

Chemistry 210 • Reference Information

Selected Densities

Metal	Density (g/cm ³)
Aluminum	2.702
Cadmium	8.65
Chromium	7.19
Cobalt	8.90
Copper	8.96
Gallium	5.907
Gold	19.32
Iron	7.874
Lead	11.35
Magnesium	1.738
Mercury	13.546
Nickel	8.90
Palladium	12.02
Silver	10.5
Tin	7.31
Titanium	4.54
Tungsten	19.35
Zinc	7.13
Zirconium	6.51

Metric Prefixes

Prefix	Symbol	Multiple
tera-	T	10 ¹²
giga-	G	10 ⁹
mega-	M	10 ⁶
kilo-	k	10 ³
hecto-	h	10 ²
deka-	dk	10 ¹
<base unit>		10 ⁰
deci-	d	10 ⁻¹
centi-	c	10 ⁻²
milli-	m	10 ⁻³
micro-	μ	10 ⁻⁶
nano-	n	10 ⁻⁹
pico-	p	10 ⁻¹²

Selected Polyatomic Ions

Ion name	Ion Formula
perchlorate	ClO ₄ ⁻
chlorate	ClO ₃ ⁻
chlorite	ClO ₂ ⁻
hypochlorite	ClO ⁻
carbonate	CO ₃ ²⁻
hydrogen carbonate (bicarbonate)	HCO ₃ ⁻
nitrate	NO ₃ ⁻
sulfate	SO ₄ ²⁻
phosphate	PO ₄ ³⁻
permanganate	MnO ₄ ⁻
bromate	BrO ₃ ⁻
iodate	IO ₃ ⁻

Selected acid names

Acid name	Acid Formula
Hydrochloric acid	HCl
Chloric acid	HClO ₃
Chlorous acid	HClO ₂

Selected Constants & Conversion Factors

$$N_A = 6.022 \times 10^{23}$$

$$\text{Absolute zero} = 0 \text{ K} = -273.15 \text{ }^{\circ}\text{C}$$

$$D_{H_2O} = 1.00 \text{ g/mL}$$

$$1.000 \text{ lb (pound)} = 453.6 \text{ g}$$

$$1 \text{ lb} = 16 \text{ oz (exact)}$$

$$1.000 \text{ mile} = 1.609 \text{ km}$$

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

$$1 \text{ ft} = 12 \text{ in (exact)}$$

$$1 \text{ gal} = 4 \text{ qt (exact)}$$

$$1.000 \text{ L} = 1.057 \text{ qt}$$

Selected Formulas

$$D = \frac{m}{V}$$

$$n = \frac{m}{M_m}$$

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

$$V_{\text{box}} = l \cdot w \cdot h = A \cdot h$$

$$V_{\text{sphere}} = \left(\frac{4}{3}\right) \pi r^3$$

$$\text{diameter} = 2 \cdot \text{radius}$$

$$\text{circumference} = \pi \cdot \text{diameter}$$

$$\text{average atomic mass} = \sum (\text{isotopic mass} \cdot \text{fractional abundance})$$

$$\% \text{ error} = \frac{|\text{experimental} - \text{actual}|}{\text{actual}} \times 100\%$$

Solutions

$$\text{Molarity} = [\text{solute}] = \frac{\text{moles of solute}}{\text{Liters of solution}} = M$$

$$\text{mass \%} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$$

$$M_1V_1 = M_2V_2$$

EM radiation and Hydrogen atom energy levels

$$c = \lambda\nu$$

$$E = h\nu$$

$$E = \frac{hc}{\lambda}$$

$$E_{\text{photon}} = |\Delta E|$$

$$E_n = -\frac{Rhc}{n^2}$$

$$\Delta E = -Rhc \left(\frac{1}{n_{\text{final}}^2} - \frac{1}{n_{\text{initial}}^2} \right)$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

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

$$Rhc = 2.18 \times 10^{-18} \text{ J}$$

Gas Laws

Assume all gases on the exam behave as ideal gases **unless otherwise stated**.

$$PV=nRT$$

$$P_{\text{total}} = P_1 + P_2 + P_3 + \dots + P_n$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{\text{rate}_a}{\text{rate}_b} = \frac{\sqrt{M_b}}{\sqrt{M_a}}$$

$$\text{Standard Temperature} = 0^\circ\text{C} = 273.15 \text{ K}$$

$$\text{Standard Pressure} = 1.000 \text{ atm} = 760.0 \text{ mmHg} = 101,300 \text{ Pa} = 101.3 \text{ kPa}$$

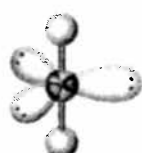
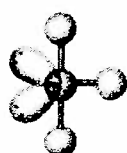
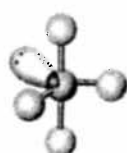
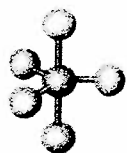
$$R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{K}\cdot\text{mol}} = 62.37 \frac{\text{L}\cdot\text{mmHg}}{\text{K}\cdot\text{mol}} = 8.314 \frac{\text{J}}{\text{K}\cdot\text{mol}}$$

H
2.1

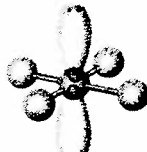
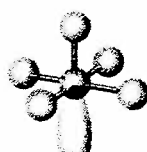
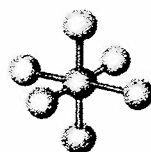
1A	2A	2.1										3A	4A	5A	6A	7A
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2	3B	4B	5B	6B	7B	8B			1B	2B	Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.8	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5
Cs 0.7	Ba 0.9	La 1.1	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2

Bond	Energy	Bond	Energy	Bond	Energy	Bond	Energy
Single Bonds							
H—H	432	N—H	391	Si—H	323	S—H	347
H—F	565	N—N	160	Si—Si	226	S—S	266
H—Cl	427	N—P	209	Si—O	368	S—F	327
H—Br	363	N—O	201	Si—S	226	S—Cl	271
H—I	295	N—F	272	Si—F	565	S—Br	218
		N—Cl	200	Si—Cl	381	S—I	~170
C—H	413	N—Br	243	Si—Br	310		
C—C	347	N—I	159	Si—I	234	F—F	159
C—Si	301					F—Cl	193
C—N	305	O—H	467	P—H	320	F—Br	212
C—O	358	O—P	351	P—Si	213	F—I	263
C—P	264	O—O	204	P—P	200	Cl—Cl	243
C—S	259	O—S	265	P—F	490	Cl—Br	215
C—F	453	O—F	190	P—Cl	331	Cl—I	208
C—Cl	339	O—Cl	203	P—Br	272	Br—Br	193
C—Br	276	O—Br	234	P—I	184	Br—I	175
C—I	216	O—I	234			I—I	151
Multiple Bonds							
C=C	614	N=N	418	C≡C	839	N≡N	945
C=N	615	N=O	607	C≡N	891	N≡O	631
C=O	745	O ₂	498	C=O	1070		

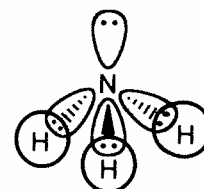
(799 in CO₂)



Structures for 5 or 6 electron regions on the central atom.



Example of an orbital overlap diagram:



Heat Constants & Equations

$$- q_{\text{system}} = q_{\text{surroundings}}$$

$$- q_{\text{lost}} = q_{\text{gained}}$$

$$q = mC_p\Delta T$$

$$q = (\text{heat capacity}) \cdot \Delta T$$

heat capacity may be abbreviated H_c

$$q_{\text{phase change}} = n\Delta H$$

$$\Delta H_{\text{reaction}} = \frac{q_{\text{reaction}}}{\text{mol}} \times \text{coefficient}$$

Specific Heat Capacity (H_2O)	$\text{J/g}\cdot^\circ\text{C}$
Solid	2.1
Liquid	4.184
Gas	2.0

Phase Changes (H_2O)	kJ/mol
ΔH_{fusion}	6.01
$\Delta H_{\text{vaporization}}$	40.7

ΔH°_f (in KJ/mol)

C(graphite)	0
C(diamond)	1.896
C(g)	715.0
CO(g)	-110.5
CO ₂ (g)	-393.5
CO ₂ (aq)	-412.9
CO ₃ ²⁻ (aq)	-676.26
HCO ₃ ⁻ (aq)	-691.11
H ₂ CO ₃ (aq)	-698.7
CH ₄ (g)	-74.87
C ₂ H ₂ (g)	227
C ₂ H ₄ (g)	52.47
C ₂ H ₆ (g)	-84.667
C ₃ H ₈ (g)	-105
C ₄ H ₁₀ (g)	-126
C ₆ H ₆ (l)	49.0
CH ₃ OH(g)	-201.2
CH ₃ OH(l)	-238.6
H ₂ O(g)	-241.826
H ₂ O(l)	-285.840
O ₂ (g)	0

SOLUBILITY CHART

Anions		Soluble (aq)	Precipitate (s)
NO_3^-	nitrate	Most cations	No common cations
$\text{C}_2\text{H}_3\text{O}_2^-$	acetate	Most cations	Ag^+
F^- Cl^- Br^- I^-	fluoride chloride bromide iodide	Most cations	Ag^+ , Pb^{2+} , Hg_2^{2+} , Ti^+
SO_4^{2-}	sulfate	Most cations	Ba^{2+} , Sr^{2+} , Pb^{2+} , Ag^+ , Ca^{2+}
CrO_4^{2-}	chromate	Most cations	Ba^{2+} , Sr^{2+} , Pb^{2+} , Ag^+
S^{2-} OH^- O^{2-}	sulfide hydroxide oxides	NH_4^+ , cations of columns 1 and 2	Most other cations
CO_3^{2-}	carbonate	NH_4^+ , cations of column 1, except Li^+	Most other cations
PO_4^{3-}	phosphate	NH_4^+ , cations of column 1, except Li^+	Most other cations

REACTIVITIES

METAL ⚡ NONMETAL

MOST Reactive

Lithium (Li)
Potassium (K)
Barium (Ba)
Calcium (Ca)
Sodium (Na)
Magnesium (Mg)
Aluminum (Al)

Manganese (Mn $\rightarrow$ Mn^{2+})

LEAST Reactive

Zinc (Zn)

Chromium (Cr $\rightarrow$ Cr^{3+})

Iron (Fe $\rightarrow$ Fe^{2+})

Cadmium (Cd)

Cobalt (Co $\rightarrow$ Co^{2+})

Nickel (Ni $\rightarrow$ Ni^{2+})

Tin (Sn $\rightarrow$ Sn^{2+})

Lead (Pb $\rightarrow$ Pb^{2+})

Hydrogen (H_2)

Copper (Cu $\rightarrow$ Cu^{2+})

Silver (Ag)

Mercury (Hg $\rightarrow$ Hg^+)

Platinum (Pt $\rightarrow$ Pt^{2+})

Gold (Au $\rightarrow$ Au^{3+})

LEAST Reactive

Note: All reactivities are for the most common ion formed. In the cases of elements that can form more than one ion, the ion indicated is the most common ion.

[illegible]