Define the following terms:

ion = charged particle, gain or loss e^-
monatomic ion = ion from an element
cation = positive ion, loss of e^-, from metal
anion = negative ion, gain of e^-, from non-metal

Ionization is not a nuclear process
Involves outer shell of valence electrons



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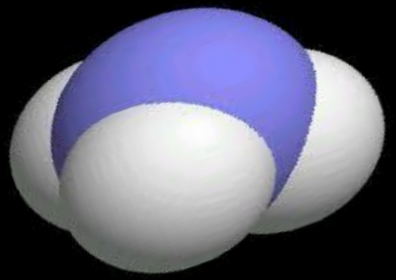
Given name or the formula of water & ammonia, write the other

H_2O water **NH_3 ammonia**



Dihydrogen Monoxide **Nitrogen Trihydride**

These are molecular compounds

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Use a Periodic Table & the name or formula of a monatomic ion, write the other

Common Mono-Atomic Ions

1+	2+										3+		3–	2–	1–	
H^+															H^-	
Li^+	Be^{2+}												N^{3-}	O^{2-} O_2^{2-}	F^-	
Na^+	Mg^{2+}										Al^{3+}		P^{3-}	S^{2-}	Cl^-	
K^+	Ca^{2+}				Cr^{2+} Cr^{3+}	Mn^{2+} Mn^{3+}	Fe^{2+} Fe^{3+}	Co^{2+} Co^{3+}	Ni^{2+}	Cu^+ Cu^{2+}	Zn^{2+}					Br^-	
										Ag^+			Sn^{2+} Sn^{4+}			I^-	
	Ba^{2+}										Hg_2^{2+} Hg^{2+}		Pb^{2+} Pb^{4+}			

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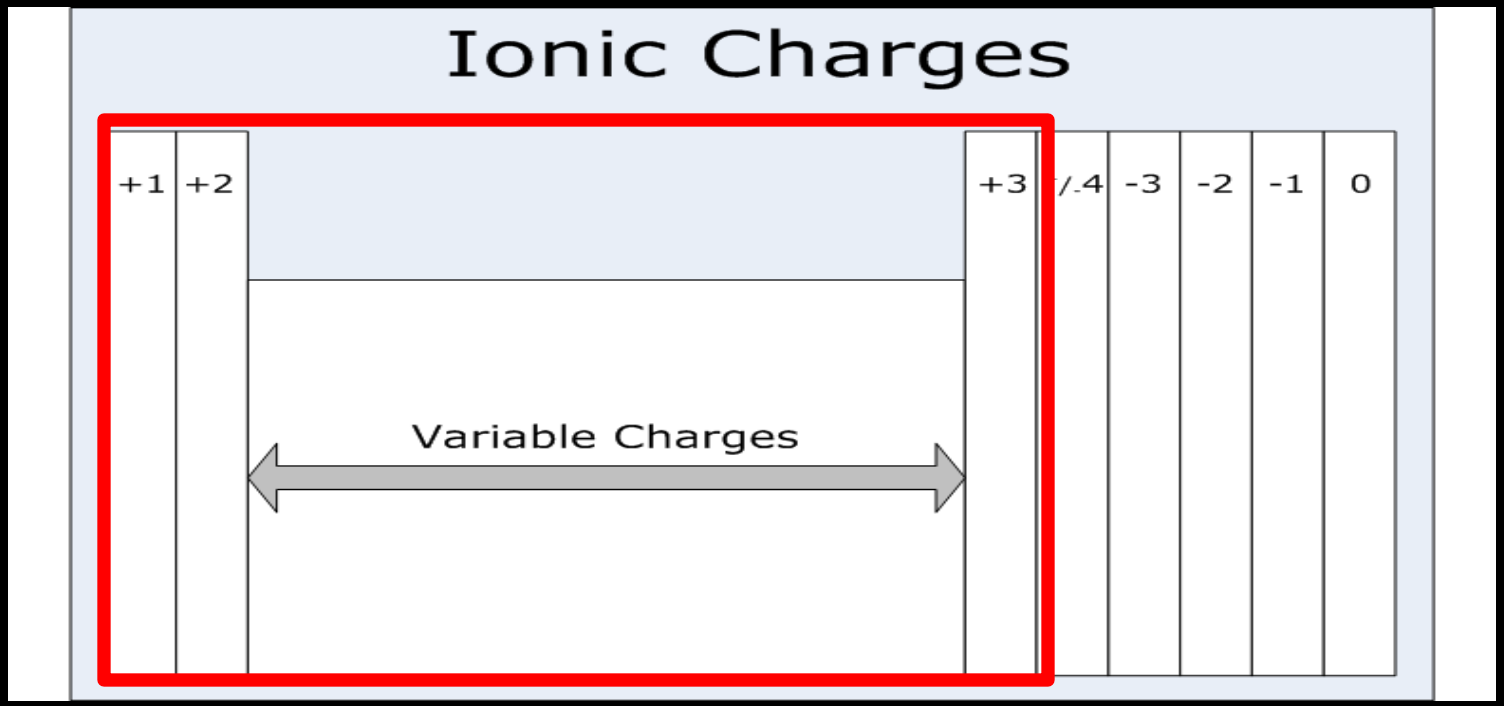
Use a Periodic Table to predict electrons lost by a metal atom to form an ion

Group 1A	**(1)**	**+ (1 understood)**
Group 2A	**(2)**	**2+**
Group 3A	**(13)**	**3+**
Transition	**(3-12)**	**form cations with various charges**



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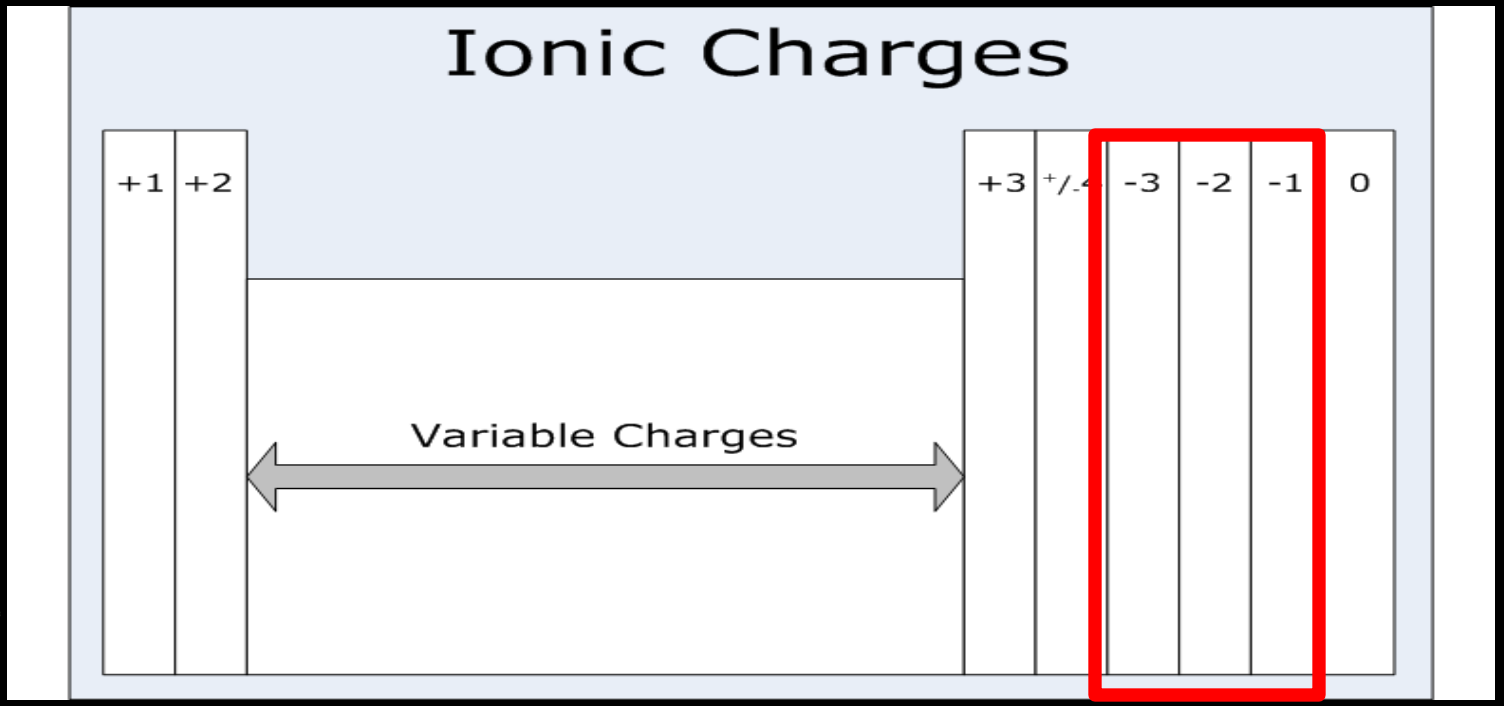
Use a Periodic Table to predict electrons gained by a non-metal atom to form an ion

Group 5A	(15)	3–
Group 6A	(16)	2–
Group 7A	(17)	– (1 understood)



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Given the formula for a monatomic ion, determine its oxidation state or oxidation number

Oxidation number = charge on ion

The Roman numeral in the formula gives the oxidation state

Iron (III) Oxide	Fe_2O_3
Lead (IV) Chloride	$PbCl_4$
Copper (I) Sulfate	Cu_2SO_4
Copper (II) Sulfate	$CuSO_4$
Mercury (II) Phosphate	$Hg_3(PO_4)_2$

1+	2+										3+		3–	2–	1–	
H^+															H^-	
Li^+	Be^{2+}												N^{3-}	O^{2-} O_2^{2-}	F^-	
Na^+	Mg^{2+}										Al^{3+}		P^{3-}	S^{2-}	Cl^-	
K^+	Ca^{2+}				Cr^{2+} Cr^{3+}	Mn^{2+} Mn^{3+}	Fe^{2+} Fe^{3+}	Co^{2+} Co^{3+}	Ni^{2+}	Cu^+ Cu^{2+}	Zn^{2+}					Br^-	
										Ag^+			Sn^{2+} Sn^{4+}			I^-	
	Ba^{2+}										Hg_2^{2+} Hg^{2+}		Pb^{2+} Pb^{4+}			

LPT

Given the name/formula (including the charge) of a polyatomic ion, write the other

Ammonium	$(NH_4)^+$
Acetate	$(C_2H_3O_2)^-$ or $(CH_3COO)^-$
Hydroxide	$(OH)^-$
Chlorate	$(ClO_3)^-$
Chlorite	$(ClO_2)^-$
Nitrate	$(NO_3)^-$
Nitrite	$(NO_2)^-$
Sulfate	$(SO_4)^{2-}$
Hydrogen sulfate	$(HSO_4)^-$
Sulfite	$(SO_3)^{2-}$
Carbonate	$(CO_3)^{2-}$
Hydrogen carbonate	$(HCO_3)^-$
Phosphate	$(PO_4)^{3-}$

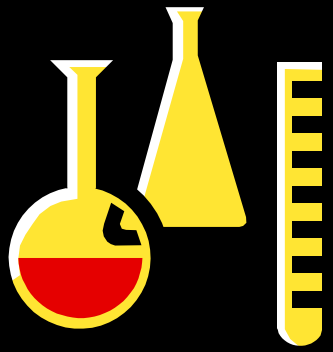
LPT

Given a formula, determine if it will act as an acid.

Acids have form

H (non-metal) like F, Cl, Br, I
H (poly-atomic) like $(SO_4)^{2-}$, $(PO_4)^{3-}$, $(ClO_3)^-$

Acids donate hydrogen ions
Acids are molecular compounds



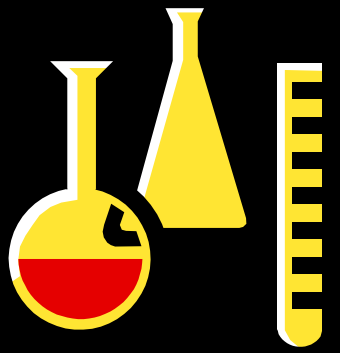
LPT

Given the formula or the name for a binary acid, write the other

Binary Acids = Hydrogen + nonmetal

HYDRO + ROOT + IC ACID

H_2S	hydrosulfuric acid (hydrogen sulfide)
HCl	hydrochloric acid (Muriatic)
HBr	hydrobromic acid
HI	hydroiodic acid
HF	hydrofluoric acid



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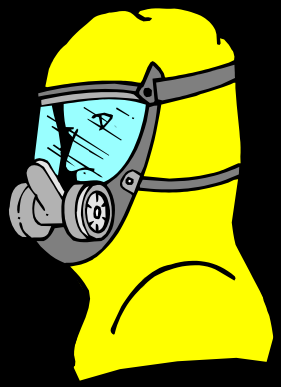
Given the name of a polyatomic ion, name the corresponding oxoacid.

H + nonmetal + Oxygen	H + polyatomic ion
–ate ions	root+ic acid
–ite ions	root+ous acid
$HClO_3$	chloric acid
$HClO_2$	chlorous acid
H_2SO_4	sulfuric acid
H_2SO_3	sulfurous acid
HNO_3	nitric acid
HNO_2	nitrous acid



LPT

Given the name or formula of an ionic compound, write the other

name the cation, then the anion as -ide

BaF_2	barium fluoride	
CaF_2	calcium fluoride	
NaBr	sodium bromide	
Mg_3N_2	magnesium nitride	
Al_2O_3	aluminum oxide	(alumina)
Li_3P	lithium phosphide	
AlN	aluminum nitride	
$CuCl_2$	copper (II) chloride	(cupric chloride)
CuCl	copper (I) chloride	(cuprous chloride)
FeN	iron (III) nitride	(ferric nitride)
Fe_3N_2	iron (II) nitride	(ferrous nitride)
$SnCl_4$	tin (IV) chloride	(stannic chloride)
$SnCl_2$	tin (II) chloride	(stannous chloride)

LPT

Table 6.9 Summary of Nomenclature System

Substance	Name	Formula
Element	Name of element	Symbol of element; exceptions: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2
Compounds made up of two nonmetals	First element in formula followed by second, changed to end in *-ide,* each element preceded by prefix to show the number of atoms in the molecule	Symbol of first element in name followed by symbol of second element, with subscripts to show number of atoms in molecule
Acid	Most common: middle element changed to end in *-ic* One more oxygen than *-ic* acid: add prefix *per-* to name of *-ic* acid One fewer oxygen than *-ic* acid: change ending of *-ic* acid to *-ous* Two fewer oxygens than *-ic* acid: add prefix *hypo-* to name of *-ous* acid No oxygen: Prefix *hydro-* followed by name of second element changed to end in *-ic*	H followed by symbol of nonmetal followed by O (if necessary), each with appropriate subscript. *Memorize the following:* Chloric acid $HClO_3$ Nitric acid HNO_3 Sulfuric acid H_2SO_4 Carbonic acid H_2CO_3 Phosphoric acid H_3PO_4
Monatomic cation	Name of element followed by ion; if element forms more than one monatomic cation, elemental name is followed by ion charge in Roman numerals and in parentheses	Symbol of element followed by superscript to indicate charge
Monatomic anion	Name of element changed to end in *-ide*	Symbol of element followed by superscript to indicate charge
Polyatomic anion from total ionization of oxyacid	Replace *-ic* in acid name with *-ate,* or replace *-ous* in acid name with *-ite,* followed by ion	Acid formula without hydrogen plus superscript showing negative charge equal to number of hydrogens removed from acid formula
Polyatomic anion from step-by-step ionization of oxyacid	Hydrogen followed by name of ion from total ionization of acid (dihydrogen in the case of $H_2PO_4^-$)	Acid formula minus one (or two for H_3PO_4) hydrogen(s), plus superscript showing negative charge equal to number of hydrogen removed from acid formula
Other polyatomic ions	Ammonium ion Hydroxide ion	NH_4^+ OH^-
Ionic compound	Name of cation followed by name of anion	Formula of cation followed by formula of anion, each taken as many times as necessary to yield a net charge of zero (polyatomic ion formulas enclosed in parentheses if taken more than once)
Hydrate	Name of anhydrous compound followed by (number prefix)hydrate, where (number prefix) indicates the number of water molecules associated with one formula unit of anhydrous compound	Formula of anhydrous compound followed by "· n H_2O" where n is number of water molecules associated with one formula unit of anhydrous compound

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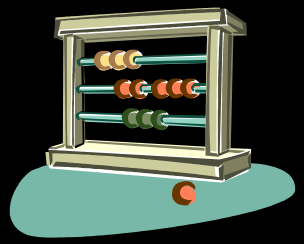
Given the formula, or a name from which the formula may be written, determine the number of atoms of each element in the formula.



Count atoms, including waters

Multiply everything inside a parenthesis by the subscript

$Ca_3(PO_4)_2$	Fe_2S_3	$CuSO_4 \cdot 5\ H_2O$		$Al_2(ClO_4)_3$
3 Ca	2 Fe	1 Cu	10 H	2 Al
2 P	3 S	1 S	5 O	3 Cl
8 O		4 O		12 O

LPT

Distinguish among atomic mass, molecular mass and formula mass

Atomic Number = Z → number protons in nucleus
Mass Number = A → protons + neutrons

Atomic Mass = in AMU's, based on Carbon-12
= average weight of atoms in element
1 amu = 1/12 of mass of carbon-12 atom

Formula Mass = average mass of atoms in formula
typically associated with ionic compounds
Molecular Mass = same as formula mass
= sum of atomic masses in compound
typically associated with molecular compounds

LPT

Calculate formula mass of any compound whose formula is known or given

Write formula

Count atoms, multiply # atoms x atomic mass

Sum

Round

NaCl

Na: 1 x 22.99 = 22.99
Cl: 1 x 35.45 = 35.44
Formula mass = 58.44

$Mg_3(PO_4)_2$

Mg: 3 x 24.31 = 72.93
P: 2 x 30.97 = 61.94
O: 8 x 16.00 = 128.00
Formula Mass = 252.87

LPT

Define the mole. Identify the number that corresponds to one mole.

Gram-Molecular Mass

Molecular Mass Expressed in grams

Contains Avogadro's Number (6.02 x 10^{23} molecules or atoms)

One Mole, REGARDLESS OF SOURCE,
Contains 6.02 x 10^{23} molecules or atoms

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Given the number of moles or formula units in any sample, calculate the other

$$1 \text{ mol} = 6.02 \times 10^{23} \text{ atoms}$$

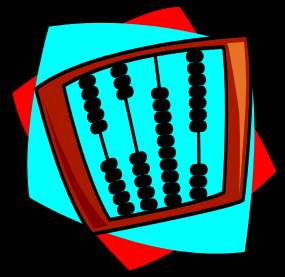
$$\#\ \text{atoms} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ atoms}} = \#\ \text{moles}$$

$$\#\ \text{moles} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mole}} = \#\ \text{atoms}$$

The "Units" tell you where the number goes!

LPT

Avogadro Related Problems



Determine the number of formula units in 6.25 moles of Li_3N

$$6.25 \text{ moles} \times \frac{6.02 \times 10^{23} \text{ formula units}}{1 \text{ mole}} = 3.76 \times 10^{24} \text{ formula units}$$

Determine the number of molecules in 9.68 moles of carbon dioxide.

$$9.68 \text{ moles} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mole}} = 5.83 \times 10^{24}$$

How many moles are present in 34.67×10^{26} molecules of sucrose?

$$34.67 \times 10^{26} \text{ molecules} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}} = 5.759 \times 10^{3} \text{ moles}$$

How many molecules are present in 2.5 moles of CO_2?

$$2.5 \text{ moles} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mole}} = 1.5 \times 10^{24} \text{ molecules}$$

LPT

Define molar mass, or interpret statements in which the term molar mass is used

Molar Mass = gram molecular mass

= mass / mole = g/mole

= formula mass (in amu's) expressed as grams

= molecular mass (in amu's) expressed as grams

Calculate the molar mass of any substance whose chemical formula is known.

Write formula

Count atoms, multiply # atoms x atomic mass

Sum and round

This gives the formula or molecular mass

Molecular mass is in amu's

Change amu's to grams

This give gram-molecular mass (weight) (molar mass)

LPT

Determine Molar Mass

NH_3

N: 1 x 14.01 = 14.01
H: 3 x 1.008 = 3.024
Molar Mass = 17.03 g/mole

MgI_2

Mg: 1 x 24.31 = 24.31
I: 2 x 126.9 = 259.8
Molar Mass = 278.1 g/mole

$CaSO_4 \cdot 10\ H_2O$

Ca: 1 x 40.08 = 40.08
S: 1 x 32.07 = 32.07
O: 4 x 16.00 = 64.00
Formula Mass = 136.15

H: 20 x 1.008 = 20.16
O: 10 x 16.00 = 160.00
Molar Mass = 180.16

Total Molar Mass for the hydrate = 136.15 + 180.16 = 316.31 g /mole

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