Andrew Howard's Memory Book:
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frank.harvard.edu/~howard/memory.html
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Units/Conversions/Constants:
length/area/volume
1 ly = 0.946 $\times 10^{18}$ cm
1 pc = 3.2616 ly = 206,000 AU
1 AU=1.5$\times 10^{13}$cm=499 light-sec=23.5 R_e
1 day = 86,400 s; 1 yr = 3.156$\times 10^7$ s
1 mi^2=640 acres;acre=(208 ft)^2=43560 ft^2
1 mag = 4 dB
Constants
c = 2.998 $\times 10^8$m s^{-1}
h = 6.626 $\times 10^{-34}$J s
G = 6.672 $\times 10^{-11}$ N m^2 kg^{-2}
e^- = 1.602 $\times 10^{-19}$ C
m_e = 9.109 $\times 10^{-31}$ kg
N_A = 6.022 $\times 10^{23}$
σ = 5.67 $\times 10^{-8}$ W m^{-2} K^{-4}
k = 1.381$\times 10^{-23} JK^{-1} \approx$ 1eV/10^4K
$V_{gas}O^\circ$ = 22.41 l mol^{-1}
energy/power
1 amu = 9.31 MeV = 1.66 $\times 10^{-24}$ g
1 Jansky = 10^{-26} W m^{-2} Hz^{-1}
eV = 1.602 $\times 10^{-19}$ J
cal = 4.184 J
1 BTU = 1.06 kJ $\approx$ 1 kJ
1 HP = 0.746 kW $\approx$ 1 kW $\approx$ 1 BTU/sec

Math:
Amazing: $e^{i\pi} = -1$; $\exp(\pi\sqrt{163}) =$ 262537412640076874 3.999999999999
$\frac{1}{\pi} = \frac{\sqrt{8}}{99^2}\sum_{n=0}\frac{(4n)!\cdot(1103+26390n)}{(n!)^4\cdot 396^{(4n)}}$
Ramanujan; accurate to $5 \times 10^{-8(n+1)}$
$\pi = \sum \frac{1}{16^k}[\frac{4}{8k+1} + \frac{2}{8k+4} - \frac{1}{8k+5} - \frac{1}{8k+6}]$
take diff. of terms for π digits
Goldbach's conjecture: every even integer greater than 2 is the sum of two primes.
circle math: for 4 mutally tangent circles (4 configs), the curvatures (1/r, line=0) obey $a^2+b^2+c^2+d^2 = 1/2(a+b+c+d)^2$.
also, given a,b,c: $d_1 + d_2 = 2(a + b + c)$
if centers have coords $z_j = x_j + y_j i$,
$(z_a a)^2 + (z_b b)^2 + (z_c c)^2 + (z_d d)^2 = 1/2(z_a a + z_b b + z_c c + z_d d)^2$
also, $z_{d_1} d_1 + z_{d_2} d_2 = 2(z_a a + z_b b + z_c c)$
high dim: $\sum_{j=1}^{n+2} b_j^2 = \frac{1}{n}(\sum_{j=1}^{n+2} b_j)^2$.
cube sums: $1729{=}1^3 + 12^3 = 9^3 + 10^3$;
$4104{=}2^3 + 16^3 = 9^3 + 15^3$
Wavelets localized in both t and f.
FFT & DWT=rotations in function space.
$\chi^2 \equiv \sum(O_n - \mu)^2/\sigma^2 = \sum(O_n - E_n)^2/E_n$
Poisson: $P_\mu(n) = e^{-\mu}\mu^n/n!$
Godel, Escher, Bach:
There exist formal systems whose negative space (set of nontheorems) is not the positive space of any formal system.
∞ primes: $N! + 1$ has prime factors $> N$, let $N \to \infty$ (Euclid)

Astronomy/Astrophysics:
solar neutrinos at Earth: 6 $\times 10^{10}$/m^2-sec
cosmic-ray muons:
$L_\odot$ = 3.8 $\times 10^{33}$ erg/s = 3.8 $\times 10^{26}$ W
$M_\odot$ = 2.0 $\times 10^{33}$ g
$\rho_c = 3H^2/8\pi G$
black hole has no B, vs neutron star
more stars than grains of sand
Universe age = 14.0 $\pm$ 0.5 Gy
4.5% matt; 30% dark matt; 65% dark en
for all λ's $\geq$ 1 mm, the Earth receives more energy from CMB than Sun
n_{star}=3$\times 10^{-58}$$m^{-3}$=$10^{10}$$Mpc^{-3}$
10^{20}+ eV cosmic rays produce Cerenkov rad. (radio) off of moon limbs
$10^{20}\gamma$/s/m^2 from Sun 1AU
High-E cosmic-rays (neutrinos) might create μscopic black holes in atmosphere if there are extra dimensions.
M_{planck} ~TeV $\approx$ COM energy
6 $\times 10^6$ solar neutrinos/s thru thumb nail
7$\times 10^{22}$ stars

Earth:
$m = 6.0 \times 10^{27}$ kg = 81.3 moons
r = 6378 km; vol = 10^{12} km^3
area = 1.5(land) + 3.6(ocean) $\times 10^{18}$ cm^2
horizon=3.9 km$\sqrt{h_m}$ = 120 mi (10k ft)
oceans 3.6 km = mean depth
3.6$\times 10^5$ km coastlines
solar E-M flux at Earth: 1.4 kW/m^2
V_{orbit} = 29.8 km/s
air: $<l> \approx 10^{-5}$ cm; $<v> \approx 5 \times 10^4$ cm/s
$\rho_{air} = 1.3 \times 10^{-3}$ g cm^{-3}
1 ATM=1.013 bar=760 torr=101.325 kPa
gas collision rate = 1 GHz at 1 atm
rock = 55-60% oxygen
El Nino: 6° ΔT EW Pacific; Δh = 1 meter
Synch orbit: 36k km; 12 hr = 20k

Mars:
r=1.3-1.6AU;d=6780km$\approx \frac{d_E}{2}$;$A_M \approx A_{E-lnd}$
year = 687 days; 'sol' = 24h37m
ϕ=25°, 13-47° in 10^7 y (small moons)
Southern summers hotter b/c eccentricity
$-100^oC < T < +17^o$ C, T_{avg} = -60°C
Permafrost down to ~40° lat.
Atmosphere: 95% CO_2, 2.7% N_2, 1.6% Ar, 0.13% O_2. P $\approx$ 5.6 mb < $10^{-2} \times P_E$
Little internal heat–no convective flow, most surface 3.5 Gya
Olympus Mons–27 km (600 km wide)
H_2O–equiv depth =10-10^4m (prob 10^2m)
B_M=400nT$\approx$1/75B_E on (10km)^2 patchs

Solar System:

	orbit. dist. (AU)	Period (dys/yrs) sider.	syn.	ecc-entr-icity	inclin. orb	rot	albedo
M	00.387	087.97d	116d	0.206	7.0	0.0	0.11
V	00.723	224.70	584	0.007	3.4	-2.5	0.65
E	01.000	365.24		0.017	0.0	23.4	0.37
M	01.524	686.98	780	0.093	1.8	25.2	0.15
J	05.203	011.86y	399	0.048	1.3	3.1	0.52
S	09.539	029.42	378	0.056	2.5	26.7	0.47
U	19.182	083.75	370	0.047	0.8	97.9	0.51
N	30.058	163.72	367	0.009	1.8	29.6	0.41
P	39.439	248.02	366	0.250	17.2	94	0.5?

	Equal Diam km	Obl-lateness	Mass E=1	per. g/cm^3	grv E=1	Esc spd k/s	Rotn Per (d)
S	1.39E6	0	3.3E5	1.41	27.9	618	25-35
M	3.48E3	0	1.2E-2	3.34	0.17	2.4	27.3
M	4.88E3	0	5.5E-2	5.34	0.38	4.3	59.3
V	1.21E4	0	8.2E-1	5.24	0.91	10.4	243
E	1.27E4	1/298	1.0E0	5.52	1.00	11.2	0.99
M	6.79E3	1/193	1.1E-1	3.94	0.38	5.0	1.03
J	1.43E5	1/15	3.2E2	1.33	2.54	59.6	0.41
S	1.20E5	1/9	9.5E1	0.70	1.08	35.6	0.44
U	5.12E4	1/45	1.5E1	1.30	0.91	21.3	0.72
N	4.86E4	1/40	1.7E1	1.76	1.19	23.8	0.77
P	2.30E3	0?	2.4E-3	1.1?	1.2?	1.2?	6.39

Chip Design:
photodiode/LED = rev/forw biased P-N
1mA/μm to avoid e^- migration
0.5-0.6 $\mu\Omega$/sqr
delay = rcl^2 [$r = R/l$; $c = C/l$]
TSMC 0.25μm:
poly over active: 6fF/μm^2, 0.6-0.7fF/μm
metal-metal: ~6-45 aF/μm^2
I_{SS}(short) = 587,-254μA/μm
0.07 Ω/sqr (0.03 Ω/sqr – m5)
t_{ox} = 57 angstroms
R_{via}: ~ 2.5 Ω per metal-metal

Mechanics:
linear expansion = 2 $\times 10^{-5}$
density: Cu 8.95; Al 2.7; Au 19.3; Ni 8.9;
tens: steel 32-80 kg/mm^2; SiCrMn 155
sound: v= $\sqrt{g\rho/r}$ = 331 m/s
Young modulus carbon nanotube 4000 Gpa

E & M/Optics:
gain = $4\pi A/\lambda^2$
1 sqr meter radiates 6 $\times 10^{-8} T^4$ W
Bands: P 225-390 MHz
L 390-1550 MHz (L = 1 GHz)
S 1.55-5.2 GHz (S = 5 GHz)
S 5.2-10.9 GHz (X = 10 GHz)
S 10.9-36 GHz (K = 3K exp)
S 36-46 GHz; V 46-56 GHz
S 56-100 GHz
1 amp-day = 1 mole = 6 $\times 10^{23}$
polished gold 99% refl from red to 10.6μ
Solid state PM to 26μ Si:As 10°K Rockwell
neon reradiates ultraviolet
I(PSF) = |FT(pupil)|^2 (diff-lim tele)
lightning rods dissipate mirror charge

Chemistry:
$H_2O + CO_2 = CH_2O + O_2$ - 5.4 eV
$H_2 + \frac{1}{2}O_2 = H_2O + 2.5$ eV
$C + O_2 = CO_2 + 4.1$ eV
$C_{H_2O}0^\circ$ = 4218 J/kg/K
$L_{H_2O}0^\circ$ = 3.34 $\times 10^5$ J/kg

Nuclear:
1Ci/$km^2 \Leftrightarrow$100mrem/yr (^{137}Cs,MeV emit)
^{99}Tc used in bone scan
n background: 10^{-2}–10^{-3} cm^2/sec
γ background @ MeV: 10^{-4}/cm^2/keV
1 rad = 100 erg/gm; 1 MegaRad = 2°
range (g/cm^2) @ 1 MeV: e^- $\approx$ 0.4; p$\approx$ 0.002; α(5 MeV) $\approx$ 0.003;
range in air at (0.1, 1, 10 MeV):
e^-: (13cm, 4m, 40m)
p: (1.5mm, 2cm, 1m)
α: (1mm, 5mm, 10cm)
c-ray μ = 2X rad from body decay (K,etc.)
boron stops n, passes γ (Z=5)
Bi passes n (34 mb), stops γ (Z=83)
$\mu/\rho \approx$ 0.07 cm^2/g @ 1 MeV light elements
$\propto 1/\sqrt{E}$ from 0.1 to 10 MeV
D+T gives 17.6 MeV

Scattering:
full moon backscatter = 10X half moon

Arms Control:
1 gm fission = 1 MegaWatt day
1 MTon throws 1 Mton of dirt
energy content [kCal/gm]: CH_4=13;
kersosene =11; "high explosive"=1-1.2;
gasoline=10; choc chip cookies=5.2
6 PSI destroys buildings
rockets: $m_0/m = exp(-v/v_0)$. Isp = v_0/g
eff = $(v/v_0)^2 exp(-v/v_0)$
bal range = g Isp^2 $\ln(2m_0/m_f)$
= 250 km for Isp = 250 s, u = 2.5 km/s
fire: diffusion flames (no premix), laminar propagation (0.5 m/s hydrocarbons)
deflagration wave: accel. by turbulence
detonation wave
~2000 nuclear tests ever; 911 in Nevada
total nuke cost = 5.5 T$
25% US electricity in 50's for U sep

Energy:
1 "Sun-day" = 1.5 $\times 10^{22}$ J
human daily consumption = 31k kcal/day
(mostly fossil fuels), US avg = 6X
Light bulb eff'cy (tungsten) = 2%
"good" windmills – $0.03/kW-h total
Xcel (MN): 453 turb., 304 MW, 10^5 homes
organic solal panel: 10% eff (Si = 20%)
$0.20/W ($0.40/W, $4.00/W for f.f., Si)
energy consumption: richest fifth-58%,
poorest fifth-4%, USA-25%
world energy use [10^{15} joules] (1997):
oil=135, nat gas=95,renewable
(mostly wood)=85, nuclear=25
US consume/yr: 1970-2000=30-40$\times 10^{15}$ J
Transport [MJ/pass-km]: Autos=2.77,
light trucks=2.69, motorcylcles=1.60,
bus=0.40, air=3.49, rail=1.62, all=2.35
Frght[MJ/tonne-km] Rail=0.35,Truck=1.36
photosynthesis=10^{16}W;humans=2$\times 10^{12}$W

Exercise	kcal/100kg/hr	(kcal/100lb/hr)
Biking 13 mph	594	(270)
Biking 15 mph	647	(294)
Biking 17 mph	752	(342)
Biking 18 mph	1003	(456)
Rowing "vigorously"	1280	(582)
Running 5 mph (12)	805	(366)
Running 6 mph (10)	977	(444)
Running 10 mph (6)	1504	(684)
Swimming 20 yd/min	422	(192)
Swimming 45 yd/min	767	(348)
Swimming 50 yd/min	924	(420)

Batteries:
Fuel cell 300 Whr/kg=1/4 kCal/g=1kJ/g
Lead acid 30 Whr/kg = 100 J/g
Zn air 140 Whr/kg = 500 J/g
Li 300 Whr/kg
Methane fuel cell 1500 Whr/kg (DARPA)
gasoline = 10 kCal/g = 40 kj/g
choc chip cookies 5.2 kCal/g
hydrogen μturbine: 4mm dia., 20 W, 2.4 $\times 10^6$ rpm, 10X P/m of Li batt, 8 diffusion-bonded Si wafers, 10% eff.

Technology:
traffic signals are inductive;
steel increases solenoid's μ
plasma disp: RBG=Ar,Ne,Xe; ionization

Biology:
body thermal = 150–500 W
10% humans died by small pox
humans: 3-10$\times 10^4$ genes, 3 Gbp
unrelated/diff race = 0.08% genetic diff
species, genus, family, order, class, phylum
brain uses 20% of body's oxygen
eye evolved 50 independent times
human eye: 1 arcmin fovea, 10 arcmin-10° sensitivity: 1-10^{12} γ; FOV=180°×120°
hook and pulley muscle
earthworm brains isomorphic,10^3-10^4 neur
human brain: 10^{10} neur, 10^{11} glial cells
grizzly evolved in 20ky-glaciers
human=63%H,26%O,9%C,1%N+P/Ca/Na
sunburn: UV-B (290-320nm); UVR–4% up every 1000ft; 65% UVR makes it to surface 10am-2pm
Medical Imaging:
MRI:
CAT: x-ray assembled image
PET: $e^+ + e^- = 2\gamma$, detect γ in scint. tube
use short half-life metabolic tracer
x-ray:

Health:
Blood pressure:
hi=>140/>90, hi-norm=139-130/85-89, norm=129-120/80-84, opt.= <120/<80
hi-norm=1.5-2.5X more likely cardiac event or die within 10yr compared to optimal. 2% ↓ in BP saves 70k/yr.
If 5mm Hg ↓: 14% ↓ stroke, 9% ↓ heart dis. deaths, 7% ↓ tot. mortality

Environment:
carbon uptake: 5 g/m^2/day (rain forest)
80% of "frontier forest" in Rus/Can/Braz
USA = 5% pop, 20% carbon emission
yearly f.f.: 70/50 mil tons S/N→acid rain
methane levels 2X since 1800; 20% of greenhouse; mostly livestock and rice
stabilizing CO_2 levels→60-80% reduction
sea lvl: +4-11" in 100 y, +6-40" next 100
ΔT since 1860=+1°F, <ΔT> in 10ky $\approx$1°F, ΔT proj. 2100 = +5-9°F

Economics:
GWP = 41 T$; GDP = 9 T$ (23%) (1999)
poverty-98: 1-$8k,2-$10,3-$13,4-$17,5-$19
12% pop.; 10% wht; 26% blk; 26% hisp.
median household income: $38.9k (1998)
CPI (all urban centers, seasonal adj)

Y	CPI	Δ%	65	31.3	1.3	84	102.1	4.3
47	21.5		66	31.9	1.9	85	105.7	3.5
48	23.7	10.2	67	32.9	3.1	86	109.9	4.0
49	24	1.3	68	34.1	3.6	87	111.5	1.5
50	23.5	-2.1	69	35.7	4.7	88	116.1	4.1
51	25.4	8.1	70	37.9	6.2	89	121.3	4.5
52	26.5	4.3	71	39.9	5.3	90	127.6	5.2
53	26.6	0.4	72	41.2	3.3	91	134.8	5.6
54	26.9	1.1	73	42.7	3.6	92	138.4	2.7
55	26.8	-0.4	74	46.8	9.6	93	142.8	3.2
56	26.8	0.0	75	52.3	11.8	94	146.4	2.5
57	27.7	3.4	76	55.8	6.7	95	150.6	2.9
58	28.6	3.2	77	58.7	5.2	96	154.8	2.8
59	29	1.4	78	62.7	6.8	97	159.5	3.0
60	29.4	1.4	79	68.5	9.3	98	162.1	1.6
61	29.8	1.4	80	78	13.9	99	164.8	1.7
62	30	0.7	81	87.2	11.8	00	169.4	2.8
63	30.4	1.3	82	94.4	8.3	01	175.7	3.7
64	30.9	1.6	83	97.9	3.7			

Geography:

Population (1997):	12) Germany, 82m
1) China, 1237m	13) Vietnam, 75m
2) India, 970m	14) Phil'ines, 73m
3) USA, 268m	15) Iran, 67m
4) Indonesia, 204m	16) Egypt, 65m
5) Brazil, 160m	17) Turkey, 64m
6) Russia, 147m	18) Thailand, 60m
7) Pakistan, 138m	19) UK, 59m
8) Japan, 126m	20) Ethiopia, 58.7m
9) Bang'esh, 122m	21) France, 58.6m
10) Nigeria, 107m	22) Italy, 57m
11) Mexico, 95m	23) Ukraine, 51m

Metro Area Population - US Cities (million)

1 NYC 20.0	11 Atlanta 3.7
2 Los Angeles 15.8	12 Miami 3.6
3 Chicago 8.8	13 Seattle 3.4
4 Washington, 7.3	14 Phoenix 2.9
5 San Francisco 6.8	15 Cleveland 2.9
6 Philadelphia 6.0	16 Minneapolis 2.8
7 Boston 5.6	17 San Diego 2.8
8 Detroit 5.4	18 St. Louis 2.6
9 Dallas 4.8	19 Denver 2.3
10 Houston 4.4	20 Pittsburgh 2.3

Pop. dist.: 58.4%-Asian; 12.4%-African; 9.5%-E/W Europe; 8.4%-Latin Amer; 5.5%-Soviet Union; 5.2%-North Amer; 0.6%-Aust + NZ
Land dist: 12% crops, 24% pasture, 32% woods, 33% desert/tundra/pavement
40% of all land has been transformed

Demographics:
105 billion humans ever
ed: 18% < HS, 34% HS, 17% some col, 7% assoc. deg., 16% BA, 8% MA+
Religious dist: 32.9% Christian (18.7% Cath., 8.4% Protestant, 3.1% Orthdx.), 17.8% Muslim, 16.7% "Non relig", 6.0% Buddhist, 4.5% Atheist, 3.2% Hindu, 0.3% Jew
Language (primary):16.5% Mandarin, 8.6% English, 8.3% Hindu/Urdi, 6.4% Spanish, 5.8% Russian, 3.7% Arabic
16k murders in USA in 1996, 68% by gun
incarceration (litetime):5%, 28% blk male
5.7 mil Americans in "judical supervision"
1.8 mil in jail
USA: 72% wht, 13% blk, 11% hsp, 4% asn
median marriage age(1996):
27.1 men, 24.8 women (increasing)
76% of US pop lives in urban areas
pop growth = 80 mil/year = NYC/month

History:
Bishop Usher: beginning: 4004 BC
end: Oct 1997 GMT 4pm

Limoges 1370: all residents kill by Black Prince (Edward, P. of Wales)
1240: Batu, grandson of Genghis Knah, kills all residents of Kiev
cross bow banned by Church in 1139 (slow reload)
archers defeat nobility (hit horses) Poitiers 1357
Mayan libraries burned by friars
Versailles: cost 2.6 B$ in 2001 dollars
Aztecs and Incas thought that a conquistador mounted on a horse was one creature
Greek civ. passed on 10^9 bits (Phil M)

Words:
Weltanschauung – philosophy of life

Gambling:
Blackjack: basic strategy (4+ decks):
key: H=hit, S=stand, D=double, P=split, HP=S if allowed to D after S, otherwise H, HR=surrender if allowed, o'wise H.
always: H a hard 7-/8-, S on a hard 17+, S on soft 20+/19+ (single/multi decks)
if soft total should be D, but rules don't allow, then H on 17-, S on 18+
surrender: 15/16 and showing 10/{9,10,A}

your	dealer's hand								
hand	2	3	4	5	6	7	8	9	10	A
8	H	H	H	H	H	H	H	H	H	H
9	H	D	D	D	D	H	H	H	H	H
10	D	D	D	D	D	D	D	D	H	H
11	D	D	D	D	D	D	D	D	D	H
12	H	H	S	S	S	H	H	H	H	H
13	S	S	S	S	S	H	H	H	H	H
14	S	S	S	S	S	H	H	H	H	H
15	S	S	S	S	S	H	H	H	HR	H
16	S	S	S	S	S	H	H	HR	HR	HR
A,2	H	H	H	D	D	H	H	H	H	H
A,3	H	H	H	D	D	H	H	H	H	H
A,4	H	H	D	D	D	H	H	H	H	H
A,5	H	H	D	D	D	H	H	H	H	H
A,6	H	D	D	D	D	H	H	H	H	H
A,7	S	D	D	D	D	S	S	H	H	H
A,8	S	S	S	S	S	S	S	S	S	S
2,2	HP	HP	P	P	P	P	H	H	H	H
3,3	HP	HP	P	P	P	P	H	H	H	H
4,4	H	H	H	HP	HP	H	H	H	H	H
5,5	D	D	D	D	D	D	D	D	H	H
6,6	HP	P	P	P	P	H	H	H	H	H
7,7	P	P	P	P	P	H	H	H	H	H
8,8	P	P	P	P	P	P	P	P	P	P
9,9	P	P	P	P	P	S	P	P	S	S
10,10	S	S	S	S	S	S	S	S	S	S
A,A	P	P	P	P	P	P	P	P	P	P

House edge (decks): -0.15%(1), 0.19%(2), 0.35%(4), 0.40%(6), 0.43%(8)
variations (edge): player may draw to S A's(+0.19%); player may re-split A's(+0.08%); late surrender(+0.09%), D on 9,10,11 only(-0.09%); D on 10,11 only(-0.18%); D after S(-0.14%); no re-split(-0.10%); dealer H on soft 17 (-0.22%), no hole card: A/10 showing (-0.02%/-0.10%)

Logic Puzzles:
n knights in a line
chicken McNuggets (3,6,20)
splitting the dinner check
3-hat problem
n R-circles $\rightarrow$ $4n$ $R/2$ circles on rect.
rect hole in rect cake – divide evenly
100 wires in bldg; voltmeter; # $\uparrow\downarrow$ trips?
4 3-link chains; 3 ops; join

Alcohol:
1 drink = 1.25 oz. of 80 proof liquor = 12 oz. beer, 5 oz. wine
Subtract 0.01% for each 40 minutes
Impairment begins at 0.02%
driving significantly effect at 0.04%
Percent Blood alcohol level:
Women:

Drinks	Body Weight								
	90	100	120	140	160	180	200	220	240
1	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.02	0.02
2	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04
3	0.15	0.14	0.11	0.10	0.09	0.08	0.07	0.06	0.06
4	0.20	0.18	0.15	0.13	0.11	0.10	0.09	0.08	0.08
5	0.25	0.23	0.19	0.16	0.14	0.13	0.11	0.10	0.09
6	0.30	0.27	0.23	0.19	0.17	0.15	0.14	0.12	0.11
7	0.35	0.32	0.27	0.23	0.20	0.18	0.16	0.14	0.13
8	0.40	0.36	0.30	0.26	0.23	0.20	0.18	0.17	0.15
9	0.45	0.41	0.34	0.29	0.26	0.23	0.20	0.19	0.17
10	0.50	0.45	0.38	0.32	0.28	0.25	0.23	0.21	0.19

Men:

Drinks	Body Weight							
	100	120	140	160	180	200	220	240
1	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02
2	0.08	0.06	0.05	0.05	0.04	0.04	0.03	0.03
3	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.05
4	0.15	0.12	0.11	0.09	0.08	0.08	0.07	0.06
5	0.19	0.16	0.13	0.12	0.11	0.09	0.09	0.08
6	0.23	0.19	0.16	0.14	0.13	0.11	0.10	0.09
7	0.26	0.22	0.19	0.16	0.15	0.13	0.12	0.11
8	0.30	0.25	0.21	0.19	0.17	0.15	0.14	0.13
9	0.34	0.28	0.24	0.21	0.19	0.17	0.15	0.14
10	0.38	0.31	0.27	0.23	0.21	0.19	0.17	0.16

Quotes:
"Indeed the only truly serious questions are the ones that even a child can formulate. Only the most naive of questions are truly serious." — Milan Kundera

"To believe that God created a plurality of worlds at least as numerous as what we call stars, renders the Christian system of faith at once little and ridiculous and scatters it in the mind like feathers in the air. The two beliefs cannot be held together in the same mind; and he who thinks that he believes in both has thought little of either." — Thomas Paine, 'Age of Reason' (1793)

"One of the things that distinguishes ours from all earlier generations is this, that we have seen our atoms." — Karl K. Darrow, 'The Renaissance of Physics'

"Taxes are the price we pay for a civilized society." — Oliver Wendell Holmes

Athletics:
Physics of rowing:
skin drag = 80%: R$\propto v^2$, P$\propto v^3$ (P=F×v)
v^2 because linear decrease in shear velocity (v at hull, 0 away), integrate
unstable because center of gravity above center of bouyancy
Anaerobic $P_a \propto M$, $v_a \propto M^{1/9}$
Aerobic $P_o \propto M^{2/3}$, $v_a \propto M^0$
deadweight: dv/v = -(1/6) dM/M
Physics of biking:

Risk:
140 g of K in humans
airplanes: don't worry about radiation (2 mr/trip); it's natural
10^4 more natural toxins than man-made pesticides in diet by weight
80% of cancer caused by environment (smoking, diet, etc.)
50% men get cancer-lifetime
25% deaths in US due to cancer
lung cancer: 80% smoking, 20% Radon
1.2 B smokers; 1/2 die prematurely of those, avg=20-25yr
good attitude = +7.5 yr
deaths/year: pass vehic+trucks-40k, firearms = 29k deaths in US (1999) motorcycles-2k, aircraft-1k, trains-0.6k
car death rate down 3X '66-'94, but now is 5X for age<18,>80, 15X for age=16,>85
laser eye dam: 0.1 μJ/cm^2 = μJ/0.1 μsec
1 PPM increase in death rate
smoke 1.4 cigarettes
spend 2 days NYC
spend 3 hours in a coal mine (accident)
travel 10 miles by bicycle (accident)
travel 300 miles car (accident)
travel 1000 miles by plane (accident)
travel 6000 miles by plane (cosmic rays)
live 2 months in Denver (high rad)
live 2 months in stone/brick building
take 1 chest x-ray
40 Tbsp peanut butter (cancer-aflatoxin)
live 2 months with a smoker
eat 100 charcoal-broiled steaks
drink 1 yr Miami water (chloroform H2O)
30 cans sacharine soda
live 5 years next to nuc plant (rad)
live 20 years near PVC plant (cancer)
live 150 years @ 20 miles from nuc power
live 50 yr @ 5 miles from nuc plant(accid)

Days lost per lifetime

unmarr male	3500	accid (safe job)	30
smoker (male)	2250	burns	27
heart disease	2100	energy gen	24
unmarr female	1600	illicit drug use	18
30% overwt	1300	poison	17
be coal miner	1100	firearm accid	13
cancer	900	natural rad	11
20% overwt	900	medical x-rays	7
+100 kcal/day	210	coffee (carcin)	6
vehicle accid.	207	oral contracep	5
pneumonia/flu	141	bicycle accident	5
alcohol (US av)	130	catastrophes	4
accident in home	95	diet drinks	2
suicide	95	reactor acc (anti)	2
diabetes	95	(pro)	0.02
homocide	90	home smk alrm	-10
legal drug misuse	90	pap test	-4
accident (avg)	74	airbags all cars	-50
drowning	41	safety 1966-76	-110
job with rad exp	40	mobile coronary	-125
falls	39		

Miscellaneous:
"Vissage" facial recog – 128 "eigenfaces"
sound doesn't carry in a snow storm
Lib of Congress = 20 Tb
smoke detector: look for scattered laser or decreased α flux from ^{241}Am
annual per cap municipal waste=0.8 tons
1st McDonalds war: NATO-Serbia
more workers in CIA than UN
avg: 1.5 sex partners/year, 60X annually (age=15-44), 100X for 18-29 marr
40% of grain fed to livestock
80% of world's food is rice/corn/wheat
3 tons of waste to make 1 gold ring
500 million autos worldwide
industrial nations: 87% cars, 20% people
O.D. screw = #× 0.013 + 0.06 ($''$)
e.g. 10-32 = 0.190$''$ O.D.
Wire gauge: (R in $\Omega/10^3$; I in Amps)
AWG=10×$\log_{10} R$+10
R=$10^{(AWG-10)/10}$
I=1/700×$10^{(50-AWG)/10}$
AWG=50-10×$\log_{10}$(700×I)