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Problem set 1

Ex 1

$R = 6.37 \times 10^6 m$

a) $l = 2\pi R = 2 * 3,14 \cdot 6.37 \times 10^6 m = 40,0036 \times 10^6 m = 40,0036 \times 10^3 Km$

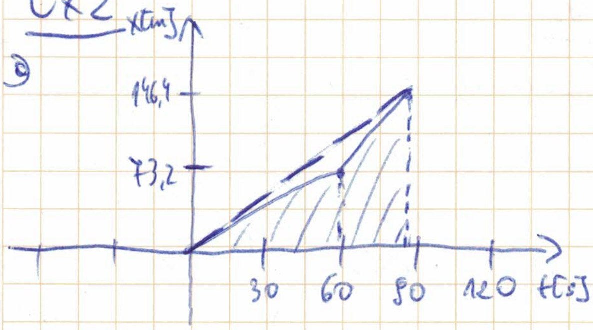
10000

b) $S = 4\pi R^2 = 4 * 3,14 \cdot (6,37 \times 10^6 m)^2 = 5,0965 \cdot 10^{14} m^2 = 5,096 \cdot 10^{18} cm^2$

c) $V = \frac{4}{3}\pi R^3 = \frac{4}{3} * 3,14 \cdot (6,37 \times 10^6 m)^3 = 1,0821 \cdot 10^{21} m^3$

Ex 2

a)



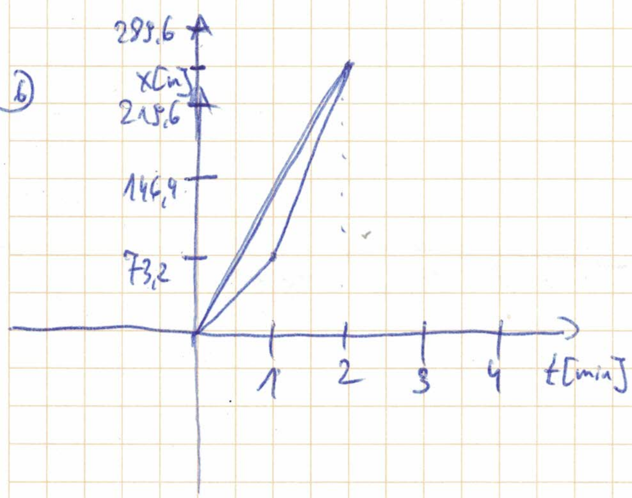
$V_{avg} = \frac{\Delta x}{\Delta t}$ $\Delta t = \frac{\Delta x}{V}$

$\Delta t_1 = \frac{73.2 m}{1,22 \frac{m}{s}} = 60s = 1 min$

$\Delta t_2 = \frac{73,2 m}{3,05 \frac{m}{s}} = 24s$

$V_{avg} = \frac{146,4 m}{84 s} = 1,74 \frac{m}{s}$

b)

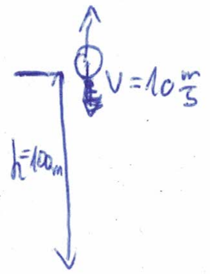


$\Delta x = V_{avg} \cdot \Delta t$

$\Delta x_1 = 1,22 \frac{m}{s} \cdot 60s = 73,2 m$ $\Delta x = 256,2 m$

$\Delta x_2 = 3,05 \frac{m}{s} \cdot 60s = 183 m$ $\Delta t = 2 min = 120s$

Ex 2



$\Updownarrow g = -9{,}81\frac{m}{s^2}$ $\Downarrow g = 9{,}81\frac{m}{s^2}$

$h_{max} = h + \Delta h$

$\underset{0}{v} = v_0 + gt \Leftrightarrow \quad v_0 = -gt$

$t = \frac{v_0}{g} = \frac{10\frac{m}{s}}{9{,}81\frac{m}{s^2}} = 1s$

$\underset{0}{v^2} = v_0^2 + 2g(\overset{\Delta h}{x - x_0})$

$v_0^2 = -2g\Delta h$

$\Delta h = \frac{v_0^2}{-2g} = \frac{(10\frac{m}{s})^2}{2 \cdot 9{,}81\frac{m}{s^2}} = 5{,}1m$

$h_{max} = h + \Delta h = 100m + 5{,}1m = 105{,}1m$

between h_1 and h_2

$v^2 = v_0^2 + 2g\Delta h \qquad v_2 = v_1 + gt$

$t = \frac{v_2 - v_1}{g}$

at 50m

$v_1 = \sqrt{v_0^2 + 2g\Delta h_1} = \sqrt{(10\frac{m}{s})^2 + 2(9{,}81\frac{m}{s^2}) \cdot 50m} = \boxed{32{,}9\frac{m}{s}}$

$v_2 = \sqrt{v_0^2 + 2g\Delta h_1} = \sqrt{(10\frac{m}{s})^2 + (2 \cdot 9{,}81\frac{m}{s^2}) \cdot 100m} = 45{,}4\frac{m}{s}$

$t = \frac{45{,}4\frac{m}{s} - 32{,}9\frac{m}{s}}{9{,}81\frac{m}{s^2}} = 1{,}3s$

the bottom of the hole

$v_{end} = \sqrt{v_0^2 + 2g\Delta h} = \sqrt{10\frac{m}{s} + 2 \cdot 9{,}81\frac{m}{s^2} \cdot 150m} = 55{,}2\frac{m}{s}$

$t = \frac{55{,}2\frac{m}{s} - 10\frac{m}{s}}{9{,}81\frac{m}{s^2}} = 6{,}6s$

Ex 3

a) $x_R = vt$ $\quad x_y = x_0 + \frac{at^2}{2}$

meeting point

$$vt = x_0 + \frac{1}{2}at^2 \Rightarrow \frac{1}{2}at^2 - vt + x_0 = 0$$

$$t = \frac{v \pm \sqrt{v^2 - 2ax_0}}{a} = \frac{v}{a}\left(1 \pm \sqrt{1 - \frac{2ax_0}{v^2}}\right)$$

$$\boxed{\Delta = v^2 - 2ax_0}$$

$$t = 1s$$

$$x_R = x_y = vt = 5\frac{m}{s} \cdot 1s = 5m$$

b) $1 - \frac{2ax_0}{v^2} < 0$ $\quad$ so $\quad 1 - \frac{2ax_0}{v^2} = 0$

$$a_{max} = \frac{v^2}{2x_0} = \frac{(5\frac{m}{s})^2}{2 \cdot 6m} = 2{,}1 m/s^2$$

for $a = a_{max}$ $\quad \Rightarrow t = \frac{v}{a} = \frac{5\frac{m}{s}}{2{,}1\frac{m}{s^2}} = 2{,}4s$