-Pogledajte i uradite zadatke o promjeni impulsa 182, 183, 184, 185.

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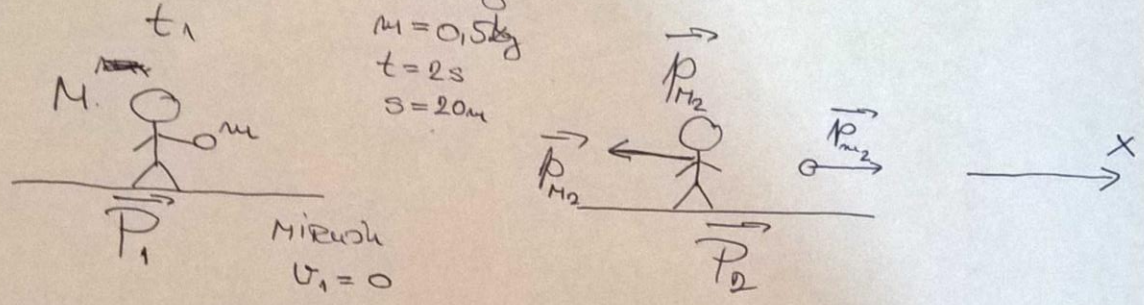
188. Raden na času.

189.



a) Trenje zanemarujemo

Duž x ose nemamo djelovanje na tijela pa vrijedi zakon održanja impulsa.
(Na tijela djeluje gravitaciona sila, sila otpora podloge (čovjek), sile su duž y ose)

$$\vec{p}_1 = \vec{p}_2$$

$$\vec{p}_1 = (M+m)\vec{v}_1 = \vec{0}$$

$$\vec{p}_2 = \vec{p}_{M_2} + \vec{p}_{m_2}$$

$$\vec{0} = \vec{p}_{M_2} + \vec{p}_{m_2} \Rightarrow \vec{p}_{m_2} = -\vec{p}_{M_2} \Rightarrow p_{m_2} = p_{M_2}$$

Vektori impulsa tijela imaju isti pravac, intezitet, a suprotan smjer. (sad možemo uzeti vektor impulsa čovjeka)

$$\left.\begin{aligned} p_{m_2} &= m v_{m_2} \\ p_{M_2} &= M v_{M_2} \end{aligned}\right\} \Rightarrow m v_{m_2} = M v_{M_2} \quad ; \quad v_{m_2} = \frac{s}{t}$$

$$v_{M_2} = \frac{m}{M} v_{m_2} \Rightarrow \boxed{v_{M_2} = \frac{ms}{Mt}} \quad v_{M_2} = 9\frac{m}{s}$$

b) Imamo silu trenja duž x-ose pa se važi zakon održanja impulsa. Koristimo II Njutnov zakon preko promjene impulsa

$$\vec{F}_M = \frac{\Delta \vec{p}_M}{\Delta t}$$

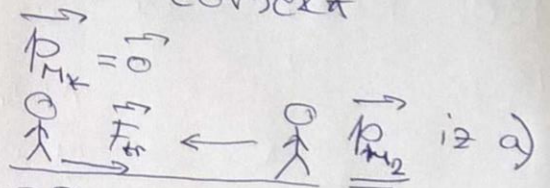
+ x-osa →

$$\Delta \vec{p}_M = \vec{p}_{Mk} - \vec{p}_{Mp}$$

$\vec{p}_{Mk} = 0$

$$\Delta \vec{p}_M = -\vec{p}_{Mp}$$

čovjek



iz a)

$p = mv$

$$\vec{F}_g + \vec{N} + \vec{F}_{tr} = \frac{-\vec{p}_{Mp}}{\Delta t}$$

$$\vec{F}_{tr} = -\frac{\vec{p}_{Mp}}{\Delta t}$$

$$-F_{tr} = -\frac{p_{Mp}}{\Delta t} \quad / \cdot (-1)$$

$$\mu M g = \frac{M v_{M_2}}{\Delta t}$$

$$\Delta t = \frac{M v_{M_2}}{\mu M g} = \frac{v_{M_2}}{\mu g}$$

$\vec{F}_g + \vec{N} = \vec{0}$ nema x k. duž y ose

$F_g = N \Rightarrow N = Mg$

$F_{tr} = \mu N = \mu M g$

v_{M_2} - početna brzina za ravnomjerno usporeno kr.

$$s = v_0 t + \frac{a t^2}{2}$$

$$a = \frac{v_{M_2} - 0}{\Delta t} = \frac{v_{M_2}}{\Delta t}$$

$$s = v_{M_2} \cdot \Delta t - \frac{v_{M_2}}{\Delta t} \frac{\Delta t^2}{2} = v_{M_2} \cdot \Delta t - \frac{v_{M_2} \Delta t}{2}$$

$$s = \frac{v_{M_2} \Delta t}{2} = \frac{v_{M_2}}{2} \cdot \frac{v_{M_2}}{\mu g}$$

$$\boxed{s = \frac{v_{M_2}^2}{2 \mu g}}$$

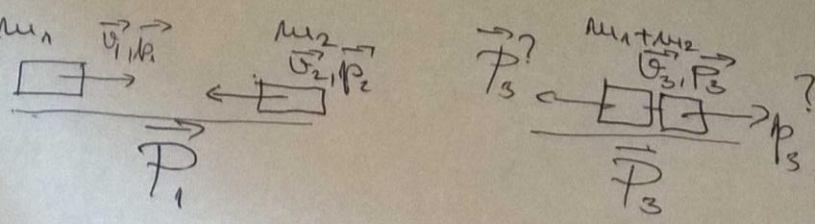
$$s = \frac{0{,}01 \frac{m^2}{s^2}}{2 \cdot 0{,}02 \cdot 10 \frac{m}{s^2}} = \frac{1}{40} m = 0{,}025 m$$

190.

$m_1 = 10t = 10000kg$

$v_1 = 1{,}5 \frac{m}{s}$

$m_2 = 15t = 15000kg$



a) $v_2 = 0{,}5 \frac{m}{s}$

duž x osi nemamo djelovanja (projekcije djelovanja su nula). Nemamo ni trenje klizanja (trenje kotrljanja omogućava kretanje)

Vrijedi zakon održanja impulsa

$$\vec{P}_1 = \vec{P}_3$$

$$\vec{P}_1 = \vec{p}_1 + \vec{p}_2 \quad ; \quad \vec{P}_3 = \vec{p}_3$$

$$\vec{p}_1 + \vec{p}_2 = \vec{p}_3$$

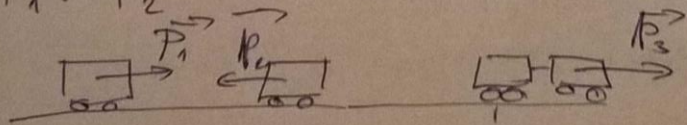
Sabiramo vektore suprotnih smjerova (isti pravac)

$\Rightarrow$ Pravac ostaje isti, smjer većeg vektora, intezitet $|p_1 - p_2| = p_3$

$p_1 = m_1 v_1 \Rightarrow p_1 = 10000kg \cdot 1{,}5 \frac{m}{s} = 15000kg \frac{m}{s}$

$p_2 = m_2 v_2 \Rightarrow p_2 = 15000kg \cdot 0{,}5 \frac{m}{s} = 7500kg \frac{m}{s}$

$p_1 > p_2 \Rightarrow$ smjer vektora $\vec{p}_1$



$P_3 = P_1 - P_2$; $P_3 = (m_1 + m_2) v_3$; $P_1 = m_1 v_1$; $P_2 = m_2 v_2$

$(m_1 + m_2) v_3 = m_1 v_1 - m_2 v_2$

$$v_3 = \frac{m_1 v_1 - m_2 v_2}{m_1 + m_2}$$

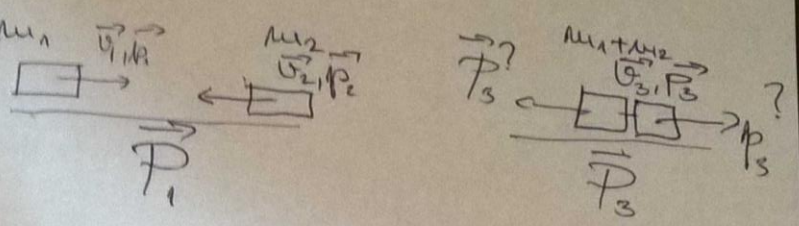
$$v_3 = \frac{P_1 - P_2}{m_1 + m_2}$$

190.

$m_1 = 10\,t = 10000\,kg$

$v_1 = 1{,}5\,\frac{m}{s}$

$m_2 = 15\,t = 15000\,kg$



a) $v_2 = 0{,}5\,\frac{m}{s}$

Vrijedi zakon održanja impulsa

$$\vec{p}_1 = \vec{p}_3$$

$$\vec{p}_1 = \vec{p}_1 + \vec{p}_2 \quad ; \quad \vec{p}_3 = \vec{p}_3$$

$$\vec{p}_1 + \vec{p}_2 = \vec{p}_3$$

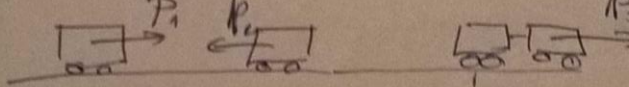
Sabiramo vektore suprotnih smjerova (lijevo +)

$\Rightarrow$ Pravac ostaje isti, smjer većeg vektora, iznos $|p_1 - p_2| = p_3$

$p_1 = m_1 v_1 \Rightarrow p_1 = 10000\,kg \cdot 1{,}5\,\frac{m}{s} = 15000\,kg\,\frac{m}{s}$

$p_2 = m_2 v_2 \Rightarrow p_2 = 15000\,kg \cdot 0{,}5\,\frac{m}{s} = 7500\,kg\,\frac{m}{s}$

$p_1 > p_2 \Rightarrow$ smjer vektora $\vec{p}_1$



$p_3 = p_1 - p_2$; $p_3 = (m_1 + m_2) v_3$; $p_1 = m_1 v_1$; $p_2 = m_2 v_2$

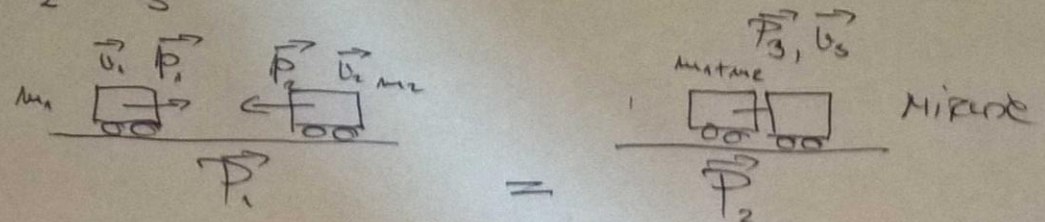
$(m_1 + m_2) v_3 = m_1 v_1 - m_2 v_2$

$$v_3 = \frac{m_1 v_1 - m_2 v_2}{m_1 + m_2}$$

$$v_3 = \frac{p_1 - p_2}{m_1 + m_2}$$

duž x osi nemamo djelovanja (projekcije djelovanja su nula). Nemamo ni trenje klizanja (trenje kotrljanja omogućava kretanje)

b) ~~v_2~~ $= 1 \frac{m}{s}$



$$\vec{p_1} + \vec{p_2} = \vec{p_3}$$

$p_1 = m_1 v_1 \Rightarrow p_1 = 15000\ kg\frac{m}{s}$

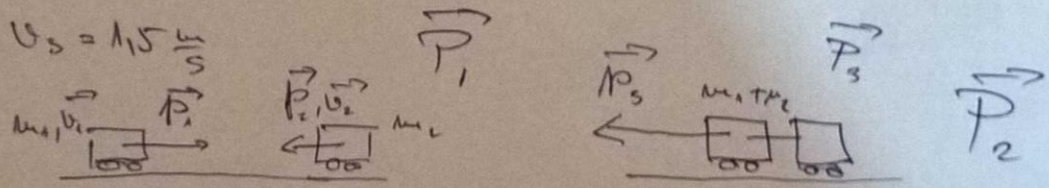
$p_2 = m_2 v_2 \Rightarrow p_2 = 15000\ kg\frac{m}{s}$

$p_3 = (m_1 + m_2) v_3$

$P_3 = |P_1 - P_2| = 0 \Rightarrow p_3 = (m_1+m_2) v_3 = 0 \Rightarrow$

$P_3 = 0 \Rightarrow v_3 = 0 \frac{m}{s}$

c) $v_3 = 1{,}5 \frac{m}{s}$



$$\vec{P_1} + \vec{P_2} = \vec{P_3}$$

$P_3 = |P_1 - P_2|$

$P_1 = m_1 v_1 \Rightarrow p_1 = 15000\ kg\frac{m}{s}$

$P_2 = m_2 v_2 \Rightarrow P_2 = 22500\ kg\frac{m}{s}$

$P_2 > P_1 \rightarrow \vec{P_3}$ SIMILAR vectora $\vec{P_2}$

$P_3 = P_2 - P_1$

$(m_1 + m_2) v_3 = P_2 - P_1$

$$v_3 = \frac{P_2 - P_1}{m_1 + m_2} \Rightarrow$$ ~~v_3~~

191. } Zadatak sličan 190.
192. }

193.

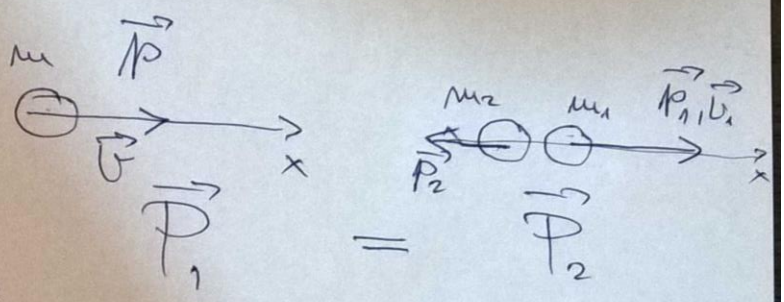
$m = 20\,kg$

$v = 15\,\frac{m}{s}$

$m_1 = 14\,kg$

$v_1 = 24\,\frac{m}{s}$

$v_2 = ?$



sistem izolovan

$\vec{P}_1 = m\vec{v} = \vec{p}$

$\vec{P}_2 = \vec{p}_1 + \vec{p}_2$; $\vec{p}_1 = m_1\vec{v}_1$; $\vec{p}_2 = m\vec{v}_2$

$\vec{p} = \vec{p}_1 + \vec{p}_2$ $\vec{p}, \vec{p}_1$ istih PRAVACA i istih SMJEROVA

$\vec{p}_2 = \vec{p} - \vec{p}_1 = \vec{p} + (-\vec{p}_1)$

"$-$" mijenja smjer $\vec{p}_1$. Sabiramo vektore $\vec{p}$ i $(-\vec{p}_1)$ koji su istih PRAVACA i SUPROTNIH SMJEROVA (zbog "$-$")

Sabiraju se tako što PRAVAC ostaje isti SMJER većeg vektora a $p_2 = |p - p_1|$

RAČUNAMO p i p_1

$p_1 = m_1 v_1 \Rightarrow p_1 = 336\,kg\frac{m}{s}$

$p_2 = mv \Rightarrow p = 300\,kg\frac{m}{s}$

$\Rightarrow p_1 > p$

$\vec{P}_2$ SMJER VEKTORA $-\vec{P}_1$

$$P_2 = P_1 - P = 36\,kg\,\frac{m}{s}$$

$$P_2 = m_2 v_2 \quad ; \quad m_2 = m - m_1 \Rightarrow m_2 = 6\,kg$$

$$v_2 = \frac{P_2}{m_2} \Rightarrow v_2 = \frac{36\,kg\,\frac{m}{s}}{6\,kg}$$

$$\boxed{v_2 = 6\,\frac{m}{s}}$$