Esim. 1:

Teho $P = \frac{W}{t}$ | energian säilymislaki

$= \frac{E_p}{t}$

$= \frac{mgh}{t}$

$= \frac{320\,kg \cdot 9{,}81\,\frac{m}{s^2} \cdot 8{,}5\,m}{7{,}0\,s}$

$= 3811{,}8\ldots\ W$

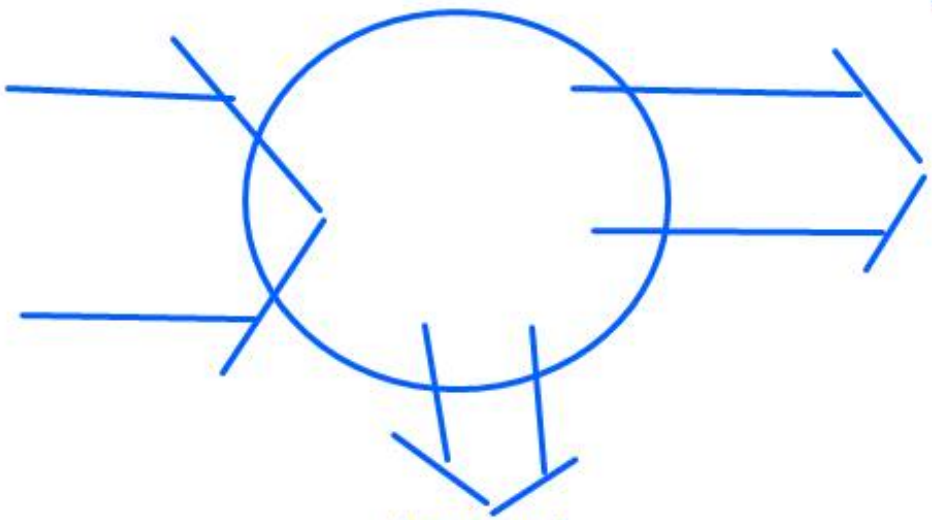
$m = 320\,kg$

$t = 7{,}0\,s$

$h = 8{,}5\,m$

V: 3,8 kW

Esim. 2:



a) $t = 1\,d = 24\,h = 86400\,s$

$E_{anto} = P_{anto} \cdot t = 180 \cdot 10^6 \frac{J}{s} \cdot 86400\,s = 1{,}5552 \cdot 10^{13}\,J$

V: $1{,}6 \cdot 10^{13}\,J$

b) $t = 86400\,s$

vettä $V = 86400\,s \cdot 1500 \frac{m^3}{s} = 1{,}296 \cdot 10^8\,m^3$

$= 1{,}296 \cdot 10^{11}\,l$

eli $m = 1{,}296 \cdot 10^{11}\,kg$

siten $E_{olio} = \Delta E_p = mgh$

$= 1{,}296 \cdot 10^{11}\ kg \cdot 9{,}81 \frac{m}{s^2} \cdot 17\ m$

$= 2{,}161\ldots \cdot 10^{13}\ J$

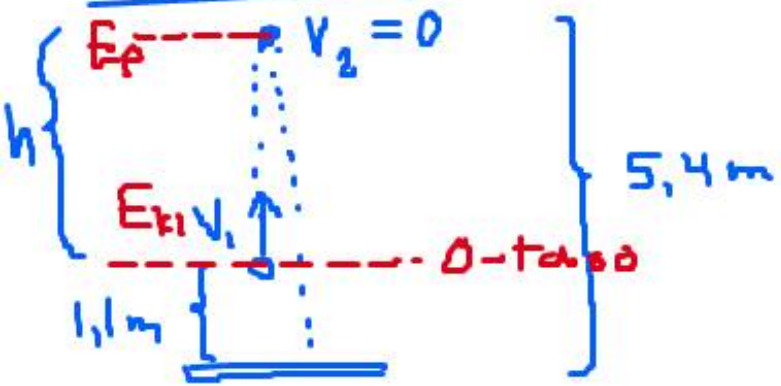
Hyötysuhde:

$$\eta = \frac{E_{anto}}{E_{olio}} = \frac{1{,}5592 \cdot 10^{13}\ J}{2{,}161\ldots \cdot 10^{13}\ J} = 0{,}7198\ldots$$

V: 72 %

V: 0,72

Esim. 3:



$h = 5{,}4\,m - 1{,}1\,m$

$= 4{,}3\,m$

Energian säilymislaki:

$$E_{k1} = E_p$$

$$\frac{1}{2} m v_1^2 = m g h \qquad | : m \quad | \cdot 2$$

$$v_1^2 = 2 g h \qquad | \sqrt{\ }$$

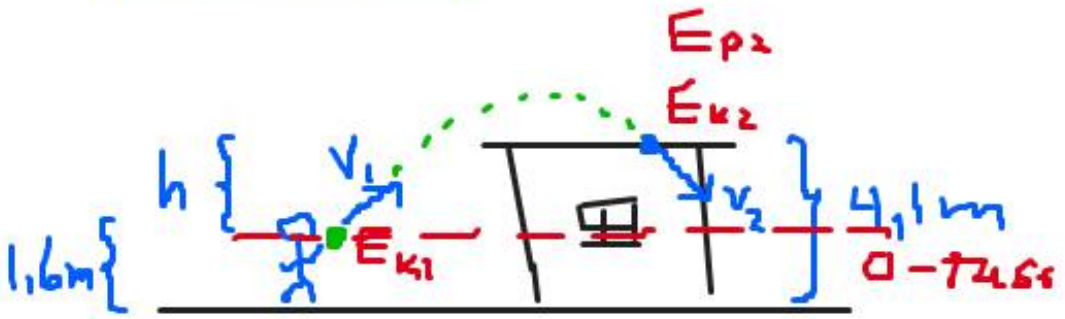
$$v_1 = \sqrt{2 g h}$$

$$= \sqrt{2 \cdot 9{,}81 \frac{m}{s^2} \cdot 4{,}3\,m}$$

$$= 9{,}185\ldots \frac{m}{s}$$

$$v : 9{,}2\ m/s$$

Esim. 4:



01. ilmanvastus pieni

Energian säil.laki:

$$E_{k1} = E_{k2} + E_{p2}$$

$$\frac{1}{2} m v_1^2 = \frac{1}{2} m v_2^2 + mgh \quad | \cdot 2 \; | : m$$

$v_1 = 9{,}9\ m/s \qquad v_2 = ?$

$h = 4{,}1\ m - 1{,}6\ m$

$= 2{,}5\ m$

$$v_1^2 = v_2^2 + 2gh \quad | -2gh$$

$$v_1^2 - 2gh = v_2^2 \quad | \sqrt{\ }$$

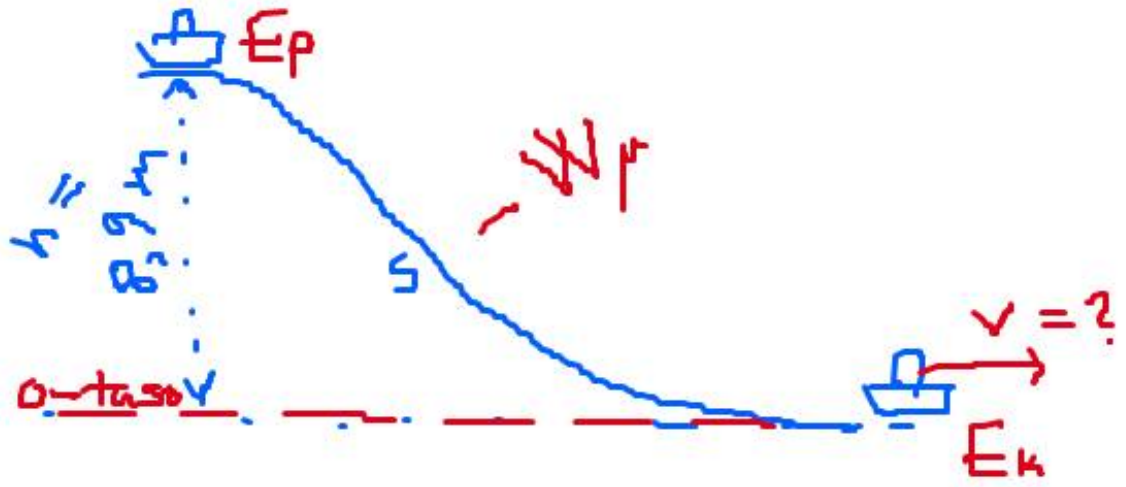
$$\sqrt{v_1^2 - 2gh} = v_2$$

$$v_2 = \sqrt{(9{,}9\ \tfrac{m}{s})^2 - 2 \cdot 9{,}81\ \tfrac{m}{s^2} \cdot 2{,}5\ m}$$

$$\approx 6{,}997\ldots\ m/s$$

$v: 7{,}0\ m/s$

Esim. 5:



$s = 56\ m$

$m = 26\ kg$

$F_\mu = 12\ N$

Energian säil. laki:

$$E_p - W_\mu = E_k$$

$$mgh - F_\mu s = \frac{1}{2} m v^2 \quad | \cdot 2$$

$$2mgh - 2F_\mu \cdot s = mv^2 \quad | : m$$

$$\frac{2mgh - 2F_\mu s}{m} = v^2 \quad | \sqrt{\ }$$

$$v = \sqrt{\frac{2mgh - 2F_\mu s}{m}}$$

$$v = \sqrt{\frac{2mgh - 2F_R s}{m}}$$

$$= \sqrt{\frac{2 \cdot 26\,kg \cdot 9{,}81\,\frac{m}{s^2} \cdot 8{,}9\,m - 2 \cdot 12\,N \cdot 56\,m}{26\,kg}}$$

$$= 11{,}08\ldots\ \frac{m}{s}$$

$$\underline{\underline{v : 11\ m/s}}$$

Esim. 6

$t = 3{,}8\ \text{s}$

$v = 100\ \text{km/h}$

$m = 451\ \text{kg}$

$P = ?$

Energian säilymislaki:

$$0 + W = E_k$$

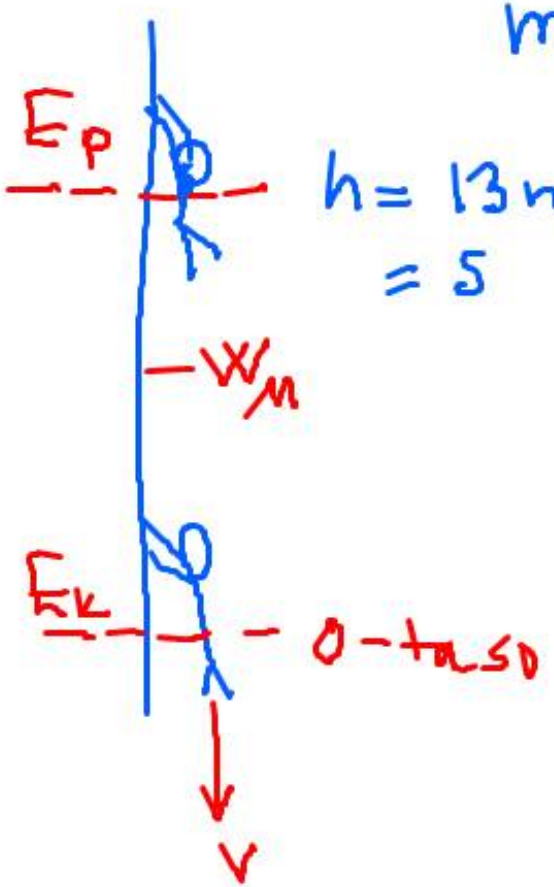
$$P \cdot t = \frac{1}{2} m v^2 \quad | : t$$

$$P = \frac{\frac{1}{2} m v^2}{t} = \frac{\frac{1}{2} \cdot 451\ \text{kg} \cdot \left(\frac{100}{3{,}6}\ \frac{\text{km}}{\text{h}}\right)^2}{3{,}8\ \text{s}}$$

$$= 45\,788{,}16\ldots\ \text{W}$$

V: 46 kW

Esim. 7: Newton III: mies vetää köyttä yhtäsuurella vastakkaisella voimalla kuin köysi vetää miestä.



siis voima $F = 860\,N$ jarruttaa miehen liikettä

Energian säilymislaki:

$$E_p - W = E_k$$

$$mgh - Fs = \frac{1}{2}mv^2 \quad | \cdot 2 \; | : m$$

$$\frac{2mgh - 2Fs}{m} = v^2 \quad | \sqrt{}$$

$$m = 97\,kg$$

$$\sqrt{\frac{2mgh - 2Fs}{m}} = v$$

$$\sqrt{\frac{2mgh - 2Fs}{m}} = v$$

$$V = \sqrt{\frac{2 \cdot 97\,kg \cdot 9{,}81\,\frac{m}{s^2} \cdot 13\,m - 2 \cdot 860\,N \cdot 13\,m}{97\,kg}}$$

$$= 15{,}40\ldots\ m/s \quad (55{,}4\ldots\ km/h)$$

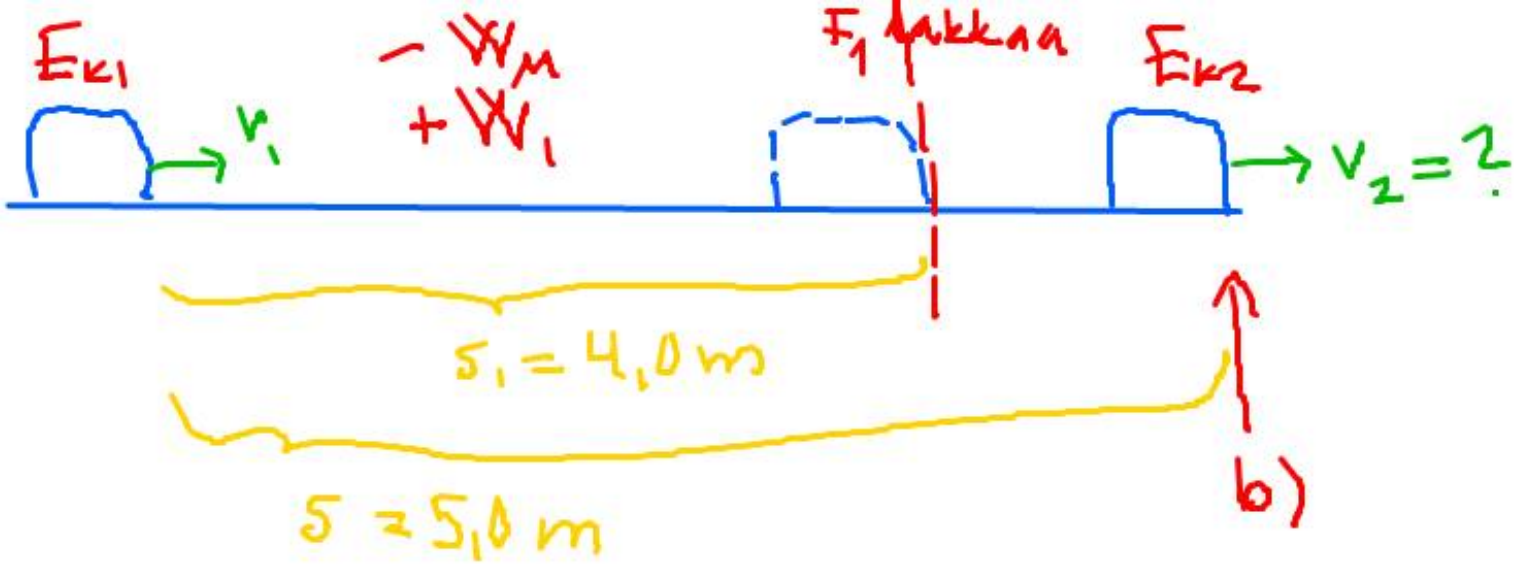
$$V : 15\ m/s$$

Esim. 8:

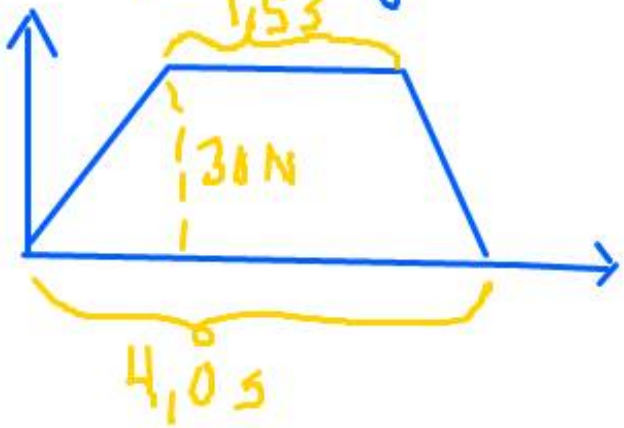
$v_1 = 1{,}4 \frac{m}{s}$

$m = 6{,}5\,kg$

$F_M = 13{,}4\,N$



a) Koska $W = Fs$, niin työ saadaan sF-koordinaatistossa alasta:



$$W_1 = \frac{4{,}0\,s + 1{,}5\,s}{2} \cdot 30\,N$$

$$= 82{,}5\,J$$

V: 83 J

b) Energian säilymislaki:

$$\frac{1}{2}mv_1^2 + W_1 - W_M = \frac{1}{2}mv_2^2$$

$$\frac{1}{2}mv_1^2 + W_1 - F_M \cdot s = \frac{1}{2}mv_2^2$$

$$\frac{1}{2} m v_1^2 + W_1 - F_\mu \cdot s = \frac{1}{2} m v_2^2 \qquad | \; s = 5{,}0\,\text{m}$$

$$| \cdot 2 \; : m$$

$$\frac{m v_1^2 + 2W_1 - 2F_\mu s}{m} = v_2^2 \qquad | \sqrt{}$$

$$\sqrt{\frac{m v_1^2 + 2W_1 - 2F_\mu s}{m}} = v_2$$

$$v_2 = \sqrt{\frac{6{,}5\,\text{kg} \cdot \left(1{,}4\,\frac{\text{m}}{\text{s}}\right)^2 + 2 \cdot 82{,}5\,\text{J} - 2 \cdot 13{,}4\,\text{J} \cdot 5{,}0\,\text{m}}{6{,}5\,\text{kg}}}$$

$$= 6{,}729\ldots\,\text{m/s}$$

$$\underline{\underline{v : 6{,}7\,\text{m/s}}}$$