

**Note: Do not return this handout when you turn in your exam. Instead, save it and use it when you are working homework problems. You will receive a fresh copy with additional equations and tables for the next exam.**

1 1A	hydrogen <b>H</b> 1.008	2 2A	helium <b>He</b> 4.003	3 3B	scandium <b>Sc</b> 44.96	4 4B	titanium <b>Ti</b> 47.88	5 5B	vanadium <b>V</b> 50.94	6 6B	chromium <b>Cr</b> 52.00	7 7B	manganese <b>Mn</b> 54.94	8	9	10	11	12	13 3A	boron <b>B</b> 10.81	14 4A	carbon <b>C</b> 12.01	15 5A	nitrogen <b>N</b> 14.01	16 6A	oxygen <b>O</b> 16.00	17 7A	hydrogen <b>H</b> 1.008	18 8A	helium <b>He</b> 4.003																			
19	potassium <b>K</b> 39.10	20	calcium <b>Ca</b> 40.08	21	scandium <b>Sc</b> 44.96	22	titanium <b>Ti</b> 47.88	23	vanadium <b>V</b> 50.94	24	chromium <b>Cr</b> 52.00	25	manganese <b>Mn</b> 54.94	26	iron <b>Fe</b> 55.85	27	cobalt <b>Co</b> 58.93	28	nickel <b>Ni</b> 58.69	29	copper <b>Cu</b> 63.55	30	zinc <b>Zn</b> 65.39	31	gallium <b>Ga</b> 69.72	32	germanium <b>Ge</b> 72.59	33	arsenic <b>As</b> 74.92	34	selenium <b>Se</b> 78.96	35	bromine <b>Br</b> 79.90	36	krypton <b>Kr</b> 83.80														
37	rubidium <b>Rb</b> 85.47	38	strontium <b>Sr</b> 87.62	39	yttrium <b>Y</b> 88.91	40	zirconium <b>Zr</b> 91.22	41	niobium <b>Nb</b> 92.91	42	molybdenum <b>Mo</b> 95.94	43	technetium <b>Tc</b> (98)	44	ruthenium <b>Ru</b> 101.1	45	rhodium <b>Rh</b> 102.9	46	palladium <b>Pd</b> 106.4	47	silver <b>Ag</b> 107.9	48	cadmium <b>Cd</b> 112.4	49	indium <b>In</b> 114.8	50	tin <b>Sn</b> 118.7	51	antimony <b>Sb</b> 121.8	52	tellurium <b>Te</b> 127.6	53	iodine <b>I</b> 126.9	54	xenon <b>Xe</b> 131.3														
55	cesium <b>Cs</b> 132.9	56	barium <b>Ba</b> 137.3	57	lanthanum <b>La</b> 138.9	72	hafnium <b>Hf</b> 178.5	73	tantalum <b>Ta</b> 180.9	74	tungsten <b>W</b> 183.8	75	rhenium <b>Re</b> 186.2	76	osmium <b>Os</b> 190.2	77	iridium <b>Ir</b> 192.2	78	platinum <b>Pt</b> 195.1	79	gold <b>Au</b> 197.0	80	mercury <b>Hg</b> 200.6	81	thallium <b>Tl</b> 204.4	82	lead <b>Pb</b> 207.2	83	bismuth <b>Bi</b> 209.0	84	polonium <b>Po</b> (210)	85	astatine <b>At</b> (210)	86	radon <b>Rn</b> (222)														
87	francium <b>Fr</b> (223)	88	radium <b>Ra</b> (226)	89	actinium <b>Ac</b> (227)	104	rutherfordium <b>Rf</b> (261)	105	dubnium <b>Db</b> (268)	106	seaborgium <b>Sg</b> (263)	107	bohrium <b>Bh</b> (262)	108	hassium <b>Hs</b> (265)	109	meitnerium <b>Mt</b> (266)	110	darmstadtium <b>Ds</b> (269)	111	roentgenium <b>Rg</b> (272)	112	copernicium <b>Cn</b> (285)	113	nihonium <b>Nh</b> (286)	114	flerovium <b>Fl</b> (289)	115	moscovium <b>Mc</b> (290)	116	livermorium <b>Lv</b> (293)	117	tennessine <b>Ts</b> (294)	118	oganesson <b>Og</b> (294)														
89	thorium <b>Th</b> 232.0	90	protactinium <b>Pa</b> 231.0	91	uranium <b>U</b> 238.0	92	neptunium <b>Np</b> (237)	93	plutonium <b>Pu</b> (244)	94	americium <b>Am</b> (243)	95	curium <b>Cm</b> (247)	96	berkelium <b>Bk</b> (247)	97	californium <b>Cf</b> (251)	98	einsteinium <b>Es</b> (252)	99	fermium <b>Fm</b> (257)	100	mendelevium <b>Md</b> (258)	101	nobelium <b>No</b> (259)	102	lawrencium <b>Lr</b> (261)	103	roentgenium <b>Rg</b> (261)	104	copernicium <b>Cn</b> (285)	105	nihonium <b>Nh</b> (286)	106	flerovium <b>Fl</b> (289)	107	moscovium <b>Mc</b> (290)	108	livermorium <b>Lv</b> (293)	109	tennessine <b>Ts</b> (294)	110	oganesson <b>Og</b> (294)						
101	praseodymium <b>Pr</b> 140.9	102	cerium <b>Ce</b> 140.1	103	neodymium <b>Nd</b> 144.2	60	neodymium <b>Nd</b> 144.2	61	promethium <b>Pm</b> (147)	62	samarium <b>Sm</b> 150.4	63	europium <b>Eu</b> 152.0	64	gadolinium <b>Gd</b> 157.3	65	terbium <b>Tb</b> 158.9	66	dysprosium <b>Dy</b> 162.5	67	holmium <b>Ho</b> 164.9	68	erbium <b>Er</b> 167.3	69	thulium <b>Tm</b> 168.9	70	ytterbium <b>Yb</b> 173.0	71	lutetium <b>Lu</b> 175.0	109	meitnerium <b>Mt</b> (269)	110	darmstadtium <b>Ds</b> (269)	111	roentgenium <b>Rg</b> (272)	112	copernicium <b>Cn</b> (285)	113	nihonium <b>Nh</b> (286)	114	flerovium <b>Fl</b> (289)	115	moscovium <b>Mc</b> (290)	116	livermorium <b>Lv</b> (293)	117	tennessine <b>Ts</b> (294)	118	oganesson <b>Og</b> (294)
105	actinium <b>Ac</b> (227)	106	thorium <b>Th</b> 232.0	107	protactinium <b>Pa</b> 231.0	108	uranium <b>U</b> 238.0	109	neptunium <b>Np</b> (237)	110	plutonium <b>Pu</b> (244)	111	americium <b>Am</b> (243)	112	curium <b>Cm</b> (247)	113	berkelium <b>Bk</b> (247)	114	californium <b>Cf</b> (251)	115	einsteinium <b>Es</b> (252)	116	fermium <b>Fm</b> (257)	117	mendelevium <b>Md</b> (258)	118	nobelium <b>No</b> (259)	119	lawrencium <b>Lr</b> (261)	120	roentgenium <b>Rg</b> (261)	121	copernicium <b>Cn</b> (285)	122	nihonium <b>Nh</b> (286)	123	flerovium <b>Fl</b> (289)	124	moscovium <b>Mc</b> (290)	125	livermorium <b>Lv</b> (293)	126	tennessine <b>Ts</b> (294)	127	oganesson <b>Og</b> (294)				

## Information Handout – Constants, Conversion Factors, Equations, and Other Data

### Physical Constants:

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1} \quad (\text{i.e. } 1 \text{ mol} = 6.022 \times 10^{23})$$

$$g \text{ (gravitational constant)} = 9.807 \text{ m/s}^2$$

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$c \text{ (speed of light)} = 2.998 \times 10^8 \text{ m/s}$$

$$R = 0.08206 \text{ (L}\cdot\text{atm)/(K}\cdot\text{mol)} = 8.314 \text{ J/(K}\cdot\text{mol)}$$

### Water:

$$\text{specific heat of water} = 4.184 \text{ J/(g}\cdot\text{K)}$$

$$\text{density of water} = 1.0 \text{ g/mL}$$

### Nomenclature Prefixes

Number	Prefix	Number	Prefix
1 (sometimes omitted)	mono-	6	hexa-
2	di-	7	hepta-
3	tri-	8	octa-
4	tetra-	9	nona-
5	penta-	10	deca-

Table 2.10

### Abbreviations and Prefixes:

amu atomic mass unit

lb pound

mi mile

in inch

ft foot

yd yard

min minute

hr hour

yr year

Prefix	Symbol	Factor	Example
femto	f	$10^{-15}$	1 femtosecond (fs) = $1 \times 10^{-15}$ s (0.000000000000001 s)
pico	p	$10^{-12}$	1 picometer (pm) = $1 \times 10^{-12}$ m (0.000000000001 m)
nano	n	$10^{-9}$	4 nanograms (ng) = $4 \times 10^{-9}$ g (0.000000004 g)
micro	$\mu$	$10^{-6}$	1 microliter ( $\mu$ L) = $1 \times 10^{-6}$ L (0.000001 L)
milli	m	$10^{-3}$	2 millimoles (mmol) = $2 \times 10^{-3}$ mol (0.002 mol)
centi	c	$10^{-2}$	7 centimeters (cm) = $7 \times 10^{-2}$ m (0.07 m)
deci	d	$10^{-1}$	1 deciliter (dL) = $1 \times 10^{-1}$ L (0.1 L)
kilo	k	$10^3$	1 kilometer (km) = $1 \times 10^3$ m (1000 m)
mega	M	$10^6$	3 megahertz (MHz) = $3 \times 10^6$ Hz (3,000,000 Hz)
giga	G	$10^9$	8 gigayears (Gyr) = $8 \times 10^9$ yr (8,000,000,000 Gyr)
tera	T	$10^{12}$	5 terawatts (TW) = $5 \times 10^{12}$ W (5,000,000,000,000 W)

### Conversion

#### Factors:

#### mass

$$1 \text{ lb} = 453.6 \text{ g}$$

$$1 \text{ amu} = 1.66 \times 10^{-24} \text{ g}$$

$$1 \text{ ton} = 2000 \text{ lb}$$

#### length

$$1 \text{ inch} = 2.54 \text{ cm (exact)}$$

$$1 \text{ yard} = 3 \text{ feet}$$

$$1 \text{ angstrom (\AA)} = 1 \times 10^{-10} \text{ m}$$

$$1 \text{ foot} = 12 \text{ inches}$$

$$1 \text{ mile} = 1.609 \text{ km}$$

#### volume

$$1 \text{ cm}^3 = 1 \text{ mL}$$

$$1 \text{ gallon} = 3.785 \text{ L}$$

$$1 \text{ m}^3 = 1000 \text{ L}$$

$$1 \text{ mL} = 0.033814 \text{ fl oz}$$

$$1 \text{ gallon} = 4 \text{ quarts} = 8 \text{ pints} = 16 \text{ cups} = 128 \text{ fl oz}$$

$$1 \text{ ft}^3 = 28.3168 \text{ L}$$

#### time

$$1 \text{ minute} = 60 \text{ seconds}$$

$$1 \text{ day} = 24 \text{ hours}$$

$$1 \text{ hour} = 60 \text{ minutes}$$

$$1 \text{ year} = 365.25 \text{ days}$$

#### pressure

$$760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm} = 1.01325 \text{ bar} = 101,325 \text{ Pa} = 101.325 \text{ kPa} = 14.73 \text{ psi absolute}$$

#### energy

$$1 \text{ cal} = 4.184 \text{ J (exact)}$$

$$1 \text{ food Calorie} = 1000 \text{ cal} = 1 \text{ kcal}$$

$$1 \text{ L}\cdot\text{atm} = 101.3 \text{ J}$$

**Selected Formulas and Equations:****unit definitions**

$$1 \text{ N} = 1 \text{ kg m s}^{-1}$$

$$1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$$

$$1 \text{ Pa} = 1 \text{ N m}^{-2} = 1 \text{ kg m}^{-1} \text{ s}^{-2}$$

**temperature conversions**

$$T (\text{in } ^\circ\text{F}) = \frac{9}{5} T (\text{in } ^\circ\text{C}) + 32$$

$$T (\text{in } ^\circ\text{C}) = \frac{5}{9} [T (\text{in } ^\circ\text{F}) - 32]$$

$$T (\text{in K}) = T (\text{in } ^\circ\text{C}) + 273.15$$

**equations for volume**

$$V_{\text{sphere}} = \frac{4}{3}\pi r^3$$

$$V_{\text{cube}} = s^3$$

$$V_{\text{cylinder}} = \pi r^2 h$$

$$V_{\text{box}} = lwh$$

$$V_{\text{cone}} = \frac{1}{3}\pi r^2 h$$

$$V = Ah$$

**miscellaneous conversion units**

$$1 \text{ warhol} = 15 \text{ minutes}$$

$$1 \text{ kardashian} = 72 \text{ days} = 6912 \text{ warhols}$$

**Figures and Tables****Properties of Subatomic Particles**

Name	Location	Charge (C)	Unit Charge	Mass (amu)	Mass (g)
electron	outside nucleus	$-1.602 \times 10^{-19}$	1-	0.00055	$0.00091 \times 10^{-24}$
proton	nucleus	$1.602 \times 10^{-19}$	1+	1.00727	$1.67262 \times 10^{-24}$
neutron	nucleus	0	0	1.00866	$1.67493 \times 10^{-24}$

**Table 2.2****Common Polyatomic Ions**

ammonium	$\text{NH}_4^+$
mercury(I)	$\text{Hg}_2^{2+}$
acetate	$\text{C}_2\text{H}_3\text{O}_2^-$
azide	$\text{N}_3^-$
cyanide	$\text{CN}^-$
hydroxide	$\text{OH}^-$
chlorate	$\text{ClO}_3^-$
bromate	$\text{BrO}_3^-$
iodate	$\text{IO}_3^-$
nitrate	$\text{NO}_3^-$
sulfate	$\text{SO}_4^{2-}$
thiosulfate	$\text{SO}_3\text{S}^{2-}$
phosphate	$\text{PO}_4^{3-}$
carbonate	$\text{CO}_3^{2-}$
chromate	$\text{CrO}_4^{2-}$
dichromate	$\text{Cr}_2\text{O}_7^{2-}$
manganate	$\text{MnO}_3^-$