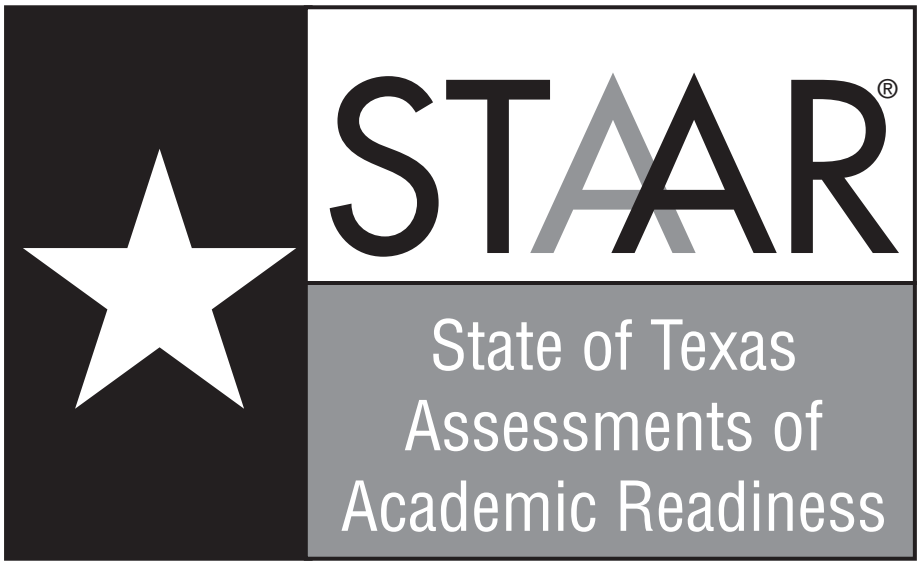


Chemistry

Administered May 2013

RELEASED

STAAR CHEMISTRY REFERENCE MATERIALS

ATOMIC STRUCTURE

Speed of light = (frequency)(wavelength) $c = f\lambda$

Energy = (Planck's constant)(frequency) $E_{photon} = hf$

$$\text{Energy} = \frac{(\text{Planck's constant})(\text{speed of light})}{(\text{wavelength})} \qquad E_{photon} = \frac{hc}{\lambda}$$

BEHAVIOR OF GASES

$$\text{Total pressure of a gas} = \begin{pmatrix}\text{sum of the partial pressures}\\ \text{of the component gases}\end{pmatrix} \qquad P_T = P_1 + P_2 + P_3 + \ \ldots$$

(Pressure)(volume) = (moles)(ideal gas constant)(temperature) $PV = nRT$

$$\frac{(\text{Initial pressure})(\text{initial volume})}{(\text{Initial moles})(\text{initial temperature})} = \frac{(\text{final pressure})(\text{final volume})}{(\text{final moles})(\text{final temperature})} \qquad \frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

(Initial pressure)(initial volume) = (final pressure)(final volume) $P_1V_1 = P_2V_2$

$$\frac{(\text{Initial volume})}{(\text{Initial temperature})} = \frac{(\text{final volume})}{(\text{final temperature})} \qquad \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{(\text{Initial volume})}{(\text{Initial moles})} = \frac{(\text{final volume})}{(\text{final moles})} \qquad \frac{V_1}{n_1} = \frac{V_2}{n_2}$$

SOLUTIONS

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liter of solution}} \qquad M = \frac{\text{mol}}{\text{L}}$$

$$\text{Ionization constant of water} = \begin{pmatrix}\text{hydrogen ion}\\ \text{concentration}\end{pmatrix}\begin{pmatrix}\text{hydroxide ion}\\ \text{concentration}\end{pmatrix} \qquad K_w = [H^+][OH^-]$$

$$\begin{pmatrix}\text{Volume of}\\ \text{solution 1}\end{pmatrix}\begin{pmatrix}\text{molarity of}\\ \text{solution 1}\end{pmatrix} = \begin{pmatrix}\text{volume of}\\ \text{solution 2}\end{pmatrix}\begin{pmatrix}\text{molarity of}\\ \text{solution 2}\end{pmatrix} \qquad V_1M_1 = V_2M_2$$

pH = –logarithm (hydrogen ion concentration) $pH = -\log[H^+]$

THERMOCHEMISTRY

$$\text{Heat gained or lost} = (\text{mass})\begin{pmatrix}\text{specific}\\ \text{heat}\end{pmatrix}\begin{pmatrix}\text{change in}\\ \text{temperature}\end{pmatrix} \qquad Q = mc_p\Delta T$$

$$\begin{matrix}\text{Enthalpy of}\\ \text{reaction}\end{matrix} = \begin{pmatrix}\text{enthalpy}\\ \text{of products}\end{pmatrix} - \begin{pmatrix}\text{enthalpy}\\ \text{of reactants}\end{pmatrix} \qquad \Delta H = \Delta H_f^o(\text{products}) - \Delta H_f^o(\text{reactants})$$

STAAR CHEMISTRY REFERENCE MATERIALS

OTHER FORMULAS

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \qquad D = \frac{m}{V}$$

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

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

CONSTANTS AND CONVERSIONS

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

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

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

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

alpha particle $(\alpha) = {}^{4}_{2}\text{He}$ beta particle $(\beta) = {}^{0}_{-1}\text{e}$ neutron $= {}^{1}_{0}\text{n}$

standard temperature and pressure (STP) = 0°C and 1 atm

0°C = 273 K

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

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

1 atm = 760 mm Hg = 101.3 kPa

R = 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 calorie (cal) = 4.18 joules (J)

1000 calories (cal) = 1 Calorie (Cal) = 1 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

Acetate	$C_2H_3O_2^-$, CH_3COO^-
Ammonium	NH_4^+
Carbonate	CO_3^{2-}
Chlorate	ClO_3^-
Chlorite	ClO_2^-
Chromate	CrO_4^{2-}
Cyanide	CN^-
Dichromate	$Cr_2O_7^{2-}$
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Hypochlorite	ClO^-
Nitrate	NO_3^-
Nitrite	NO_2^-
Perchlorate	ClO_4^-
Permanganate	MnO_4^-
Phosphate	PO_4^{3-}
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

Solubility Rules

Soluble compounds contain	**Common exceptions**
$C_2H_3O_2^-$, CH_3COO^-	None
NH_4^+	None
NO_3^-	None
CN^-	None
ClO^-	None
ClO_2^-	None
ClO_3^-	None
ClO_4^-	None
Br^-	Compounds of Ag^+, Pb^{2+}, and Hg_2^{2+}
Cl^-	Compounds of Ag^+, Pb^{2+}, and Hg_2^{2+}
I^-	Compounds of Ag^+, Pb^{2+}, and Hg_2^{2+}
SO_4^{2-}	Compounds of Sr^{2+}, Ba^{2+}, Pb^{2+}, and Hg_2^{2+}

Insoluble compounds contain	**Common exceptions**
CO_3^{2-}	Compounds of NH_4^+ and the alkali metal cations
PO_4^{3-}	Compounds of NH_4^+ and the alkali metal cations
CrO_4^{2-}	Compounds of NH_4^+ and the alkali metal cations
$Cr_2O_7^{2-}$	Compounds of NH_4^+ and the alkali metal cations
OH^-	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}
S^{2-}	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}

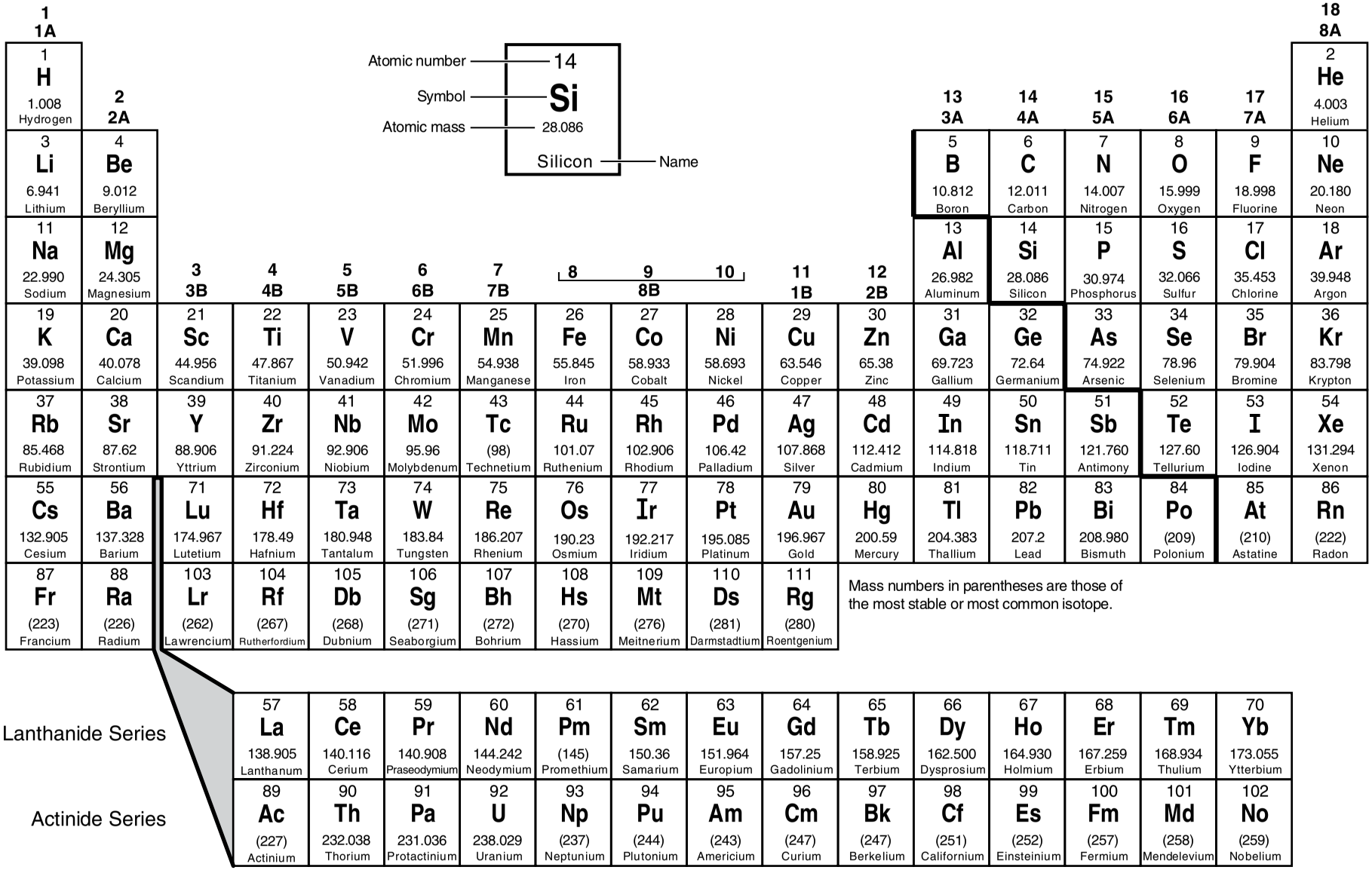
ACTIVITY SERIES

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



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