

Physik Übungsblatt 1

- 1)
a) $1000.000 \text{ V} = 1 \text{ MV} //$
b) $0,002 \text{ g} = 2 \text{ mg} //$
c) $3 \cdot 10^{-6} \text{ m} = 3 \mu\text{m} //$
d) $30.000 \text{ s} = 500 \text{ min} = 8,3 \text{ h} = 0,3475 \text{ Tage} = 30 \text{ ks} //$

- 2)
a) $0,0000.0000.00071 \text{ mm} //$
b) $= 0,0000.0000.00071 \cdot 10^{-3} \text{ m} = 7,1 \text{ Pm} //$
c) $= 7,1 \cdot 10^{-15} \text{ m} = 71 \cdot 10^{-16} \text{ m} //$
3) $E_{\text{PEV}} = 11,651 \text{ Trillionen Joule} //$
a) $11.651.000.000.000.000.000 \text{ J} = 11.651 \text{ PJ} //$
b) $11,651 \cdot 10^{18} //$

- 4) $AE = 1,5 \cdot 10^8 \text{ km} \quad c = 3 \cdot 10^8 \text{ m/s} //$
a) $AE = 1,5 \cdot 10^{11} \text{ m} \quad c = 18 \cdot 10^9 \text{ m/min} //$
b) $\frac{c}{AE} = \frac{18 \cdot 10^9 \text{ m/min}}{1,5 \cdot 10^{11} \text{ m}} = 0,12 \text{ AE/min} //$
c) $\frac{AE}{c} = \frac{1,5 \cdot 10^{11} \text{ m}}{18 \cdot 10^9 \text{ m/min}} = 8,33 \text{ min} \approx 8 \text{ min } 20 \text{ s} //$
d) $LJ = 3 \cdot 10^8 \text{ m/s} \cdot 60 \cdot 60 \cdot 24 \cdot 365 = 9,4608 \cdot 10^{15} \text{ m} //$
e) $\frac{AE}{LJ} = \frac{1,5 \cdot 10^{11} \text{ m}}{9,4608 \cdot 10^{15} \text{ m}} = 15,855 \cdot 10^{-6} \text{ LJ} //$

- 10)
a) $\bar{x}_R = (24 \text{ kg} + 33 \text{ kg} + 32 \text{ kg} + 28 \text{ kg} + 35 \text{ kg} + 25 \text{ kg}) / 6 = 29,5 \text{ kg} //$
b) $\bar{x}_L = (34 \text{ kg} + 39 \text{ kg} + 33 \text{ kg} + 32 \text{ kg} + 27 \text{ kg} + 30 \text{ kg} + 25 \text{ kg}) / 7 = 31,43 \text{ kg} //$
c) $\sigma_{\text{GR}} = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2} = \sqrt{\frac{1}{6-1} ((24 \text{ kg} - 29,5 \text{ kg})^2 + (33 \text{ kg} - 29,5 \text{ kg})^2 + (32 \text{ kg} - 29,5 \text{ kg})^2 + (28 \text{ kg} - 29,5 \text{ kg})^2 + (35 \text{ kg} - 29,5 \text{ kg})^2 + (25 \text{ kg} - 29,5 \text{ kg})^2)} = 4,5 \text{ kg} //$
d) $\sigma_L = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2} = \sqrt{\frac{1}{7-1} ((34 \text{ kg} - 31,43 \text{ kg})^2 + (39 \text{ kg} - 31,43 \text{ kg})^2 + (33 \text{ kg} - 31,43 \text{ kg})^2 + (32 \text{ kg} - 31,43 \text{ kg})^2 + (27 \text{ kg} - 31,43 \text{ kg})^2 + (30 \text{ kg} - 31,43 \text{ kg})^2 + (25 \text{ kg} - 31,43 \text{ kg})^2)} = 4,65 \text{ kg} //$
e) $\sigma_{x_{\text{GR}}} = \pm \frac{\sigma_{\text{GR}}}{\sqrt{n}} = \pm \frac{4,5 \text{ kg}}{\sqrt{6}} = \pm 1,84 \text{ kg} //$
f) $\sigma_L = \pm \frac{\sigma_L}{\sqrt{n}} = \pm \frac{4,65 \text{ kg}}{\sqrt{7}} = \pm 1,76 \text{ kg} //$

$$11) J(m, r, a) = m \cdot r^2 \cdot \left(\frac{a}{a-1}\right) \quad g = 9.81 \text{ m/s}^2 \quad m = (0.515 \pm 0.005) \text{ kg} \quad r = (0.0028 \pm 0.0001) \text{ m} \quad a = (0.12 \pm 0.005) \text{ m/s}^2$$

$$J = m \cdot r^2 \cdot \left(\frac{a}{a-1}\right) = 0.515 \text{ kg} \cdot (0.0028 \text{ m})^2 \cdot \left(\frac{9.81 \text{ m/s}^2}{0.12 \text{ m/s}^2} - 1\right) = 0.0003233 \text{ kgm}^2 = 32.33 \cdot 10^{-6} \text{ kgm}^2$$

$$\frac{\partial J}{\partial m} = r^2 \cdot \left(\frac{a}{a-1}\right) = (0.0028 \text{ m})^2 \cdot \left(\frac{9.81 \text{ m/s}^2}{0.12 \text{ m/s}^2} - 1\right) = 6.278 \cdot 10^{-6} \text{ m}^2$$

$$\frac{\partial J}{\partial r} = m \cdot 2r \cdot \left(\frac{a}{a-1}\right) = 0.515 \text{ kg} \cdot 2(0.0028 \text{ m}) \cdot \left(\frac{9.81 \text{ m/s}^2}{0.12 \text{ m/s}^2} - 1\right) = 230.9 \cdot 10^{-3} \text{ kgm}$$

$$\frac{\partial J}{\partial a} = -\frac{m r^2}{a^2} = \frac{0.515 \text{ kg} \cdot (0.0028 \text{ m})^2 \cdot 9.81 \text{ m/s}^2}{(0.12 \text{ m/s}^2)^2} = 2.7 \cdot 10^{-3} \frac{\text{kgm}}{\text{s}^2}$$

$$\Delta J = \left| \frac{\partial J}{\partial m} \right| \Delta m + \left| \frac{\partial J}{\partial r} \right| \Delta r + \left| \frac{\partial J}{\partial a} \right| \Delta a = 6.278 \cdot 10^{-6} \text{ m}^2 \cdot 0.005 \text{ kg} + 230.9 \cdot 10^{-3} \text{ kgm} \cdot 0.0001 \text{ m} + 2.7 \cdot 10^{-3} \frac{\text{kgm}}{\text{s}^2} \cdot 0.005 \text{ m/s}^2 = 3.975 \cdot 10^{-5} \text{ kgm}^2$$

2) Unterschied absoluter und relativer Fehler?