The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

1995 IUPAC masses and Approved Names from http://www.chem.qmw.ac.uk/iupac/AtWt/
masses for 107-111 from C&EN, March 13, 1995, p. 35
112 from http://www.gsi.de/z112e.html

TABLE 7.2 Solubility Rules

Compounds Containing the Following Ions Are Mostly Soluble	Exceptions
Li^+, Na^+, K^+, NH_4^+	None
NO_3^-, $C_2H_3O_2^-$	None
Cl^-, Br^-, I^-	When any of these ions pairs with Ag^+, Hg_2^{2+}, or Pb^{2+}, the compound is insoluble.
SO_4^{2-}	When SO_4^{2-} pairs with Sr^{2+}, Ba^{2+}, Pb^{2+}, or Ca^{2+}, the compound is insoluble.
Compounds Containing the Following Ions Are Mostly Insoluble	**Exceptions**
OH^-, S^{2-}	When either of these ions pairs with Li^+, Na^+, K^+, or NH_4^+, the compound is soluble.
	When S^{2-} pairs with Ca^{2+}, Sr^{2+}, or Ba^{2+}, the compound is soluble.
	When OH^- pairs with Ca^{2+}, Sr^{2+}, or Ba^{2+}, the compound is slightly soluble.*
CO_3^{2-}, PO_4^{3-}	When either of these ions pairs with Li^+, Na^+, K^+, or NH_4^+, the compound is soluble.

*For many purposes these can be considered insoluble.

TABLE 5.6 Some Common Polyatomic Ions

Name	Formula	Name	Formula
acetate	$C_2H_3O_2^-$	hypochlorite	ClO^-
carbonate	CO_3^{2-}	chlorite	ClO_2^-
hydrogen carbonate (or bicarbonate)	HCO_3^-	chlorate	ClO_3^-
hydroxide	OH^-	perchlorate	ClO_4^-
nitrate	NO_3^-	permanganate	MnO_4^-
nitrite	NO_2^-	sulfate	SO_4^{2-}
chromate	CrO_4^{2-}	sulfite	SO_3^{2-}
dichromate	$Cr_2O_7^{2-}$	hydrogen sulfite (or bisulfite)	HSO_3^-
phosphate	PO_4^{3-}	hydrogen sulfate (or bisulfate)	HSO_4^-
hydrogen phosphate	HPO_4^{2-}	peroxide	O_2^{2-}
ammonium	NH_4^+	cyanide	CN^-

TABLE 2.2 SI Prefix Multipliers

Prefix	Symbol	Multiplier	
tera-	T	1,000,000,000,000	(10^{12})
giga-	G	1,000,000,000	(10^{9})
mega-	M	1,000,000	(10^{6})
kilo-	k	1,000	(10^{3})
deci-	d	0.1	(10^{-1})
centi-	c	0.01	(10^{-2})
milli-	m	0.001	(10^{-3})
micro-	μ	0.000001	(10^{-6})
nano-	n	0.000000001	(10^{-9})
pico-	p	0.000000000001	(10^{-12})
femto-	f	0.000000000000001	(10^{-15})

NAME Key

Su2019/1301/Exam 3/Dooley

July 26, 2019

Multiple Choice: (3 Pts Each) Write the letter corresponding to the correct answer in the blank provided.

b 1. According to Avogadro, how many M&Ms are there in a mole of M&Ms?

a. 6.022×10^{-42}
b. 6.022×10^{23}
c. 3.011×10^{23}
d. 6.022
e. 6.022×10^{32}

e 2. How many molecules are in 76.3 g N_2O_4? The molar mass of N_2O_4 is 92.02 g/mol.

a. 5.54×10^{25} N_2O_4 molecules
b. 7.26×10^{23} N_2O_4 molecules
c. 1.38×10^{24} N_2O_4 molecules
d. 4.59×10^{25} N_2O_4 molecules
e. 4.99×10^{23} N_2O_4 molecules

$76.3\,g\,N_2O_4 \left(\frac{1\,mol}{92.02\,g}\right)\left(\frac{6.02\times10^{23}}{1\,mol}\right) = 4.993\times10^{23}$

e 3. How many moles of C_3H_8 contain 9.25×10^{24} molecules of C_3H_8?

a. 65.1 moles C_3H_8
b. 28.6 moles C_3H_8
c. 34.9 moles C_3H_8
d. 46.2 moles C_3H_8
e. 15.4 moles C_3H_8

$9.25\times10^{24}\,molec \left(\frac{1\,mol}{6.02\times10^{23}}\right) = 15.4\,mol$

d 4. Which of the following samples contains the most He atoms?

a. 1 mol He
b. 6.022×10^{23} atoms He
c. 4.00 g He
d. A-C contain (to at least 3 sig figs) the same number of He atoms
e. There is no way of telling based on the information given

All of these are 1 mol He

C 5. You have 1 mole of $(NH_4)_2SO_4$. How many moles of hydrogen atoms do you have?

a. 2
b. 4
c. 8
d. 1
e. none of the above

8

$1\,mol\,(NH_4)_2SO_4 = 8\,mol\,H$

$Ca_3(PO_4)_2$

C 6. Calculate the molar mass of Ca3(PO4)2.

a. 87.05 g/mol
b. 215.21 g/mol
c. 310.18 g/mol
d. 279.21 g/mol
e. 246.18 g/mol

$3 \times 40.08g + 2 \times 30.97g + 8 \times 16.00g$

$310.18 g/mol$

a 7. Calculate the mass percent composition of sulfur in $Al_2(SO_4)_3$.

a. 28.12 %
b. 9.372 %
c. 42.73 %
d. 21.38 %
e. 35.97 %

$\frac{3(32.07g)}{342.17g} \times 100\%$

$= 28.12\%$

$MM = 2(26.98g) + 3(32.07g) + 12(16.0g)$

$342.17 g/mol$

C 8. The best example of an electrolyte is:

a. a covalent molecule dissolved in water that remains intact in solution.
b. a covalent compound dissolved in water that dissociates into its ions.
c. an ionic compound that is both dissolved in water and dissociated into its ions. ✓
d. an ionic compound that is dissolved in water and does not dissociate into ions.
e. an ionic compound that is insoluble in water.

} Never covalent!

↑ must dissoc. to be an electrolyte (Note, this instance does not happen as ALL Ionics that dissolve also dissociate.

a 9. The covalent compound CH_3OH dissolves in water. When a molecule of it dissolves, I expect that it will:

a. remain intact as CH_3OH
b. remain intact (but gain an electron) as CH_3OH^-
c. dissociate into C^{+4}, H^{+1}, and O^{2-}
d. dissociate into CH_3^+ and OH^-
e. dissociate into C^{4+}, H^+, and OH^-

e 10. The ionic compound tin(IV) nitrate is soluble in water. When this compound dissolves in water, it will:

a. remain intact as $Sn(NO_3)_4$
b. remain intact as Sn_4NO_3
c. dissociate into Sn^{4+}, N^{3-}, and O^{2-}
d. dissociate into Sn, N, and O
e. dissociate into Sn^{4+} and NO_3^-

Problems: Work the following problems showing a logical progression of steps. Answers without work will not receive credit!

1. (5 Points) How many carbon atoms are there in .250 carat diamond? (Note: carats are a unit of mass used in the jewelry industry, and diamonds are a form of elemental carbon so all of the mass of a diamond is carbon.) 1 carat = 0.200g

$$.250 \text{ carat C}\left(\frac{.200 \text{ g C}}{1 \text{ carat}}\right)\left(\frac{1 \text{ mol C}}{12.01 \text{ g C}}\right)\left(\frac{6.02\times10^{23} \text{ atoms}}{1 \text{ mol C}}\right)$$

$$= 2.51\times10^{21} \text{ atoms C}$$

2. (10 Pts) How many grams of AgBr (MM= 187.77 g/mol) can be made from 12.36 g Ag?

$$12.36 \text{ g Ag}\left(\frac{1 \text{ mol Ag}}{107.87 \text{ g Ag}}\right)\left(\frac{1 \text{ mol AgBr}}{1 \text{ mol Ag}}\right)\left(\frac{187.77 \text{ g AgBr}}{1 \text{ mol AgBr}}\right)$$

$$= 21.52 \text{ g AgBr}$$

3. (5 Points) A compound has a mass percent of 46.89% for bromine. Calculate how many grams of bromine there are in a 6.304 g sample of the compound.

$$6.304 \text{ g Sample}\left(\frac{46.89 \text{ g Br}}{100 \text{ g sample}}\right) = 2.956 \text{ g Br}$$

Balance the following chemical equations. (5 Points Each) *You can leave blanks empty if the coefficient is 1.

1. $\underline{2}\ NO + \underline{2}\ CO \rightarrow \underline{\ \ }\ N_2 + \underline{2}\ CO_2$

2 x N 2
4 = 4 O 2 4
2 x C 2

2. $\underline{\ \ }\ Al_2S_3 + \underline{6}\ H_2O \rightarrow \underline{2}\ Al(OH)_3 + \underline{3}\ H_2S$

2 Al x 2
3 S x 3
12 = H = 12
6 x O = 6

3. Write (do not balance) the reaction that occurs when solid magnesium reacts with aqueous copper(I) nitrate to form aqueous magnesium nitrate and solid copper.

$$Mg(s) + CuNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + Cu(s)$$

Solubility Rules: Using your solubility rules, determine if the following are soluble or insoluble. (10 Points)

1. $Cu_3(PO_4)_2$ Insol	2. NH_4OH Sol
3. K_2CO_3 Sol	4. AgCl Insol
5. $CaSO_4$ Insol	

Precipitation Reactions: Write a chemical equation (doesn't have to be balanced, but must include phases) for the precipitation reaction that occurs (or "No Reaction" if none occurs) when the following pairs of reactants are mixed. (20 Points)

1. $BaBr_2(aq) + K_2SO_4(aq) \rightarrow$ $BaSO_4(s) + KBr(aq)$

Potential Products		Soluble or Insoluble	
$BaSO_4$	2	insol	2
KBr	2	sol	2

2. $NaC_2H_3O_2(aq) + Ag_2SO_4(aq) \rightarrow$ No RXN

Potential Products	Soluble or Insoluble
Na_2SO_4	sol
$AgC_2H_3O_2$	sol