SCH3U Formula and Data Sheet · Grade 11 Chemistry

ONTARIO CURRICULUM

Scientific Investigation Skills and Career Exploration

SCIENTIFIC NOTATION	$a \times 10^{n}, \quad 1 \le \lvert a \rvert < 10$ Every digit of a is significant.
PERCENT ERROR	$\%\ \text{error} = \dfrac{\lvert \text{experimental} - \text{accepted} \rvert}{\text{accepted}} \times 100\%$

Matter, Chemical Trends, and Chemical Bonding

MASS NUMBER	$A = \text{protons} + \text{neutrons}$ The atomic number Z is the number of protons.
AVERAGE ATOMIC MASS	$\bar{m} = \sum(\text{isotope mass} \times \text{fractional abundance})$
ELECTRONEGATIVITY DIFFERENCE	$\Delta EN = \lvert EN_1 - EN_2 \rvert$ Roughly: above 1.7 ionic, 0.5 to 1.7 polar covalent, below 0.5 non-polar covalent.

Chemical Reactions

SYNTHESIS	$\mathrm{A + B \longrightarrow AB}$
DECOMPOSITION	$\mathrm{AB \longrightarrow A + B}$
SINGLE DISPLACEMENT	$\mathrm{A + BC \longrightarrow AC + B}$ Only if A is above B on the activity series.
DOUBLE DISPLACEMENT	$\mathrm{AB + CD \longrightarrow AD + CB}$ Goes when a product is a precipitate, a gas or water.
COMPLETE COMBUSTION	$\mathrm{C_xH_y + O_2 \longrightarrow CO_2 + H_2O}$
METAL OXIDE IN WATER	$\mathrm{Na_2O + H_2O \longrightarrow 2\,NaOH}$ Makes a base.
NON-METAL OXIDE IN WATER	$\mathrm{CO_2 + H_2O \longrightarrow H_2CO_3}$ Makes an acid.

Quantities in Chemical Reactions

AMOUNT FROM MASS	$n = \dfrac{m}{M}$
NUMBER OF PARTICLES	$N = nN_A$
MOLE RATIO	$n_{\mathrm{B}} = n_{\mathrm{A}} \times \dfrac{b}{a}$ For $a\mathrm{A} \rightarrow b\mathrm{B}$, from the balanced equation.
PERCENT COMPOSITION	$\%\ \text{element} = \dfrac{m_{\text{element}}}{m_{\text{compound}}} \times 100\%$
PERCENTAGE YIELD	$\%\ \text{yield} = \dfrac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$
MOLECULAR FORMULA	$\text{multiple} = \dfrac{M_{\text{molecular}}}{M_{\text{empirical}}}$

Solutions and Solubility

MOLAR CONCENTRATION	$c = \dfrac{n}{V}$ V in litres; mol/L is written M.
DILUTION	$c_1V_1 = c_2V_2$
PARTS PER MILLION	$\text{ppm} = \dfrac{m_{\text{solute}}}{m_{\text{solution}}} \times 10^{6}$
PERCENT CONCENTRATION	$\%\,(m/V) = \dfrac{m_{\text{solute}}\ (\mathrm{g})}{V_{\text{solution}}\ (\mathrm{mL})} \times 100\%$
NEUTRALIZATION	$\text{acid} + \text{base} \longrightarrow \text{salt} + \text{water}$ At the endpoint, moles of acid and base match the equation's ratio.

Gases and Atmospheric Chemistry

KELVIN TEMPERATURE	$T(\mathrm{K}) = T(^{\circ}\mathrm{C}) + 273.15$
BOYLE'S LAW	$P_1V_1 = P_2V_2$ Constant T and n.
CHARLES' LAW	$\dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$ Constant P and n.
GAY-LUSSAC'S LAW	$\dfrac{P_1}{T_1} = \dfrac{P_2}{T_2}$ Constant V and n.
COMBINED GAS LAW	$\dfrac{P_1V_1}{T_1} = \dfrac{P_2V_2}{T_2}$
IDEAL GAS LAW	$PV = nRT$
MOLAR VOLUME	$n = \dfrac{V}{V_m}$ V_m = 22.4 L/mol at STP, 24.8 L/mol at SATP.
DALTON'S LAW	$P_{\text{total}} = P_1 + P_2 + P_3 + \ldots$

Constants

Constant	Value
Avogadro constant	$N_A = 6.022 \times 10^{23}\ \mathrm{mol^{-1}}$
Gas constant	$R = 8.314\ \mathrm{kPa{\cdot}L/(mol{\cdot}K)}$
STP	$0\ ^{\circ}\mathrm{C}$ and 101.325 kPa, $V_m = 22.4\ \mathrm{L/mol}$
SATP	$25\ ^{\circ}\mathrm{C}$ and 100 kPa, $V_m = 24.8\ \mathrm{L/mol}$
Pressure	$1\ \mathrm{atm} = 101.325\ \mathrm{kPa} = 760\ \mathrm{mmHg}$

The molar volumes are RT/P at each condition.

Metric Prefixes

Prefix	Factor	Prefix	Factor
kilo- (k)	10^{3}	milli- (m)	10^{-3}
hecto- (h)	10^{2}	micro- (μ)	10^{-6}
deca- (da)	10^{1}	nano- (n)	10^{-9}
deci- (d)	10^{-1}	pico- (p)	10^{-12}
centi- (c)	10^{-2}	mega- (M)	10^{6}

Significant Figures

Rule	Example
Non-zero digits count	4.56 has 3
Zeros between digits count	1.007 has 4
Leading zeros do not count	0.0032 has 2
Trailing zeros count after a decimal point	2.50 has 3
Multiply or divide: keep the fewest significant figures	$2.5 \times 3.14 = 7.9$
Add or subtract: keep the fewest decimal places	$12.1 + 0.25 = 12.4$

Solubility Rules (in Water)

Compounds containing	Solubility	Exceptions
$\mathrm{NH_4^+}$ and group 1 cations: $\mathrm{Li^+}$, $\mathrm{Na^+}$, $\mathrm{K^+}$, $\mathrm{Rb^+}$, $\mathrm{Cs^+}$	soluble	none
$\mathrm{Cl^-}$, $\mathrm{Br^-}$, $\mathrm{I^-}$	soluble	with $\mathrm{Ag^+}$, $\mathrm{Hg_2^{2+}}$, $\mathrm{Pb^{2+}}$
$\mathrm{F^-}$	soluble	with group 2 cations, $\mathrm{Pb^{2+}}$, $\mathrm{Fe^{3+}}$
$\mathrm{C_2H_3O_2^-}$, $\mathrm{HCO_3^-}$, $\mathrm{NO_3^-}$, $\mathrm{ClO_3^-}$	soluble	none
$\mathrm{SO_4^{2-}}$	soluble	with $\mathrm{Ag^+}$, $\mathrm{Ba^{2+}}$, $\mathrm{Ca^{2+}}$, $\mathrm{Hg_2^{2+}}$, $\mathrm{Pb^{2+}}$, $\mathrm{Sr^{2+}}$
$\mathrm{CO_3^{2-}}$, $\mathrm{CrO_4^{2-}}$, $\mathrm{PO_4^{3-}}$, $\mathrm{S^{2-}}$	insoluble	with group 1 cations and $\mathrm{NH_4^+}$
$\mathrm{OH^-}$	insoluble	with group 1 cations and $\mathrm{Ba^{2+}}$

Activity Series of Metals

Most active to least active
Li, K, Ba, Ca, Na, Mg, Al, Zn, Cr, Fe, Ni, Sn, Pb, (H), Cu, Ag, Au

Ordered by standard reduction potential. A metal displaces any metal below it from a solution of its ions; one above H displaces hydrogen from an acid.

Common Polyatomic Ions

Ion	Name	Ion	Name
$\mathrm{NH_4^+}$	ammonium	$\mathrm{H_3O^+}$	hydronium
$\mathrm{OH^-}$	hydroxide	$\mathrm{CN^-}$	cyanide
$\mathrm{NO_3^-}$	nitrate	$\mathrm{NO_2^-}$	nitrite
$\mathrm{SO_4^{2-}}$	sulfate	$\mathrm{SO_3^{2-}}$	sulfite
$\mathrm{HSO_4^-}$	hydrogen sulfate	$\mathrm{HCO_3^-}$	hydrogen carbonate
$\mathrm{CO_3^{2-}}$	carbonate	$\mathrm{PO_4^{3-}}$	phosphate
$\mathrm{ClO_3^-}$	chlorate	$\mathrm{ClO_4^-}$	perchlorate
$\mathrm{C_2H_3O_2^-}$	acetate	$\mathrm{MnO_4^-}$	permanganate
$\mathrm{CrO_4^{2-}}$	chromate	$\mathrm{Cr_2O_7^{2-}}$	dichromate

Periodic Trends

Property	Across a period (left to right)	Down a group
Atomic radius	decreases	increases
Ionization energy	increases	decreases
Electronegativity	increases	decreases
Electron affinity	increases	decreases
Metallic character	decreases	increases

Noble gases are left out of the electronegativity and electron affinity trends.

Molar Masses (g/mol)

Element	M	Element	M	Element	M
H	1.0080	Al	26.982	Fe	55.845
He	4.0026	Si	28.085	Cu	63.546
Li	6.94	P	30.974	Zn	65.38
C	12.011	S	32.06	Br	79.904
N	14.007	Cl	35.45	Ag	107.87
O	15.999	K	39.098	Sn	118.71
F	18.998	Ca	40.078	I	126.90
Na	22.990	Cr	51.996	Ba	137.33
Mg	24.305	Mn	54.938	Pb	207.2

Sources, read November 24, 2026: OpenStax, Chemistry 2e, 4.2 Classifying Chemical Reactions, Table 4.1 (solubility rules); OpenStax, Chemistry 2e, Appendix L: Standard Electrode (Half-Cell) Potentials (activity series order); CIAAW, Abridged Standard Atomic Weights 2024; NIST, CODATA Fundamental Physical Constants.