The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Albany, New York 12234

REFERENCE TABLES FOR PHYSICS

LIST OF PHYSICAL CONSTANTS

Name	*Symbol*	*Value(s)*
Gravitational constant	G	6.7×10^{-11} N•m^2/kg^2
Acceleration due to gravity (up to 16 km altitude)	g	9.8 m/s^2
Speed of light in a vacuum	c	3.0×10^8 m/s
Speed of sound at STP		3.3×10^2 m/s
Mass-energy relationship		1 u (amu) = 9.3×10^2 MeV
Mass of the Earth		6.0×10^{24} kg
Mass of the Moon		7.4×10^{22} kg
Mean radius of the Earth		6.4×10^6 m
Mean radius of the Moon		1.7×10^6 m
Mean distance from Earth to Moon		3.8×10^8 m
Electrostatic constant	k	9.0×10^9 N•m^2/C^2
Charge of the electron (1 elementary charge)		1.6×10^{-19} C
One coulomb	C	6.3×10^{18} elementary charges
Electronvolt	eV	1.6×10^{-19} J
Planck's constant	h	6.6×10^{-34} J•s
Rest mass of the electron	m_e	9.1×10^{-31} kg
Rest mass of the proton	m_p	1.7×10^{-27} kg
Rest mass of the neutron	m_n	1.7×10^{-27} kg

ABSOLUTE INDICES OF REFRACTION

($\lambda = 5.9 \times 10^{-7}$ m)

Air	1.00
Alcohol	1.36
Canada Balsam	1.53
Corn Oil	1.47
Diamond	2.42
Glass, Crown	1.52
Glass, Flint	1.61
Glycerol	1.47
Lucite	1.50
Quartz, Fused	1.46
Water	1.33

WAVELENGTHS OF LIGHT IN A VACUUM

Violet	$4.0 - 4.2 \times 10^{-7}$ m
Blue	$4.2 - 4.9 \times 10^{-7}$ m
Green	$4.9 - 5.7 \times 10^{-7}$ m
Yellow	$5.7 - 5.9 \times 10^{-7}$ m
Orange	$5.9 - 6.5 \times 10^{-7}$ m
Red	$6.5 - 7.0 \times 10^{-7}$ m

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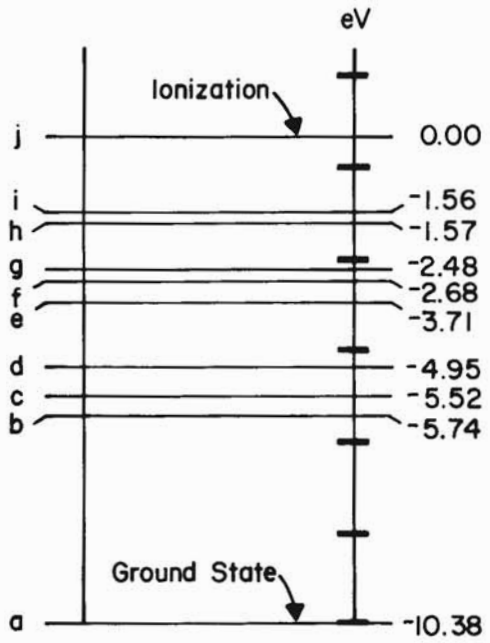
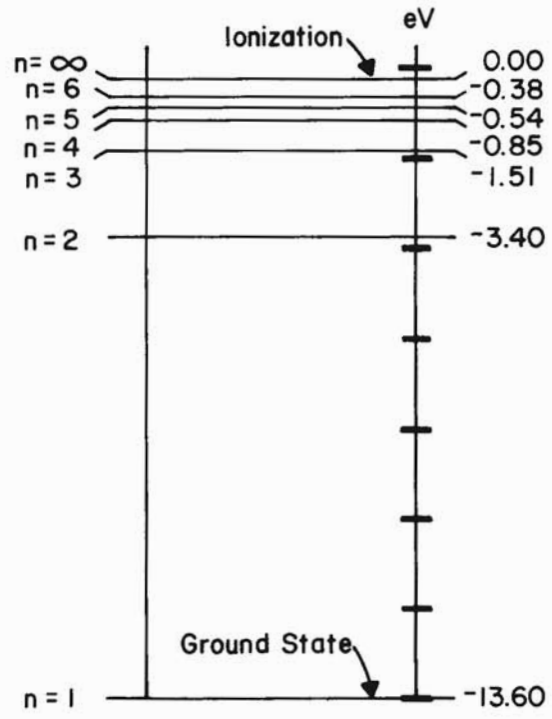
HEAT CONSTANTS

	Specific Heat (average) (kJ/kg•C°)	*Melting Point* (°C)	*Boiling Point* (°C)	*Heat of Fusion* (kJ/kg)	*Heat of Vaporization* (kJ/kg)
Alcohol (ethyl)	2.43 (liq.)	−117	79	109	855
Aluminum	0.90 (sol.)	660	2467	396	10500
Ammonia	4.71 (liq.)	−78	−33	332	1370
Copper	0.39 (sol.)	1083	2567	205	4790
Iron	0.45 (sol.)	1535	2750	267	6290
Lead	0.13 (sol.)	328	1740	25	866
Mercury	0.14 (liq.)	−39	357	11	295
Platinum	0.13 (sol.)	1772	3827	101	229
Silver	0.24 (sol.)	962	2212	105	2370
Tungsten	0.13 (sol.)	3410	5660	192	4350
Water (ice)	2.05 (sol.)	0	—	334	—
Water (water)	4.19 (liq.)	—	100	—	2260
Water (steam)	2.01 (gas)	—	—	—	—
Zinc	0.39 (sol.)	420	907	113	1770

ENERGY LEVEL DIAGRAMS FOR MERCURY AND HYDROGEN



A few energy levels for the mercury atom

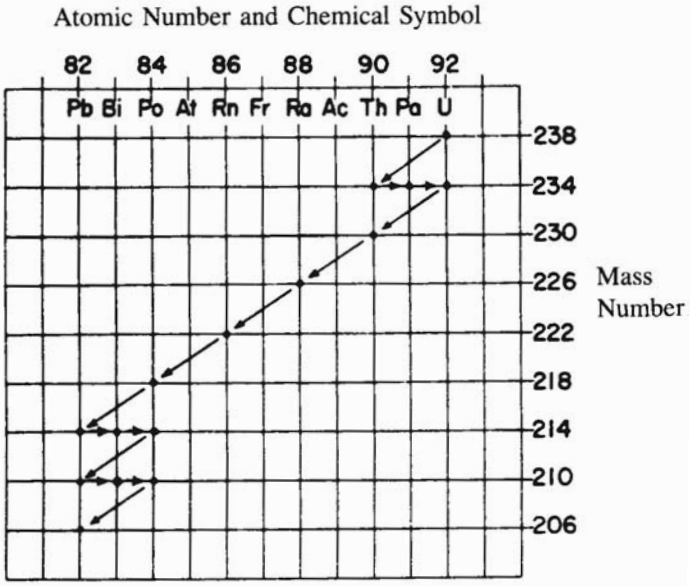


Energy levels for the hydrogen atom

VALUES OF TRIGONOMETRIC FUNCTIONS

Angle	Sine	Cosine	Angle	Sine	Cosine
1°	.0175	.9998	46°	.7193	.6947
2°	.0349	.9994	47°	.7314	.6820
3°	.0523	.9986	48°	.7431	.6691
4°	.0698	.9976	49°	.7547	.6561
5°	.0872	.9962	50°	.7660	.6428
6°	.1045	.9945	51°	.7771	.6293
7°	.1219	.9925	52°	.7880	.6157
8°	.1392	.9903	53°	.7986	.6018
9°	.1564	.9877	54°	.8090	.5878
10°	.1736	.9848	55°	.8192	.5736
11°	.1908	.9816	56°	.8290	.5592
12°	.2079	.9781	57°	.8387	.5446
13°	.2250	.9744	58°	.8480	.5299
14°	.2419	.9703	59°	.8572	.5150
15°	.2588	.9659	60°	.8660	.5000
16°	.2756	.9613	61°	.8746	.4848
17°	.2924	.9563	62°	.8829	.4695
18°	.3090	.9511	63°	.8910	.4540
19°	.3256	.9455	64°	.8988	.4384
20°	.3420	.9397	65°	.9063	.4226
21°	.3584	.9336	66°	.9135	.4067
22°	.3746	.9272	67°	.9205	.3907
23°	.3907	.9205	68°	.9272	.3746
24°	.4067	.9135	69°	.9336	.3584
25°	.4226	.9063	70°	.9397	.3420
26°	.4384	.8988	71°	.9455	.3256
27°	.4540	.8910	72°	.9511	.3090
28°	.4695	.8829	73°	.9563	.2924
29°	.4848	.8746	74°	.9613	.2756
30°	.5000	.8660	75°	.9659	.2588
31°	.5150	.8572	76°	.9703	.2419
32°	.5299	.8480	77°	.9744	.2250
33°	.5446	.8387	78°	.9781	.2079
34°	.5592	.8290	79°	.9816	.1908
35°	.5736	.8192	80°	.9848	.1736
36°	.5878	.8090	81°	.9877	.1564
37°	.6018	.7986	82°	.9903	.1392
38°	.6157	.7880	83°	.9925	.1219
39°	.6293	.7771	84°	.9945	.1045
40°	.6428	.7660	85°	.9962	.0872
41°	.6561	.7547	86°	.9976	.0698
42°	.6691	.7431	87°	.9986	.0523
43°	.6820	.7314	88°	.9994	.0349
44°	.6947	.7193	89°	.9998	.0175
45°	.7071	.7071	90°	1.0000	.0000

URANIUM DISINTEGRATION SERIES



SUMMARY OF EQUATIONS

MECHANICS

$$\bar{v} = \frac{\Delta s}{\Delta t}$$

$$\bar{v} = \frac{v_f + v_i}{2}$$

$$\bar{a} = \frac{\Delta v}{\Delta t}$$

$$\Delta s = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$$

$$v_f^2 = v_i^2 + 2a\Delta s$$

$$F = ma$$

$$w = mg$$

$$F = \frac{Gm_1 m_2}{r^2}$$

$$p = mv$$

$$J = F\Delta t$$

$$F\Delta t = m\Delta v$$

a = acceleration
r = distance between centers
F = force
g = acceleration due to gravity
G = universal gravitation constant
J = impulse
m = mass
p = momentum
Δs = displacement
t = time
v = velocity
w = weight

ENERGY

$$W = F\Delta s$$

$$P = \frac{W}{\Delta t} = \frac{F\Delta s}{\Delta t} = F\bar{v}$$

$$\Delta \text{PE} = mg\Delta h$$

$$\text{KE} = \frac{1}{2} mv^2$$

$$F = kx$$

$$\text{PE}_s = \frac{1}{2} kx^2$$

F = force
g = acceleration due to gravity
h = height
k = spring constant
KE = kinetic energy
m = mass
P = power
PE = potential energy
PE_s = potential energy stored in a spring
Δs = displacement
t = time
v = velocity
W = work
x = change in spring length from the equilibrium position

ELECTRICITY AND MAGNETISM

$$F = \frac{kq_1 q_2}{r^2}$$

$$E = \frac{F}{q}$$

$$V = \frac{W}{q}$$

$$E = \frac{V}{d}$$

$$I = \frac{\Delta q}{\Delta t}$$

$$R = \frac{V}{I}$$

$$P = VI = I^2 R = \frac{V^2}{R}$$

$$W = Pt = VIt = I^2 Rt$$

d = separation of parallel plates
r = distance between centers
E = electric field intensity
F = force
I = current
k = electrostatic constant
ℓ = length of conductor
P = power
q = charge
R = resistance
t = time
V = electric potential difference
W = energy

Series Circuits:

$$I_t = I_1 = I_2 = I_3 = \ldots$$

$$V_t = V_1 + V_2 + V_3 + \ldots$$

$$R_t = R_1 + R_2 + R_3 + \ldots$$

Parallel Circuits:

$$I_t = I_1 + I_2 + I_3 + \ldots$$

$$V_t = V_1 = V_2 = V_3 = \ldots$$

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

INTERNAL ENERGY

$$Q = mc\Delta T_c$$

$$Q_f = mH_f$$

$$Q_v = mH_v$$

c = specific heat
H_f = heat of fusion
H_v = heat of vaporization
m = mass
Q = amount of heat
T_c = Celsius temperature

WAVE PHENOMENA

$T = \frac{1}{f}$

$v = f\lambda$

$n = \frac{c}{v}$

$\sin \theta_c = \frac{1}{n}$

$n_1 \sin \theta_1 = n_2 \sin \theta_2$

$n_1 v_1 = n_2 v_2$

$\frac{\lambda}{d} = \frac{x}{L}$

c = speed of light in a vacuum
d = distance between slits
f = frequency
L = distance from slit to screen
n = index of absolute refraction
T = period
v = speed
x = distance from central maximum to first-order maximum
λ = wavelength
θ = angle
θ_c = critical angle of incidence relative to air

ELECTROMAGNETIC APPLICATIONS

$F = qvB$

$\frac{N_p}{N_s} = \frac{V_p}{V_s}$

$V_p I_p = V_s I_s$ (ideal)

% Efficiency = $\frac{V_s I_s}{V_p I_p} \times 100$

$V = B\ell v$

B = flux density
F = force
I_p = current in primary coil
I_s = current in secondary coil
N_p = number of turns of primary coil
N_s = number of turns of secondary coil
q = charge
v = velocity
V_p = voltage of primary coil
V_s = voltage of secondary coil
ℓ = length of conductor
V = electric potential difference

MODERN PHYSICS

$W_o = hf_o$

$E_{photon} = hf$

$KE_{max} = hf - W_o$

$p = \frac{h}{\lambda}$

$E_{photon} = E_i - E_f$

c = speed of light in a vacuum
E = energy
f = frequency
f_o = threshold frequency
h = Planck's constant
KE = kinetic energy
p = momentum
W_o = work function
λ = wavelength

MOTION IN A PLANE

$v_{iy} = v_i \sin \theta$

$v_{ix} = v_i \cos \theta$

$a_c = \frac{v^2}{r}$

$F_c = \frac{mv^2}{r}$

a_c = centripetal acceleration
F_c = centripetal force
m = mass
r = radius
v = velocity
θ = angle

GEOMETRIC OPTICS

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$\frac{S_o}{S_i} = \frac{d_o}{d_i}$

d_i = image distance
d_o = object distance
f = focal length
S_i = image size
S_o = object size

NUCLEAR ENERGY

$E = mc^2$

$m_f = \frac{m_i}{2^n}$

c = speed of light in a vacuum
E = energy
m = mass
n = number of half-lives