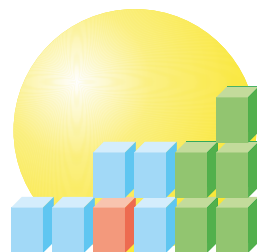




**PHYSICAL CONSTANTS**

Absolute zero ..... -273.15 °C  
 Avogadro constant .....  $6.022\ 140\ 857 \cdot 10^{23}\ \text{mol}^{-1}$   
 Base of natural logarithms ..... 2.718 281 828...  
 Electronvolt .....  $1.602\ 176\ 6208 \cdot 10^{-19}\ \text{J}$   
 Faraday constant .....  $96\ 485.332\ 89\ \text{C mol}^{-1}$   
 Constant of gravitation .....  $6.674\ 08 \cdot 10^{-11}\ \text{Nm}^2\ \text{kg}^{-2}$   
 Molar volume of ideal gas .....  $0.022\ 710\ 947\ \text{m}^3\ \text{mol}^{-1}$   
 Elementary charge .....  $1.602\ 176\ 6208 \cdot 10^{-19}\ \text{C}$   
 Standard pressure ..... 101 325 Pa  
 Molar gas constant .....  $8.314\ 4598\ \text{J mol}^{-1}\ \text{K}^{-1}$   
 Pi ..... 3.141 592 653 589 793...  
 Planck constants .....  $6.626\ 070\ 040 \cdot 10^{-34}\ \text{J s}$



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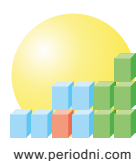
**GUIDELINES FOR BALANCING REDOX EQUATIONS**

- Write a skeleton equation
  - Separate the redox reaction into half-reactions
    - Assign oxidation numbers for each atom
    - Identify and write out all redox couples in reaction
    - Combine these redox couples into two half-reactions
  - Balance the atoms in each half reaction
    - Balance all other atoms except H and O
    - Balance the oxygen atoms with H<sub>2</sub>O
    - Balance the hydrogen atoms with H<sup>+</sup>
    - In a basic medium, add one OH<sup>-</sup> to each side for every H<sup>+</sup> ion
  - Balance the charge with e<sup>-</sup>
  - Make electron gain equivalent to electron loss in the half-reactions
  - Add the half-reactions together
  - Simplify the equation
- Finally, check that the elements and charges are balanced

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**PERIODIC TABLE OF THE ELEMENTS**

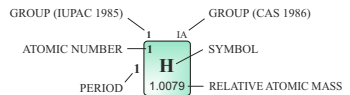
1 1 1 H 1.0079	2 2 2 He 4.0026																														
3 3 3 Li 6.941	4 4 4 Be 9.0122											5 5 5 B 10.811	6 6 6 C 12.011	7 7 7 N 14.007	8 8 8 O 15.999	9 9 9 F 18.998	10 10 10 Ne 20.180														
11 3 3 Na 22.990	12 4 4 Mg 24.305											13 13 13 Al 26.982	14 14 14 Si 28.086	15 15 15 P 30.974	16 16 16 S 32.065	17 17 17 Cl 35.453	18 18 18 Ar 39.948														
19 4 4 K 39.098	20 4 4 Ca 40.078											21 4 4 Sc 44.956	22 4 4 Ti 47.867	23 5 5 V 50.942	24 5 5 Cr 51.996	25 5 5 Mn 54.938	26 5 5 Fe 55.845	27 5 5 Co 58.933	28 5 5 Ni 58.693	29 5 5 Cu 63.546	30 5 5 Zn 65.38	31 5 5 Ga 69.723	32 5 5 Ge 72.64	33 5 5 As 74.922	34 5 5 Se 78.96	35 5 5 Br 79.904	36 5 5 Kr 83.798				
37 5 5 Rb 85.468	38 5 5 Sr 87.62											39 5 5 Y 88.906	40 5 5 Zr 91.224	41 5 5 Nb 92.906	42 5 5 Mo 95.96	43 5 5 Tc (98)	44 5 5 Ru 101.07	45 5 5 Rh 102.91	46 5 5 Pd 106.42	47 5 5 Ag 107.87	48 5 5 Cd 112.41	49 5 5 In 114.82	50 5 5 Sn 118.71	51 5 5 Sb 121.76	52 5 5 Te 127.60	53 5 5 I 126.90	54 5 5 Xe 131.29				
55 6 6 Cs 132.91	56 6 6 Ba 137.33	57 6 6 La 138.91	58 6 6 Ce 140.12	59 6 6 Pr 140.91	60 6 6 Nd 144.24	61 6 6 Pm (145)	62 6 6 Sm 150.36	63 6 6 Eu 151.96	64 6 6 Gd 157.25	65 6 6 Tb 158.93	66 6 6 Dy 162.50	67 6 6 Ho 164.93	68 6 6 Er 167.26	69 6 6 Tm 168.93	70 6 6 Yb 173.05	71 6 6 Lu 174.97	72 6 6 Hf 178.49	73 6 6 Ta 180.95	74 6 6 W 183.84	75 6 6 Re 186.21	76 6 6 Os 190.23	77 6 6 Ir 192.22	78 6 6 Pt 195.08	79 6 6 Au 196.97	80 6 6 Hg 200.59	81 6 6 Tl 204.38	82 6 6 Pb 207.2	83 6 6 Bi 208.98	84 6 6 Po (209)	85 6 6 At (210)	86 6 6 Rn (222)
87 7 7 Fr (223)	88 7 7 Ra (226)	89 7 7 Ac (227)	90 7 7 Th 232.04	91 7 7 Pa 231.04	92 7 7 U 238.03	93 7 7 Np (237)	94 7 7 Pu (244)	95 7 7 Am (243)	96 7 7 Cm (247)	97 7 7 Bk (247)	98 7 7 Cf (251)	99 7 7 Es (252)	100 7 7 Fm (257)	101 7 7 Md (258)	102 7 7 No (259)	103 7 7 Lr (262)	104 7 7 Rf (267)	105 7 7 Db (268)	106 7 7 Sg (271)	107 7 7 Bh (272)	108 7 7 Hs (277)	109 7 7 Mt (276)	110 7 7 Ds (281)	111 7 7 Rg (280)	112 7 7 Cn (285)	113 7 7 Nh (285)	114 7 7 Fl (287)	115 7 7 Mc (289)	116 7 7 Lv (291)	117 7 7 Ts (294)	118 7 7 Og (294)



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<span style="color:blue">■</span> Metal	<span style="color:red">■</span> Semimetal	<span style="color:green">■</span> Nonmetal
<span style="color:blue">■</span> Alkali metal	<span style="color:yellow">■</span> Chalcogens element	<span style="color:green">■</span> Halogens element
<span style="color:blue">■</span> Alkaline earth metal	<span style="color:green">■</span> Halogens element	<span style="color:green">■</span> Noble gas
<span style="color:blue">■</span> Transition metals	<span style="color:purple">■</span> Lanthanide	<span style="color:purple">■</span> Actinide

STANDARD STATE (25 °C; 101 kPa)  
 Ne - gas    Fe - solid  
 Hg - liquid    Tc - synthetic



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Print out and then use scissors or a hobby knife to carefully cut out the shapes. Fold the cut-out bookmark in half on the dotted line so that the two sides match and then glue.