

STAAR CHEMISTRY REFERENCE MATERIALS



ATOMIC STRUCTURE

$$\text{Speed of light} = (\text{frequency})(\text{wavelength})$$

$$c = f\lambda$$

$$\text{Energy} = (\text{Planck's constant})(\text{frequency})$$

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

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

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

BEHAVIOR OF GASES

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

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

$$(\text{Pressure})(\text{volume}) = (\text{moles})(\text{ideal gas constant})(\text{temperature})$$

$$PV = nRT$$

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

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

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

$$P_1V_1 = P_2V_2$$

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

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

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

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

SOLUTIONS

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

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

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

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

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

$$V_1M_1 = V_2M_2$$

$$\text{pH} = -\log(\text{hydrogen ion concentration})$$

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

THERMOCHEMISTRY

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

$$Q = mc_p\Delta T$$

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

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

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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.

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



