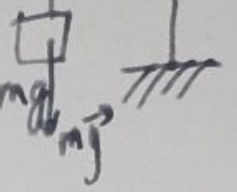

from pulley axle will be different.

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Exercise sheet 1

Units

1. a) $154\,kg$ in $[t] = 0.154\,t$

b) $20°C$ in $[K] = 293\,K$

c) $3\cdot10^8\,m/s = 3\cdot10^8 \cdot \frac{10^{-3}\,km}{\frac{1}{3.6}\cdot10^{-3}\,hr} = 3\cdot10^8 \cdot 3.6\,\frac{km}{hr} = 1.08\cdot10^9\,\frac{km}{hr}$

d) $9.81\,m/s^2 = 9.81\,N/kg$

e) $9.8067\,Pa$ in $[bar] = \frac{9.8067}{10^5}\,bar = 9.8067\cdot10^{-5}\,bar$

f) $17\,cm^2 = 17\,[10^{-2}\,m]^2 = 17\cdot10^{-4}\,m^2$

g) $28.3\,l = 28.3\cdot10^{-3}\,m^3 = 28.3\cdot10^{-3}\,[10^3\cdot10\,mm]^3 = 28.3\cdot10^6\,mm^3 = 2.83\cdot10^7\,mm^3$

h) $8\,kcal = 8\cdot10^3\cdot4.2\,J = 33.6\,kJ$

i) $3\cdot10^6\,J = 3\cdot10^6\,W\cdot s = 3\cdot10^6\cdot\frac{kW}{10^3}\cdot\frac{hr}{3600} = \frac{3}{3.6}\,kW\cdot hr = 5/6\,kW\cdot hr.$

j) $2928\,\Omega$ in $\left[\frac{cm^2\,g}{s^3\,A^2}\right] = 2928\,\frac{kg\,m^2}{s^3\,A^2} = 2928\,\frac{10^3\cdot10^4\,cm^2\,g}{3.6^3\,10^3\,s^3\,A^2} = \frac{2.928}{3.6^3\cdot10^2}\,\frac{cm^2\,g}{s^3\,A^2} = 6.28\cdot10^{-4}\,\frac{cm^2\,g}{s^3\,A^2}$

$[\Omega] = \frac{[V]}{[I]} = \frac{[P]}{[I^2]} = \frac{[A]}{[I^2\,t]} = \frac{[F\cdot s]}{[I^2\cdot t]} = \frac{kg\cdot m}{s^2}\cdot\frac{m}{A^2 s} = \frac{kg\,m^2}{s^3 A^2}$

k) $1.5C = 1.5A \cdot s = 1.5 \cdot 10^3 mA \cdot \frac{1}{3.6} \cdot 10^{-3} h = \frac{1.5}{3.6} mA \cdot h = \frac{5}{12} mA \cdot h.$

l) $0.511\ MeV/Particle = 0.511 \cdot 10^6 \cdot 1.6 \cdot 10^{-19} J/mol \cdot N_A^{-1} =$

$= 0.511 \cdot 10^6 \cdot 1.6 \cdot 6.02 \cdot 10^4\ J/mol = 10^{10} \cdot 4.92\ J/mol =$

$= 5 \cdot 10^{10}\ J/mol$

Estimates

1. a) Number of atoms in Earth N_E.

Assuming „average" M of Earth (mass of mol) as that of Silicon,

$N_E = N_A \cdot \frac{m_E}{M_{Si}} = 6 \cdot 10^{23} mol^{-1} \cdot \frac{6 \cdot 10^{24} kg}{28 \cdot 10^{-3} kg\ mol^{-1}} \approx$

$\approx 10^{50}$.

b) Number of trajectories $= 2^{200} = (10^{\log_{10} 2})^{200} \approx$

$\approx 10^{60}$.

So $N_T >> N_E$.

Galton board

Important – need to find average position, not average N/column. Imagine all balls marked with their column and put in line.

$-15, -14, -12, \underbrace{-11}_{2}, -8, -7, -6, \underbrace{-6, -5}_{7}, \underbrace{-4}_{6}, \underbrace{-3}_{7}, \underbrace{-2}_{10}, \underbrace{-1}_{13}, \underbrace{0}_{17}, \underbrace{1}_{10}, \underbrace{2}_{9}$

$\underbrace{3}_{9}, \underbrace{4}_{8}, \underbrace{5}_{6}, \underbrace{6}_{2}, 7, 8, \underbrace{9}_{5}, \underbrace{10}_{3}, 11, 12, 13, 15.$

$N_{balls} = 9+7+6+7+10+13+17+10+9+2+8+6+2+2+5+3+4 = 130$

$\langle s \rangle = \frac{-15-14-12-11 \cdot 2-8-7-6 \cdot 2-5 \cdot 7+\ldots+10 \cdot 3+11+12+13+15}{130} \approx 0.52 \approx 1,$ round 0.

$\sigma_s = \sqrt{\frac{[(-15-1)^2+(-14-1)^2+(-12-1)^2+(-11-1)^2 2+(-8-1)^2+(-7-1)^2+(-6-1)^2 \cdot 2+(-5+1)^2 \cdot 7}{+(-4-1)^2 6+(-3-1)^2 7+(-2-1)^2 10+(-1-1)^2 13+(0-1)^2 17+\ldots]}{130-1}} \approx$

≈ 5, about 1/6 of position range.