Physikübungen: 1-6

1)

$G = 6,674.10^{-11}\ N.m^2.kg^{-2}$

$R_E = 6\,375\,000\ m$

$\rho = 5500\ kg.m^{-3}$

$F_G = m.g$

$$F_G = \frac{G.m.M_E}{R^2_E}$$

$$m.g = \frac{G.m.M_E}{R^2_E}$$

$$\frac{R^2_E.g}{G} = M_E$$

$$M_E = \frac{R^2_E.g}{G}$$

$$M_E = \frac{(6\,375\,000)^2 * 9.81}{6.674 * 10^{-11}}$$

$M_E = 5,9737 \times 10^{24}\ kg$

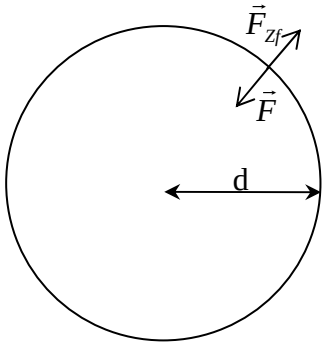
oder

$$M_E = \rho . \frac{4}{3} . \pi . R^3$$

$$M_E = 5500 . \frac{4}{3} . \pi . (6\,375\,000)^3$$

$M_E = 5,9687 \times 10^{24}\ kg$

2)
T = 27,3 Tage = 2 358 720 s
r = d = 387 000 km = $387 . 10^6$ m
G = $6,67 . 10^{-11}$ Nm^2kg^{-2} (siehe Blätter)



$\vec{F}_{Zf} = -\vec{F}$

Zentrifugalkraft = - Gravitationskraft

⇨ Die Beträge der beiden Kräfte sind gleich: $F_{Zf} = F$

$$F_{Zf} = \frac{m_M . v_M^2}{r} = \frac{m_M . v_M^2}{d}$$

und

$$F = G\frac{m_M . m_E}{d^2}$$

$$\Rightarrow \frac{m_M . v_M^2}{d} = G\frac{m_M . m_E}{d^2}$$

$$v_M^2 = G\frac{m_E}{d}$$

$$m_E = \frac{v_M^2 . d}{G} \quad \text{und} \quad v_M = \frac{2.\pi.d}{T} = \frac{2\pi.387.10^6}{2358720} = 1030,895\,\text{m/s}$$

ergibt: $m_E = \frac{(1030,895)^2 . 387.10^6}{6,67.10^{-11}} = 6,166 . 10^{24}$ kg

3)

$G = 6,674.10^{-11}\ N.m^2.kg^{-2}$

Distanz Erde - Sonne : 150 000 000 km = 150 000 000 000 m

$==> r = 150\,000\,000\,000\ m$

Zeit für eine Umlaufbahn : 365.25 Tage = 8766 Stunden = 525 960 Minuten = 31 557 600 s

$==> t = 31\,557\,600\ s$

$v = 2\pi f$

$$v = \frac{2.\pi.150000000000}{31\,557\,600} = 29\,865,3192\ m/s$$

$$F_Z = \frac{m_1.v^2}{r}$$

$$F = G.\frac{m_1.m_2}{r^2}$$

$F_Z = F$

$$==> \frac{m_1.v^2}{r} = G.\frac{m_1.m_2}{r^2}$$ mit m_1 = Masse der Erde und m_2 = Masse der Sonne

$$m_2 = \frac{v^2.r}{G} = \frac{(29\,865,3192)^2.150000000000}{6,674.10^{-11}} = 2,0047 \times 10^{30}\ kg$$

4)

$g = 9{,}87\ m/s^2$

$r_E = 6\,370\ km = 6\,370\,000\ m$

$t = 1\ Tag = 84600\ s$

$\vec{g} = \vec{a}_Z$

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

und

$v = \frac{2\pi r_E}{T}$

$$\Rightarrow a_Z = 9{,}78 = \frac{\left(\frac{2\pi r_E}{T}\right)^2}{r} = \frac{4\pi^2 r_E^2}{T^2 r_E} = \frac{4\pi^2 r_E}{T}$$

$$\Rightarrow T^2 = \frac{4\pi^2 r_E}{9{,}78} \Leftrightarrow T = \sqrt{\frac{4\pi^2 .6370000}{9{,}78}} = 5070{,}843s$$

$$\Rightarrow f = \frac{86400}{5070{,}843} = 17{,}04\ mal/Tag$$

5)

$m_{Mond} = 7,348.10^{22}\ kg$

$r_{Mond} = 1\,738\,000\ m$

$G = 6,674.10^{-11}\ N.m^2.kg^{-2}$

$F = m.a$

$$F = \frac{G.m.M_{Mond}}{R^2_{Mond}}$$

$$m.a = \frac{G.m.M_{Mond}}{R^2_{Mond}}$$

$$a = \frac{G.M_{Mond}}{R^2_{Mond}} = \frac{6,674.10^{-11}.7,348\cdot 10^{22}}{(1\,738\,000)^2} = 1,6225\ m/s^2$$

$F = m.a = 1.1,6225 = 1,6225\ N$

6)

$\rho_{Blei} = 11{,}3\,{}^{g}\!/\!_{cm^3} = 11300\,{}^{kg}\!/\!_{m^3}$

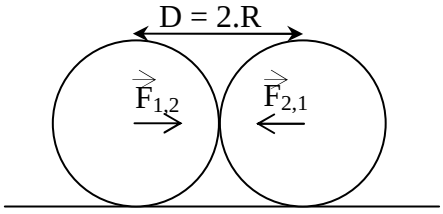
$F = F_{1,2} = F_{2,1} = 10$ N

$m_1 = m_2 = m$

$m = \rho.V$

$V = \frac{4}{3}\pi.R^3$

$D = 2.R$



$$F = G\frac{m^2}{(2R)^2}$$

$$10 = G\frac{\left(\rho_{Blei}\cdot\frac{4}{3}\pi R^3\right)^2}{4R^2}$$

$$10 = G\frac{16}{9}\pi^2\frac{R^6}{4R^2}\rho_{Blei}^2$$

$$10 = G\frac{4}{9}\pi^2 R^4\rho_{Blei}^2$$

$$\Rightarrow R^4 = \frac{10\cdot 9}{G.4.\pi^2.\rho_{Blei}^2} = \frac{90}{6{,}67.10^{-11}.4.\pi^2.(11300)^2} = 267{,}67$$

$$\Rightarrow R = \sqrt[4]{267{,}67} = 4{,}04\text{m}$$

$$D = 2.R = 2\cdot 4{,}04 = 8{,}08\text{m}$$