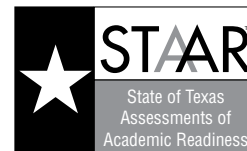


Chemistry

Administered May 2013

RELEASED

STAAR CHEMISTRY REFERENCE MATERIALS



ATOMIC STRUCTURE

Speed of light = (frequency)(wavelength)

$$c = f\lambda$$

Energy = (Planck's constant)(frequency)

$$E_{\text{photon}} = hf$$

Energy = $\frac{(\text{Planck's constant})(\text{speed of light})}{(\text{wavelength})}$

$$E_{\text{photon}} = \frac{hc}{\lambda}$$

BEHAVIOR OF GASES

Total pressure of a gas = $\left(\begin{array}{l} \text{sum of the partial pressures} \\ \text{of the component gases} \end{array} \right)$

$$P_T = P_1 + P_2 + P_3 + \dots$$

(Pressure)(volume) = (moles)(ideal gas constant)(temperature)

$$PV = nRT$$

$\frac{(\text{Initial pressure})(\text{initial volume})}{(\text{Initial moles})(\text{initial temperature})} = \frac{(\text{final pressure})(\text{final volume})}{(\text{final moles})(\text{final temperature})}$

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

(Initial pressure)(initial volume) = (final pressure)(final volume)

$$P_1V_1 = P_2V_2$$

$\frac{(\text{Initial volume})}{(\text{Initial temperature})} = \frac{(\text{final volume})}{(\text{final temperature})}$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$\frac{(\text{Initial volume})}{(\text{Initial moles})} = \frac{(\text{final volume})}{(\text{final moles})}$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

SOLUTIONS

Molarity = $\frac{\text{moles of solute}}{\text{liter of solution}}$

$$M = \frac{\text{mol}}{\text{L}}$$

Ionization constant of water = $\left(\begin{array}{l} \text{hydrogen ion} \\ \text{concentration} \end{array} \right) \left(\begin{array}{l} \text{hydroxide ion} \\ \text{concentration} \end{array} \right)$

$$K_w = [\text{H}^+][\text{OH}^-]$$

$\left(\begin{array}{l} \text{Volume of} \\ \text{solution 1} \end{array} \right) \left(\begin{array}{l} \text{molarity of} \\ \text{solution 1} \end{array} \right) = \left(\begin{array}{l} \text{volume of} \\ \text{solution 2} \end{array} \right) \left(\begin{array}{l} \text{molarity of} \\ \text{solution 2} \end{array} \right)$

$$V_1M_1 = V_2M_2$$

pH = -logarithm (hydrogen ion concentration)

$$\text{pH} = -\log[\text{H}^+]$$

THERMOCHEMISTRY

Heat gained or lost = (mass) $\left(\begin{array}{l} \text{specific} \\ \text{heat} \end{array} \right) \left(\begin{array}{l} \text{change in} \\ \text{temperature} \end{array} \right)$

$$Q = mc_p\Delta T$$

Enthalpy of reaction = $\left(\begin{array}{l} \text{enthalpy} \\ \text{of products} \end{array} \right) - \left(\begin{array}{l} \text{enthalpy} \\ \text{of reactants} \end{array} \right)$

$$\Delta H = \Delta H_f^\circ(\text{products}) - \Delta H_f^\circ(\text{reactants})$$

STAAR CHEMISTRY REFERENCE MATERIALS

OTHER FORMULAS

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

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

$$\text{Percent error} = \left(\frac{\text{accepted value} - \text{experimental value}}{\text{accepted value}} \right) (100)$$

$$\text{Percent yield} = \left(\frac{\text{actual yield}}{\text{theoretical yield}} \right) (100)$$

CONSTANTS AND CONVERSIONS

$$\text{Avogadro's number} = 6.02 \times 10^{23} \text{ particles per mole}$$

$$h = \text{Planck's constant} = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$c = \text{speed of light} = 3.00 \times 10^8 \frac{\text{m}}{\text{s}}$$

$$K_w = \text{ionization constant of water} = 1.00 \times 10^{-14} \left(\frac{\text{mol}}{\text{L}} \right)^2$$

$$\text{alpha particle } (\alpha) = {}_2^4\text{He} \quad \text{beta particle } (\beta) = {}_{-1}^0\text{e} \quad \text{neutron} = {}_0^1\text{n}$$

$$\text{standard temperature and pressure (STP)} = 0^\circ\text{C and 1 atm}$$

$$0^\circ\text{C} = 273 \text{ K}$$

$$\text{volume of ideal gas at STP} = 22.4 \frac{\text{L}}{\text{mol}}$$

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

$$1 \text{ atm} = 760 \text{ mm Hg} = 101.3 \text{ kPa}$$

$$R = \text{ideal gas constant} = 0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} = 8.31 \frac{\text{L} \cdot \text{kPa}}{\text{mol} \cdot \text{K}} = 62.4 \frac{\text{L} \cdot \text{mm Hg}}{\text{mol} \cdot \text{K}}$$


$$1 \text{ calorie (cal)} = 4.18 \text{ joules (J)}$$

$$1000 \text{ calories (cal)} = 1 \text{ Calorie (Cal)} = 1 \text{ kilocalorie (kcal)}$$

RULES FOR SIGNIFICANT FIGURES

1. Non-zero digits and zeros between non-zero digits are always significant.
2. Leading zeros are not significant.
3. Zeros to the right of all non-zero digits are only significant if a decimal point is shown.
4. For values written in scientific notation, the digits in the coefficient are significant.
5. In a common logarithm, there are as many digits after the decimal point as there are significant figures in the original number.

STAAR CHEMISTRY REFERENCE MATERIALS

POLYATOMIC IONS		ACTIVITY SERIES	
Acetate	$C_2H_3O_2^-$, CH_3COO^-	Soluble compounds contain $C_2H_3O_2^-$, CH_3COO^-	
Ammonium	NH_4^+	None	
Carbonate	CO_3^{2-}	None	
Chlorate	ClO_3^-	None	
Chlorite	ClO_2^-	None	
Chromate	CrO_4^{2-}	None	
Cyanide	CN^-	None	
Dichromate	$Cr_2O_7^{2-}$	Compounds of Ag^+ , Pb^{2+} , and Hg_2^{2+}	
Hydrogen carbonate	HCO_3^-	Compounds of Ag^+ , Pb^{2+} , and Hg_2^{2+}	
Hydroxide	OH^-	Compounds of Ag^+ , Pb^{2+} , and Hg_2^{2+}	
Hypochlorite	ClO^-	Compounds of Sr^{2+} , Ba^{2+} , Pb^{2+} , and Hg_2^{2+}	
Nitrate	NO_3^-	Common exceptions Compounds of NH_4^+ and the alkali metal cations	
Nitrite	NO_2^-	Compounds of NH_4^+ and the alkali metal cations	
Perchlorate	ClO_4^-	Compounds of NH_4^+ and the alkali metal cations	
Permanganate	MnO_4^-	Compounds of NH_4^+ and the alkali metal cations	
Phosphate	PO_4^{3-}	Compounds of NH_4^+ , the alkali metal cations, Ca^{2+} , Sr^{2+} , and Ba^{2+}	
Sulfate	SO_4^{2-}	Compounds of NH_4^+ , the alkali metal cations, Ca^{2+} , Sr^{2+} , and Ba^{2+}	
Sulfite	SO_3^{2-}	None	
		Insoluble compounds contain CO_3^{2-} PO_4^{3-} CrO_4^{2-} $Cr_2O_7^{2-}$ OH^- S^{2-}	
Metal			
Lithium			
Potassium			
Barium			
Calcium			
Sodium			
Magnesium			
Aluminum			
Manganese			
Zinc			
Chromium			
Iron			
Cobalt			
Nickel			
Tin			
Lead			
(Hydrogen)			
Copper			
Mercury			
Silver			
Platinum			
Gold			

STAAR CHEMISTRY REFERENCE MATERIALS

PERIODIC TABLE OF THE ELEMENTS

																		18 8A
																		2 He 4.003 Helium
																		9 F 18.998 Fluorine
																		10 Ne 20.180 Neon
																		17 7A
																		8 O 15.999 Oxygen
																		16 6A
																		7 N 14.007 Nitrogen
																		15 5A
																		6 C 12.011 Carbon
																		14 4A
																		5 B 10.812 Boron
																		13 3A
																		14 Si 28.086 Silicon
																		15 P 30.974 Phosphorus
																		16 S 32.066 Sulfur
																		17 Cl 35.453 Chlorine
																		18 Ar 39.948 Argon
																		36 Kr 83.798 Krypton
																		54 Xe 131.294 Xenon
																		86 Rn (222) Radon
																		53 I 126.904 Iodine
																		84 Po (209) Polonium
																		85 At (210) Astatine
																		83 Bi 208.980 Bismuth
																		82 Pb 207.2 Lead
																		81 Tl 204.383 Thallium
																		80 Hg 200.59 Mercury
																		79 Au 196.967 Gold
																		111 Rg (280) Roentgenium
																		110 Ds (281) Darmstadtium
																		109 Mt (276) Meitnerium
																		108 Hs (270) Hassium
																		107 Bh (272) Bohrium
																		106 Sg (271) Seaborgium
																		105 Db (268) Dubnium
																		104 Rf (267) Rutherfordium
																		103 Lr (262) Lawrencium
																		71 Lu 174.967 Lutetium
																		70 Yb 173.055 Ytterbium
																		69 Tm 168.934 Thulium
																		68 Er 167.259 Erbium
																		67 Ho 164.930 Holmium
																		66 Dy 162.500 Dysprosium
																		65 Tb 158.925 Terbium
																		64 Gd 157.25 Gadolinium
																		63 Eu 151.964 Europium
																		62 Sm 150.36 Samarium
																		61 Pm (145) Promethium
																		94 Pu (244) Plutonium
																		93 Np (237) Neptunium
																		92 U 238.029 Uranium
																		91 Pa 231.036 Protactinium
																		90 Th 232.038 Thorium
																		89 Ac (227) Actinium
																		88 Ra (226) Radium
																		87 Fr (223) Francium
																		85 At (210) Astatine
																		84 Po (209) Polonium
																		83 Bi 208.980 Bismuth
																		82 Pb 207.2 Lead
																		81 Tl 204.383 Thallium
																		80 Hg 200.59 Mercury
																		79 Au 196.967 Gold
																		78 Pt 195.085 Platinum
																		77 Ir 192.217 Iridium
																		76 Os 190.23 Osmium
																		75 Re 186.207 Rhenium
																		74 W 183.84 Tungsten
																		73 Ta 180.948 Tantalum
																		72 Hf 178.49 Hafnium
																		71 Lu 174.967 Lutetium
																		70 Yb 173.055 Ytterbium
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																		64 Gd 157.25 Gadolinium
																		63 Eu 151.964 Europium
																		62 Sm 150.36 Samarium
																		61 Pm (145) Promethium
																		60 Nd 144.242 Neodymium
																		59 Pr 140.908 Praseodymium
																		58 Ce 140.116 Cerium
																		57 La 138.905 Lanthanum
																		56 Ba 137.328 Barium
																		55 Cs 132.905 Cesium
																		54 Xe 131.294 Xenon
																		53 I 126.904 Iodine
																		52 Te 127.60 Tellurium
																		51 Sb 121.760 Antimony
																		50 Sn 118.711 Tin
																		49 In 114.818 Indium
																		48 Cd 112.412 Cadmium
																		47 Ag 107.868 Silver
																		46 Pd 106.42 Palladium
																		45 Rh 102.906 Rhodium
																		44 Ru 101.07 Ruthenium
																		43 Tc (98) Technetium
																		42 Mo 95.96 Molybdenum
																		41 Nb 92.906 Niobium
																		40 Zr 91.224 Zirconium
																		39 Y 88.906 Yttrium
																		38 Sr 87.62 Strontium
																		37 Rb 85.468 Rubidium
																		36 Kr 83.798 Krypton
																		35 Br 79.904 Bromine
																		34 Se 78.96 Selenium
																		33 As 74.922 Arsenic
																		32 Ge 72.64 Germanium
																		31 Ga 69.723 Gallium
																		30 Zn 65.38 Zinc
																		29 Cu 63.546 Copper
																		28 Ni 58.693 Nickel
																		27 Co 58.933 Cobalt
																		26 Fe 55.845 Iron
																		25 Mn 54.938 Manganese
																		24 Cr 51.996 Chromium
																		23 V 50.942 Vanadium
																		22 Ti 47.867 Titanium
																		21 Sc 44.956 Scandium
																		20 Ca 40.078 Calcium
																		19 K 39.098 Potassium
																		18 Ar 39.948 Argon
																		17 Cl 35.453 Chlorine
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																		7 N 14.007 Nitrogen
																		6 C 12.011 Carbon
																		5 B 10.812 Boron
																		4 Be 9.012 Beryllium
																		3 Li 6.941 Lithium
																		2 He 4.003 Helium
																		1 H 1.008 Hydrogen

Mass numbers in parentheses are those of the most stable or most common isotope.

Lanthanide Series

Actinide Series