เฉลยโมเมนตัมเชิงเส้น
และการชน

(5.1)

$u = 0$ $m = 0.06$ kg

$\Delta p = m(V_2 - V_1)$ $g = 10$ m/s

$V_1^2 = u^2 + 2gS_1 = 0 + 20 \times 2 = 40$

$V_1 = \sqrt{40} = 2\sqrt{10}$ m/s $= 6.32$ m/s

$V_2 = \sqrt{2gS_2} = \sqrt{20 \times 1.8} = \sqrt{2 \times 2 \times 9}$

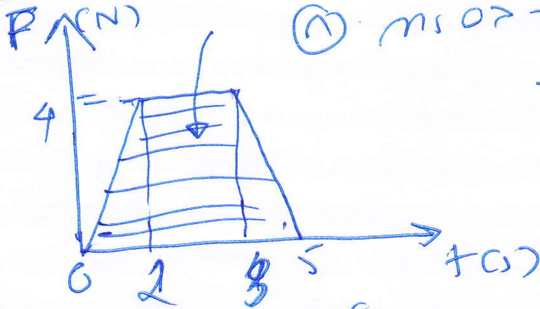
$= 6$ m/s

$\Delta p = 0.06(6 - (-6.32))$

$= 0.06(12.32)$ kg m/s

$= 0.74$ kg m/s

(5.2)



ก) การดล = พ.ท. ใต้กราฟ

$= \frac{1}{2} \times 4 \times (1 + 5)$

$= 12$ kg.m/s

ในทิศ + x ตามแนวแกน + x

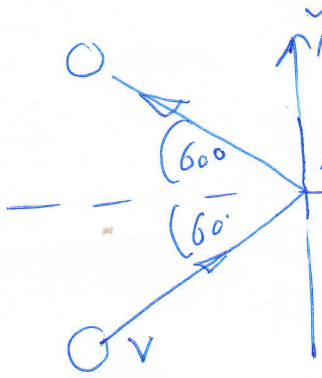
ข) $\Delta p = m(V_2 - V_1^{\,0}) = 2 \times V_2 = 12$

$V_2 = 6$ m/s ทิศ + x

ค) $\Delta \vec{p} = 12\hat{i} = m(V_2 - V_1) = 2(\vec{V_2} - (-2\hat{i}))$

$6\hat{i} = \vec{V_2} + 2\hat{i}$

5.3



$m = 3\ kg$

$V = 10\ m/s$

$\rightarrow +$

$\leftarrow -$

$$\Delta P_x = m(V_{2x} - V_{1x}) = m(-V\cos 60° - V\cos 60°)$$

$$= -2mV\cos 60° = -2 \times 3 \times 10 \times \frac{1}{2}$$

$$= -30\ kg\cdot m/s \quad \text{προς } -x$$

$$F_{\text{μέση δύναμη}} = \frac{\Delta P_x}{\Delta t} = \frac{-30}{0.2}\ \frac{kg\cdot m/s}{s} = -150\ N$$

την αντιμετωπίζουμε

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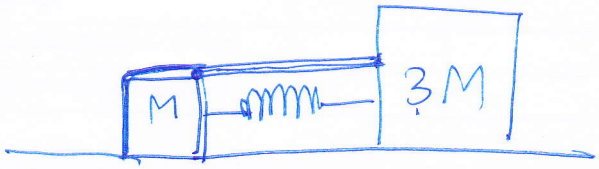
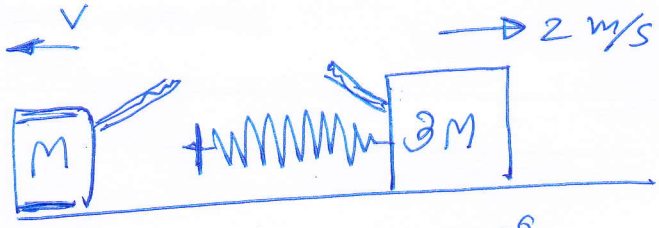
5.4



$\Sigma \vec{P}_{\text{αρχ}} = \Sigma \vec{P}_{\text{τελ}}$

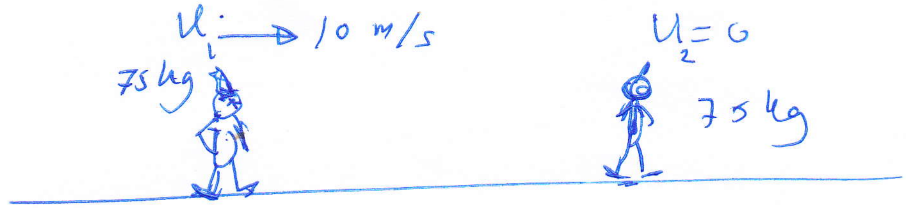


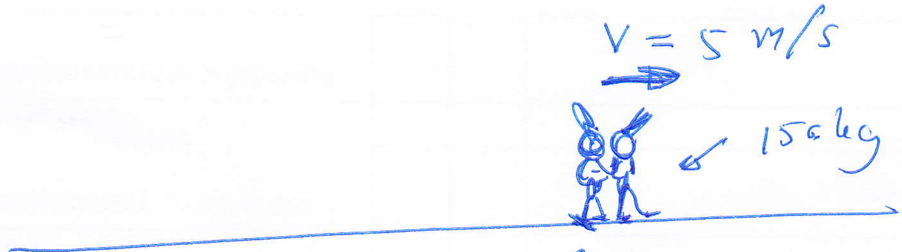
$$(M + 3M)\vec{u}^{\,0} = (3M)V_1 + M(-V)$$

$$0 = 3M(2) - MV$$

$$V = 6\ m/s \quad \#$$

5.5





$\Delta t = 0.1$ s

$F_{เฉลี่ย} = 4,500$ N

ที่ทำให้กระดูกไม่หัก

การชนของคนแรก $\Delta P = m(v-u)$

$= 75(5-10)$

$= -375$ kg.m/s

ได้ $F = \frac{\Delta P}{\Delta t} = \frac{-375}{0.1} = -3750$ N

เครื่องหมาย ⊖ แรงต้าน ขนาด น้อยกว่า 4,500 N

กระดูกยังคงไม่หัก

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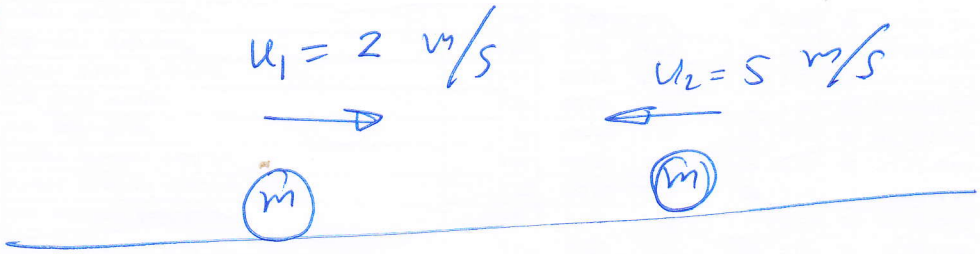
5.6



סכום התנע לפני = סכום התנע אחרי

$$mu_1 + mu_2 = mv_1 + mv_2$$

$$2 - 5 = v_1 + v_2$$

$$v_1 + v_2 = -3 \quad \text{——— (1)}$$

סכום האנרגיות לפני = סכום האנרגיות אחרי

$$\frac{1}{2}mu_1^2 + \frac{1}{2}mu_2^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2$$

$$u_1^2 + u_2^2 = v_1^2 + v_2^2$$

$$4 + 25 = v_1^2 + v_2^2$$

$$v_1^2 + v_2^2 = 29 \quad \text{——— (2)}$$

מ-(1) $(v_1+v_2)^2 = 9 = v_1^2 + 2v_1v_2 + v_2^2$

$$v_1^2 + v_2^2 + 2v_1v_2 = 9 \quad \text{——— (3)}$$

מ-(2) ו-(3) $\Rightarrow$ $29 + 2v_1v_2 = 9$

$$2v_1v_2 = -20$$

$$v_1v_2 = -10 \quad \text{——— (4)}$$

$$v_1 = -\frac{10}{v_2} \Rightarrow -\frac{10}{v_2} + v_2 = -3$$

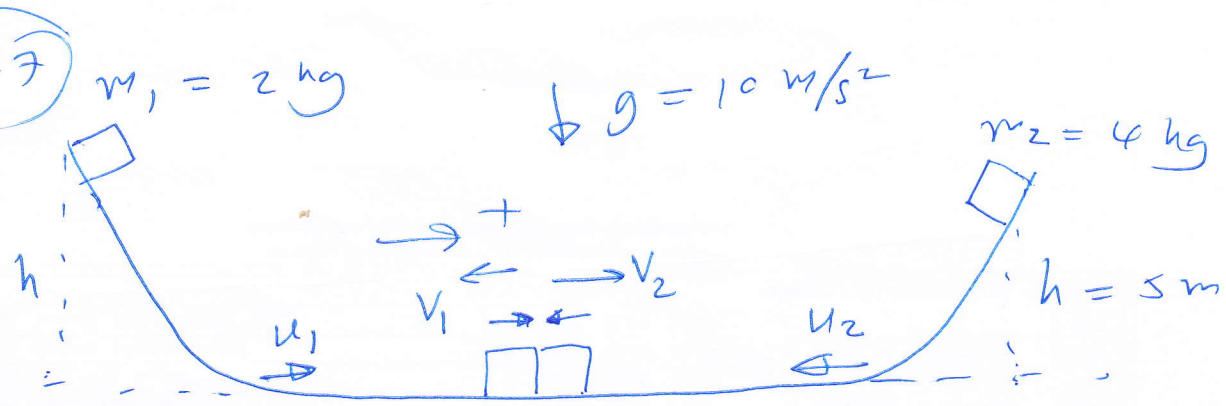
$$v_2^2 + 3v_2 - 10 = 0 \Rightarrow$$

$$(v_2+5)(v_2-2) = 0 \quad , v_2 = -5, 2 \text{ m/s}$$

מ-(1) v_2 מהירות -5 m/s $\vec{v} = -5\hat{i}$ m/s

$$v_1 = \frac{-10}{-5} = 2 \text{ m/s} \quad \# \equiv 2\hat{i} \text{ m/s}$$

5.7



(α) $u_1 = u_2 = \sqrt{2gh} = \sqrt{20 \times 5} = 10\ m/s$

$$\Sigma \vec{P}_{\text{πριν}} = \Sigma \vec{P}_{\text{μετά}}$$

$$m_1 u_1 + m_2 u_2 = m_1 \vec{v}_1 + m_2 \vec{v}_2$$

$$2 \times 10 - 4 \times 10 = 2\vec{v}_1 + 4\vec{v}_2$$

$$-20 = 2\vec{v}_1 + 4\vec{v}_2$$

$$\vec{v}_1 + 2\vec{v}_2 = -10 \quad \text{——— (1)}$$

$$\Sigma E_{\text{κ πριν}} = \Sigma E_{\text{κ μετά}}$$

$$\frac{1}{2} m_1 u_1^2 + \frac{1}{2} m_2 u_2^2 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$$

$$2 \times 100 + 4 \times (100) = 2v_1^2 + 4v_2^2$$

$$300 = 100 + 200 = v_1^2 + 2v_2^2 \quad \text{——— (2)}$$

από (1) (αντικατάσταση) $\Rightarrow v_1 + 2v_2 = -10$

$$(-10 - 2v_2)^2 + 2v_2^2 = 300$$

$$100 + 40v_2 + 4v_2^2 + 2v_2^2 = 300$$

$$6v_2^2 + 40v_2 - 200 = 0$$

$$3v_2^2 + 20v_2 - 100 = 0$$

$$(3v_2 - 10)(v_2 + 10) = 0$$

$$v_2 = \frac{10}{3}, -10 \ m/s \quad , v_2 > 0$$

$\therefore$ for $v_2 = \frac{10}{3}\ m/s \Rightarrow v_1 = -10 - 2\left(\frac{10}{3}\right) = -\frac{50}{3}\ m/s$

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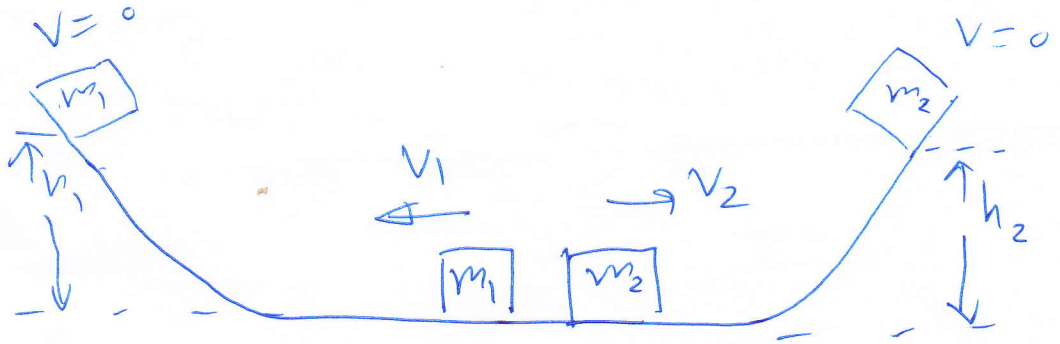
(a)



จากพลังงานศักย์

$$V_1 = \sqrt{2gh_1} \Rightarrow h_1 = \frac{V_1^2}{2g}$$

$$h_1 = \frac{\left(\frac{50}{3}\right)^2}{20} = 13.9 \text{ m}$$

$$h_2 = \frac{V_2^2}{2g} = \frac{\left(\frac{10}{3}\right)^2}{20} = 0.56 \text{ m}$$

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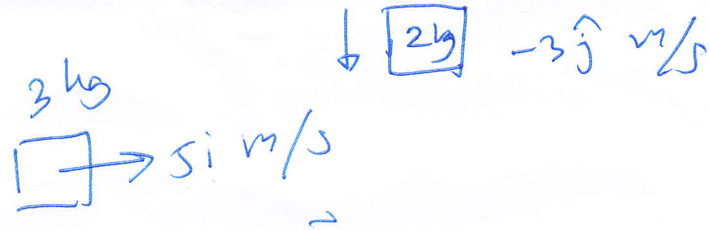
5.8



$\sum \vec{P}_{ก่อน} = \sum \vec{P}_{หลัง}$

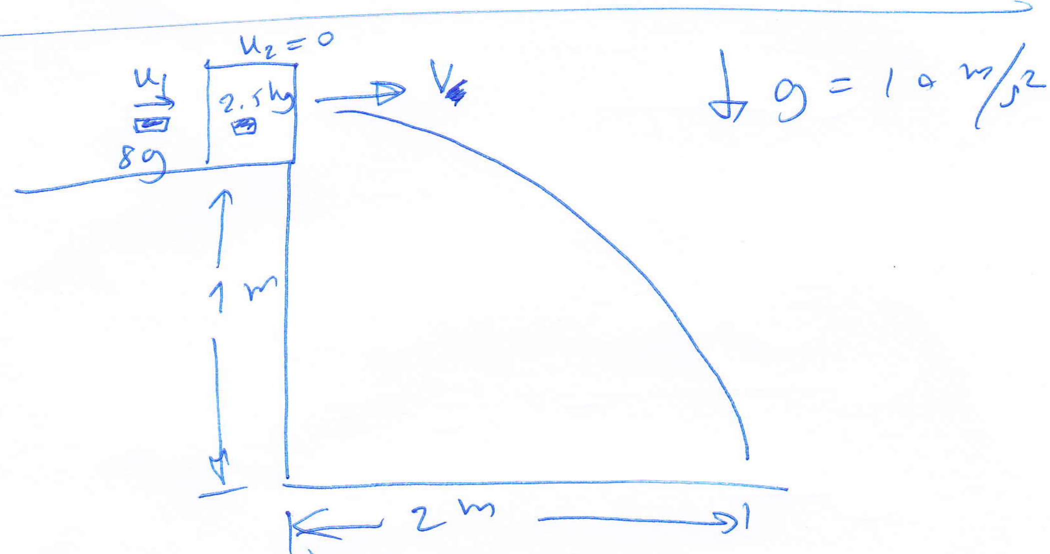
$m_1\vec{u}_1 + m_2\vec{u}_2 = (m_1 + m_2)\vec{v}$

$3(5\hat{i}) + 2(-3\hat{j}) = (3+2)\vec{v}$

$15\hat{i} - 6\hat{j} = 5\vec{v}$

$\vec{v} = 3\hat{i} - \frac{6}{5}\hat{j}$ m/s

5.9



$\sum \vec{P}_{ก่อน} = \sum \vec{P}_{หลัง}$

$m_1u_1 + m_2u_2^{\,0} = (m_1 + m_2)v$

$0.008\,u_1 = (0.008 + 2.5)V$

$0.008\,u_1 = 2.508\,V$

$8u_1 = 2508V \longrightarrow ①$

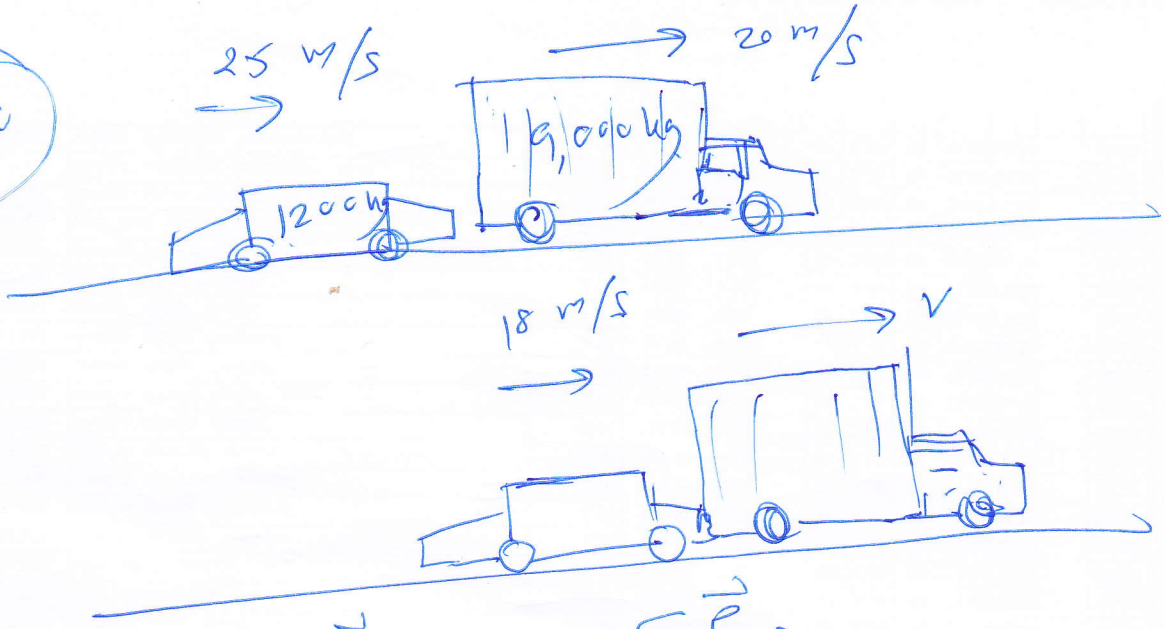
จากเหตุการณ์เป็นแบบโปรเจกไทล์

$S_y = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2S}{g}} = \sqrt{\frac{2\times 1}{10}} = \sqrt{0.2}$

จาก $S_x = V_xt = Vt \Rightarrow 2 = V(\sqrt{0.2})$

$\Rightarrow V = \frac{2}{\ldots} \longrightarrow ②$ แทน ② ใน ① $u_1 = \frac{2508}{8}\left(\frac{2}{\sqrt{0.2}}\right)$

5.10



$$\sum \vec{P}_{\text{ini}} = \sum \vec{P}_{\text{fin}}$$

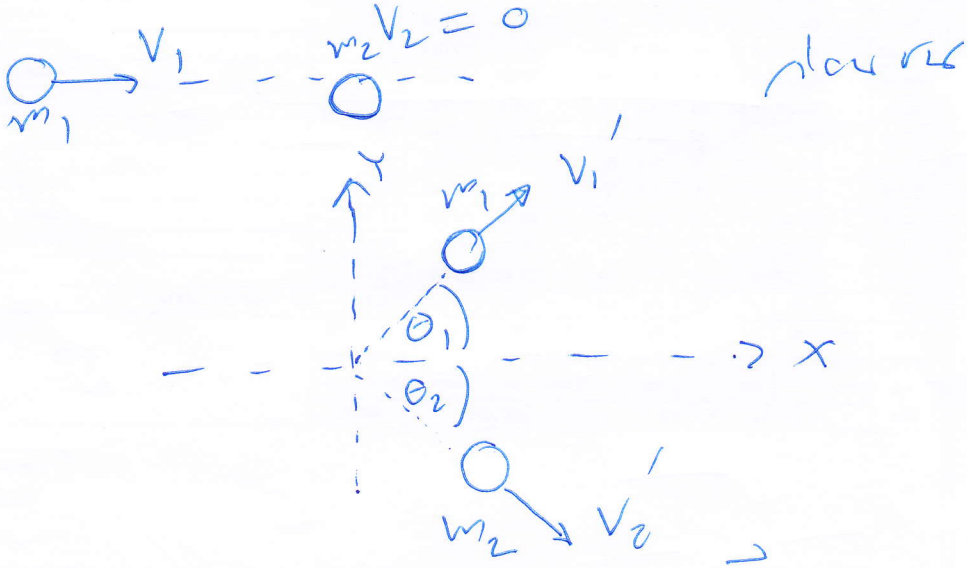
$$m_1 \vec{u}_1 + m_2 \vec{u}_2 = m_1 \vec{v}_1 + m_2 \vec{v}_2$$

$$1200 \times 25 + 9{,}000 \times 20 = 1200 \times 18 + 9{,}000\, V$$

$$30{,}000 + 180{,}000 = 21{,}600 + 9{,}000\, V$$

$$V = 20.93 \text{ m/s}$$

5.11



along x, $\sum \vec{P}_{x\,\text{ini}} = \sum \vec{P}_{x\,\text{fin}}$

$$m_1 V_1 + 0 = m_1 V_1' \cos\theta_1 + m_2 V_2' \cos\theta_2 \quad (1)$$

กฎการอนุรักษ์ y : $\Sigma \vec{P}_{y\,ก่อน} = \Sigma \vec{P}_{y\,หลัง}$

$$0 = m_1 v_1' \sin\theta_1 - m_2 v_2' \sin\theta_2 \quad \text{— ②}$$

จาก ① $m_2 v_2' \cos\theta_2 = m_1 v_1 - (\cos\theta_1) m_1 v_1'$

จาก ② $m_2 v_2' \sin\theta_2 = m_1 v_1' \sin\theta_1$ — ③ ④

④ ÷ ③ ได้ว่า

$$\tan\theta_2 = \frac{m_1 v_1' \sin\theta_1}{m_1 v_1 - m_1 v_1' \cos\theta_1}$$

ถ้า $m_1 = m_2$ ได้ว่า

$$\tan\theta_2 = \frac{v_1' \sin\theta_1}{v_1 - v_1' \cos\theta_1} \quad \#$$