# Massachusetts Comprehensive Assessment System
## Chemistry Formula and Constants Sheet

### Common Polyatomic Ions

| Ion | Ionic Formula |
|---|---|
| **Ammonium** | $NH_4^+$ |
| **Carbonate** | $CO_3^{2-}$ |
| **Hydroxide** | $OH^-$ |
| **Nitrate** | $NO_3^-$ |
| **Phosphate** | $PO_4^{3-}$ |
| **Sulfate** | $SO_4^{2-}$ |

**Combined Gas Law:** $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

**Ideal Gas Law:** $PV = nRT$

**Absolute Temperature Conversion:** $K = °C + 273$

**Moles of Solute:** $M_1V_1 = M_2V_2$

**Definition of pH:** $pH = -\log[H_3O^+] = -\log[H^+]$

**Molar Volume of Ideal Gas at STP:** 22.4 L/mol

**Ideal Gas Constant:** $R = 0.0821\ L \cdot atm/mol \cdot K = 8.31\ L \cdot kPa/mol \cdot K$

**Avogadro's Number:** $6.02 \times 10^{23}$ particles/mol

**STP:** 1 atm (101.3 kPa), 273 K (0°C)

### Nuclear Symbols

| Name | Symbol |
|---|---|
| **Alpha particle** | $\alpha$ or ${}_2^4He$ |
| **Beta particle** | $\beta$ or ${}_{-1}^0e$ |
| **Gamma ray** | $\gamma$ |
| **Neutron** | ${}_0^1n$ |

MASSACHUSETTS DEPARTMENT OF EDUCATION
MCAS
MASSACHUSETTS COMPREHENSIVE ASSESSMENT SYSTEM

# Massachusetts Comprehensive Assessment System

## *Periodic Table of the Elements*

| Period | Group (Family) 1A / 1 | 2A / 2 | 3B / 3 | 4B / 4 | 5B / 5 | 6B / 6 | 7B / 7 | 8B / 8 | 8B / 9 | 8B / 10 | 1B / 11 | 2B / 12 | 3A / 13 | 4A / 14 | 5A / 15 | 6A / 16 | 7A / 17 | 8A / 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00794 H 1 Hydrogen | | | | | | | | | | | | | | | | | 4.00260 He 2 Helium |
| 2 | 6.941 Li 3 Lithium | 9.01218 Be 4 Beryllium | | | | | | | | | | | 10.81 B 5 Boron | 12.0111 C 6 Carbon | 14.0067 N 7 Nitrogen | 15.9994 O 8 Oxygen | 18.998403 F 9 Fluorine | 20.179 Ne 10 Neon |
| 3 | 22.98977 Na 11 Sodium | 24.305 Mg 12 Magnesium | | | | | | | | | | | 26.98154 Al 13 Aluminum | 28.0855 Si 14 Silicon | 30.97376 P 15 Phosphorus | 32.06 S 16 Sulfur | 35.453 Cl 17 Chlorine | 39.948 Ar 18 Argon |
| 4 | 39.0983 K 19 Potassium | 40.08 Ca 20 Calcium | 44.9559 Sc 21 Scandium | 47.88 Ti 22 Titanium | 50.9415 V 23 Vanadium | 51.996 Cr 24 Chromium | 54.9380 Mn 25 Manganese | 55.847 Fe 26 Iron | 58.9332 Co 27 Cobalt | 58.69 Ni 28 Nickel | 63.546 Cu 29 Copper | 65.39 Zn 30 Zinc | 69.72 Ga 31 Gallium | 72.59 Ge 32 Germanium | 74.9216 As 33 Arsenic | 78.96 Se 34 Selenium | 79.904 Br 35 Bromine | 83.80 Kr 36 Krypton |
| 5 | 85.4678 Rb 37 Rubidium | 87.62 Sr 38 Strontium | 88.9059 Y 39 Yttrium | 91.224 Zr 40 Zirconium | 92.9064 Nb 41 Niobium | 95.94 Mo 42 Molybdenum | (98) Tc 43 Technetium | 101.07 Ru 44 Ruthenium | 102.906 Rh 45 Rhodium | 106.42 Pd 46 Palladium | 107.868 Ag 47 Silver | 112.41 Cd 48 Cadmium | 114.82 In 49 Indium | 118.71 Sn 50 Tin | 121.75 Sb 51 Antimony | 127.60 Te 52 Tellurium | 126.905 I 53 Iodine | 131.29 Xe 54 Xenon |
| 6 | 132.905 Cs 55 Cesium | 137.33 Ba 56 Barium | 138.906 La 57 Lanthanum | 178.49 Hf 72 Hafnium | 180.948 Ta 73 Tantalum | 183.85 W 74 Tungsten | 186.207 Re 75 Rhenium | 190.2 Os 76 Osmium | 192.22 Ir 77 Iridium | 195.08 Pt 78 Platinum | 196.967 Au 79 Gold | 200.59 Hg 80 Mercury | 204.383 Tl 81 Thallium | 207.2 Pb 82 Lead | 208.980 Bi 83 Bismuth | (209) Po 84 Polonium | (210) At 85 Astatine | (222) Rn 86 Radon |
| 7 | (223) Fr 87 Francium | 226.025 Ra 88 Radium | 227.028 Ac 89 Actinium | (261) Rf* 104 Rutherfordium | (262) Db 105 Dubnium | (263) Sg 106 Seaborgium | (262) Bh 107 Bohrium | (265) Hs 108 Hassium | (266?) Mt 109 Meitnerium | (269?) 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 |

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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lanthanide Series | 140.12 Ce 58 Cerium | 140.908 Pr 59 Praseodymium | 144.24 Nd 60 Neodymium | (145) Pm 61 Promethium | 150.36 Sm 62 Samarium | 151.96 Eu 63 Europium | 157.25 Gd 64 Gadolinium | 158.925 Tb 65 Terbium | 162.50 Dy 66 Dysprosium | 164.930 Ho 67 Holmium | 167.26 Er 68 Erbium | 168.934 Tm 69 Thulium | 173.04 Yb 70 Ytterbium | 174.967 Lu 71 Lutetium |
| Actinide Series | 232.038 Th 90 Thorium | 231.036 Pa 91 Protactinium | 238.029 U 92 Uranium | 237.048 Np 93 Neptunium | (244) Pu 94 Plutonium | (243) Am 95 Americium | (247) Cm 96 Curium | (247) Bk 97 Berkelium | (251) Cf 98 Californium | (252) Es 99 Einsteinium | (257) Fm 100 Fermium | (258) Md 101 Mendelevium | (259) No 102 Nobelium | (260) Lr 103 Lawrencium |