UTS FISIKA IA 2016 Reynald Saputra

1) a. * Saat $t = t_1$ sampai $t = t_3$, $a_x(t) = -\frac{3}{5}t + 9$ sehingga

$$a_x(t_3) = -3$$
$$-\frac{3}{5}t_3 + 9 = -3$$
$$-\frac{3}{5}t_3 = -12$$
$$t_3 = 20 \text{ sekon}$$

* Karena di t_4, mobil berhenti maka

$$\int_0^{t_4} a_x(t)\,dt = 0$$
$$\frac{(10+15)}{2}\cdot 3 - \frac{(t_4 - 15 + t_4 - 20)}{2}\cdot 3 = 0$$
$$\frac{75}{2} - \frac{(2t_4 - 35)}{2}\cdot 3 = 0$$
$$75 - 6t_4 + 105 = 0$$
$$6t_4 = 180$$
$$t_4 = 30 \text{ sekon}$$

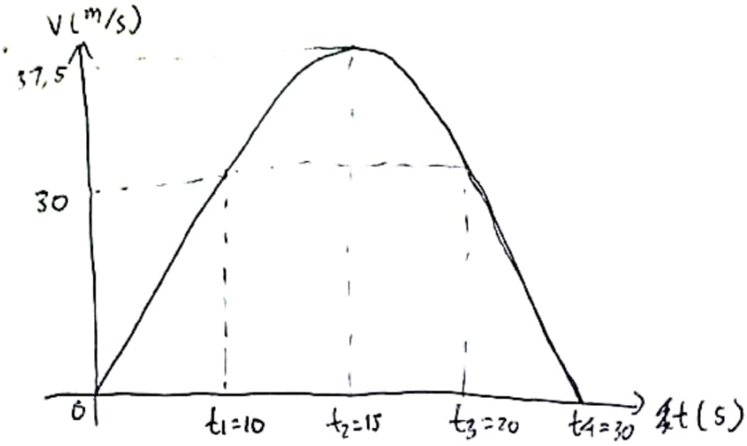
b. * Untuk $\cancel{t_1 - t_2}$ $0 - t_1$: $V(t) = 3t \Rightarrow V(t_1) = V(10) = 30$

* Untuk $t_1 - t_2$: $V(t) = -\frac{3}{10}t^2 + 9t + C \Rightarrow V(10) = -\frac{3}{10}\cdot 10^2 + 90 + C = 30$
$\Rightarrow C = -30$

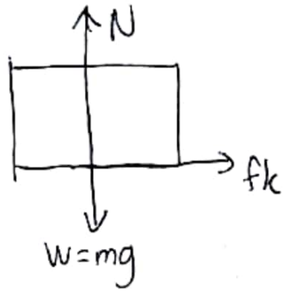
* Jarak : $\int_0^{t_2} v(t)\,dt = \int_0^{t_1} v(t)\,dt + \int_{t_1}^{t_2} v(t)\,dt$

$$= \int_0^{10} 3t\,dt + \int_{10}^{15} \left(-\frac{3}{10}t^2 + 9t - 30\right)dt$$
$$= \frac{3}{2}t^2\Big|_0^{10} + \left[-\frac{1}{10}t^3 + \frac{9}{2}t^2 - 30t\right]_{10}^{15}$$
$$= 150 + \left(-\frac{1}{10}\cdot 15^3 + \frac{9}{2}\cdot 15^2 - 30\cdot 15 + \frac{1}{10}\cdot 10^3 - \frac{9}{2}\cdot 10^2 + 30\cdot 10\right)$$
$$= 150 + 175$$
$$= 325 \text{ m}$$

c.



2) a.



b. $\Sigma F_x = m \cdot a_1$ (a_1 percepatan balok relatif terhadap tanah)

$f_k = m \cdot a_1$

$\mu_k \cdot N = m \cdot a_1$

$\mu_k \, mg = m \cdot a_1$

$a_1 = \mu_k \cdot g = (0{,}15)(10) = 1{,}5 \text{ m/s}^2$

c. Misal a_{12} percepatan relatif balok terhadap mobil.

$a_{12} = a_1 - a_2 = 1{,}5 - 2 = -0{,}5 \text{ m/s}^2$

$\Rightarrow s = V_0 \cdot t + \frac{1}{2} a_{12} t^2$

$-4 = 0 - \frac{1}{2} \cdot (0{,}5) \, t^2$

$t^2 = 16$

$t = 4$ sekon

d. komponen kecepatan horizontal saat menyentuh tanah sama dengan kecepatan horizontal saat meninggalkan mobil.

$V_x = V_0 + a_1 t = 0 + (1{,}5)(4) = 6 \text{ m/s}$

3) a. Misal benda berhenti di titik D (Di antara B dan C).

$\Delta E_k + \Delta E_p = W_{gesek}$

$(0 - \frac{1}{2} m V_0^2) + (mg \, s_{BD} \sin\theta) = -\mu_k mg \cos\theta \cdot s_{BD}$

$\mu_k \, mg \cos\theta \, s_{BD} + mg \, s_{BD} \sin\theta = \frac{1}{2} m V_0^2$

$$s_{BD} = \frac{V_0^2}{2g(\mu_k \cos\theta + \sin\theta)} = \frac{5^2}{2(10)(0{,}5 \cdot \frac{4}{5} + \frac{3}{5})} = 1{,}25 \text{ m}$$

b. Energi yang hilang : $|W_{gesek}| = \mu_k mg \cos\theta \, S_{BD} = (0,5)(5)(10)\frac{4}{5}(\cancel{1,76}^{1,25}) \approx 25$ J

c. * gaya gesek statik max : $\mu_s mg\cos\theta = 28$ N

* gaya : $mg \sin\theta = 30$ N

Karena gaya lebih besar maka benda akan turun kembali

d. Dari a),

$V_0^2 = 2g\,S_{BC}(\sin\theta + \mu_k \cos\theta) = 40$

$V_0 = \sqrt{40}$ m/s $\approx 6,32$ m/s

4) a. Karena lenting sempurna maka,

$V_A - V_B = V_B' - V_A'$

$V_A - 0 = V_B' - V_A'$

$V_A = V_B' - V_A' \Rightarrow V_A' = V_B' - V_A = V_B' - V_0$

$\Rightarrow$ Hukum kekekalan momentum,

$m_A V_A + m_B V_B = m_A V_A' + m_B V_B'$

$2m_B V_0 + m_B(0) = 2m_B(V_B' - V_0) + m_B V_B'$

$2V_0 = 2V_B' - 2V_0 + V_B'$

$4V_0 = 3V_B'$

$V_B' = \frac{4}{3}V_0$

$\Rightarrow m_B V_B' + m_C V_C = m_B V_B'' + m_C V_C'$

$m_B(\frac{4}{3}V_0) + 2m_B(0) = m_B(V_C' - V_B') + 2m_B V_C'$

$\frac{4}{3}V_0 = V_C' - V_B' + 2V_C'$

$\frac{4}{3}V_0 = 3V_C' - \frac{4}{3}V_0$

$\frac{8}{3}V_0 = 3V_C'$

$V_C' = \frac{8}{9}V_0$

b. Karena tidak ada gaya eksternal maka kecepatan pusat massa konstan.

$$V = \frac{m_A V_A + m_B V_B + m_C V_C}{m_A + m_B + m_C} = \frac{m_A V_0}{m_A + \frac{1}{2}m_A + m_A} = \frac{m_A V_0}{\frac{5}{2}m_A} = \frac{2}{5}V_0$$

c. • Waktu dari B ke C: $t_1 = \frac{L}{V_B'} = \frac{3L}{4V_0}$ sekon $\Rightarrow$ jarak A $= V_A' t_1$

$= (V_B' - V_A)\, t_1$

$= (\frac{4}{3}V_0 - V_0)\, \frac{3L}{4V_0}$

$= \frac{1}{4} L$ meter

* Ketika B menumbuk A untuk kedua kalinya,

$\cancel{V_A'}$ $|V_A'|t + |V_B''|t = \frac{3}{4}L$

$\frac{1}{3}V_0 t + |(V_C' - V_B')|t = \frac{3}{4}L$

$\frac{1}{3}V_0 t + \frac{4}{9}V_0 t = \frac{3}{4}L$

$\frac{7}{9} V_0 t = \frac{3}{4}L$

$t = \frac{27}{28}\frac{L}{V_0}$ sekon

* Selang waktu : $t_1 + t = \frac{3}{4}\frac{L}{V_0} + \frac{27}{28}\frac{L}{V_0} = \frac{48}{28}\frac{L}{V_0} = \frac{12}{7}\frac{L}{V_0}$ sekon

5) a. ~~20 detik = 10 putaran~~
~~2 detik = 1 putaran~~

* $\theta = \omega_0 \cdot t + \frac{1}{2}\alpha_1 t^2$

$20\pi = 0 + \frac{1}{2}\alpha_1 (20)^2$

$40\pi = 400\,\alpha_1$

$\alpha_1 = \frac{\pi}{10}$ rad/s^2

* $\omega_t = \omega_0 + \alpha_1 t$

$\omega_{20} = 0 + \frac{\pi}{10} \cdot 20$

$= 2\pi$ rad/s

b. ~~$\omega_t^2 = \omega_0^2 + 2\alpha_2\theta$~~

* $\omega_t = \omega_0 + \alpha_2 t$

$0 = \omega_{20} + \alpha_2 (50)$

$0 = 2\pi + \alpha_2 (50)$

$\alpha_2 = -\frac{\pi}{25}$ rad/s^2

* $\theta = \omega_0 \cdot t + \frac{1}{2}\alpha_2 t^2$

$= \omega_{20}\, t + \frac{1}{2}\alpha_2 t^2$

$= 2\pi (50) - \frac{1}{2} \cdot \frac{\pi}{25} \cdot (50)^2$

$= 100\pi - 50\pi$

$= 50\pi \rightarrow 25$ putaran

c. * $a_t = \alpha R = \alpha_2 . R = -\frac{\pi}{25} . 2 = -\frac{2\pi}{25}$ m/s^2

* $a_{sp} = \omega^2 R = \omega_{25}^2 \cdot R = (2\pi \cdot 5 - \frac{1}{2} \cdot \frac{\pi}{25} \cdot 5^2)^2 \cdot 2$

$= \left(\frac{19}{2}\pi\right)^2 \cdot 2$

$= \frac{361}{2}\pi^2$ m/s^2