$\underline{3/182}$ No difference between cases (a) & (b).

$G_1 = G_2: \quad mv = (3m)v', \quad v' = \frac{v}{3}$

$T = \frac{1}{2}mv^2, \quad T' = \frac{1}{2}(3m)\left(\frac{v}{3}\right)^2 = \frac{1}{6}mv^2$

$n = \frac{T - T'}{T} = \frac{\frac{1}{2}mv^2 - \frac{1}{6}mv^2}{\frac{1}{2}mv^2} = \underline{\frac{2}{3}}$

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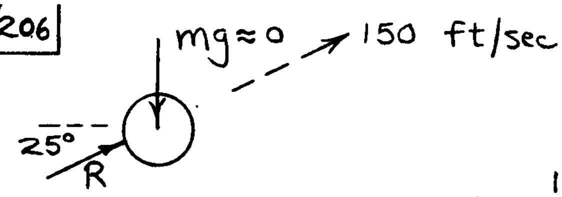


$$\nearrow^{+} \; R\Delta t = mv : \quad R(0.001) = \frac{1.62/16}{32.2}(150)$$

$$\underline{R = 472 \text{ lb}}$$

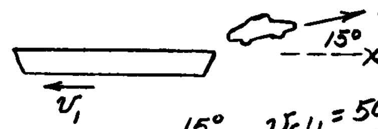
$$\nearrow^{+} \; R = ma : \quad 472 = \frac{1.62/16}{32.2}\, a$$

$$\underline{a = 150{,}000 \text{ ft/sec}^2 \; (4660g)}$$

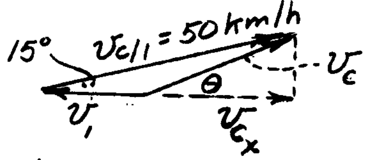
$$v^2 - v_0^2 = 2ad : \quad 150^2 - 0^2 = 2(150{,}000)\, d$$

$$\underline{d = 0.075 \text{ ft or } 0.900 \text{ in.}}$$

▸3/218



v_c = absolute velocity of car.



$\underline{v}_c = \underline{v}_1 + \underline{v}_{c/1}$

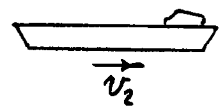
$v_{c_x} = 50\cos 15^\circ - v_1$

$= 48.296 - v_1$ km/h

$\Delta G_x = 0$; $500 \times 10^3 v_1 = 1500(48.296 - v_1)$, $v_1 = 0.144 \frac{\text{km}}{\text{h}}$

$v_{c_x} = 48.152$ km/h   or $v_1 = 40.1 \frac{\text{mm}}{\text{s}}$

$\Delta G_x = 0$



$1500(48.152) = 501500\, v_2$

$v_2 = 0.144$ km/h

or $\underline{v_2 = 40.0 \text{ mm/s}}$

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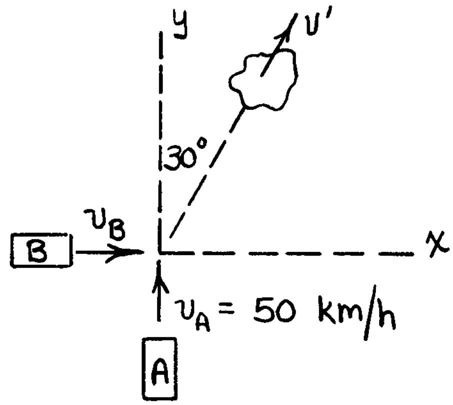

$G_{1x} = G_{2x}$: $m_B v_B + 0 = (m_A + m_B) v' \sin 30°$

$$1600\, v_B = 2800\, v' \left(\tfrac{1}{2}\right) \qquad (1)$$

$G_{1y} = G_{2y}$: $m_A v_A + 0 = (m_A + m_B) v' \cos 30°$

$$1200\,(50) = 2800\, v' (0.866) \qquad (2)$$

From (2): $v' = 24.7$ km/h

From (1): $\underline{v_B = 21.7 \text{ km/h}}$

3/261 Let v_s and v_b stand for rebound velocities from steel and brass plates.

Impact speed $= \sqrt{2gh} = \sqrt{2(9.81)(0.15)} = 1.716$ m/s

$$\left.\begin{array}{l} 0.6 = \dfrac{v_s}{1.716},\ v_s = 1.029 \text{ m/s} \\ 0.4 = \dfrac{v_s}{1.716},\ v_b = 0.686 \text{ m/s} \end{array}\right\} \quad \omega = \frac{1.029 - 0.686}{0.60}$$

$$= 0.572 \text{ rad/s}$$

CCW

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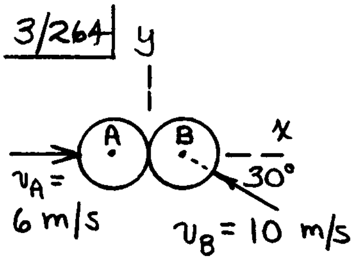

$v_{A_y}' = v_{A_y} = 0$

$v_{B_y}' = v_{B_y} = 10 \sin 30° = 5$ m/s

$$m_A v_{A_x} + m_B v_{B_x} = m_A v_{A_x}' + m_B v_{B_x}'$$

$$6 - 10\cos 30° = v_{A_x}' + v_{B_x}' \qquad (1)$$

$$e = \frac{v_{B_x}' - v_{A_x}'}{v_{A_x} - v_{B_x}} : \quad 0.75 = \frac{v_{B_x}' - v_{A_x}'}{6 - (-10\cos 30°)} \qquad (2)$$

Solve Eqs. (1) & (2): $\begin{cases} v_{A_x}' = -6.83 \text{ m/s} \\ v_{B_x}' = 4.17 \text{ m/s} \end{cases}$

Magnitudes and directions $\angle \theta$ x

$\underline{v_A' = 6.83 \ \frac{m}{s} @ \theta_A = 180°}$

$\underline{v_B' = 6.51 \ \frac{m}{s} @ \theta_B = 50.2°}$

Initial: $T_1 = \frac{1}{2} m (6^2 + 10^2) = 68 m$

Final: $T_2 = \frac{1}{2} m (6.83^2 + 6.51^2) = 44.5 m$

$$n = \frac{68 - 44.5}{68}(100\%) = \underline{34.6\%}$$

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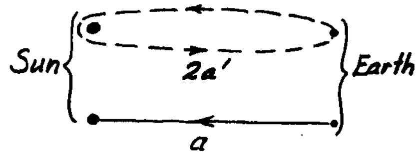
Radius of actual orbit around the sun is a, which is the major axis $2a'$ of the degenerate ellipse.



R = radius of sun

g = gravitational accel. on surface of sun

Orbital period Eq. 3/40

For actual orbit $\tau = 2\pi \dfrac{a^{3/2}}{R\sqrt{g}}$

For degenerate ellipse $\tau' = 2\pi \dfrac{(a/2)^{3/2}}{R\sqrt{g}}$

so $\dfrac{\tau'}{\tau} = \dfrac{(\frac{1}{2})^{3/2}}{1}$

But time t to fall is $t = \frac{1}{2}\tau' = \frac{1}{2}\left(\frac{1}{2}\right)^{3/2}\tau = \frac{1}{4\sqrt{2}} 365.26$

$= \underline{64.6 \text{ days}}$

3/283 The apogee speed at C is

$$v_a = R\sqrt{\frac{g}{a}}\sqrt{\frac{r_{min}}{r_{max}}}$$

$$= 6371(10^3)\sqrt{\frac{9.825}{(2\cdot 6371+240+320)1000/2}}\sqrt{\frac{6371+240}{6371+320}}$$

$$= 7697 \text{ m/s}$$

The circular orbit speed at $h = 320$ km is

$$v_{circ} = R\sqrt{g/r_{max}} = 7720 \text{ m/s}$$

$$\Delta v = v_{circ} - v_a = 7720 - 7697 = 23.25 \text{ m/s}$$

$$F\Delta t = m\Delta v: \quad 2(30\,000)(\Delta t) = 85\,000(23.25)$$

$$\underline{\Delta t = 32.9 \text{ s}}$$

The burn to increase speed is at C.

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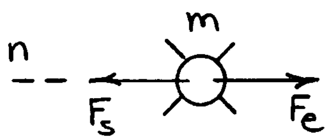

F_s : force exerted on spacecraft by sun

F_e : force exerted on spacecraft by earth

$$\Sigma F_n = ma_n : \quad F_s - F_e = m\frac{v^2}{\rho} = m\rho\omega^2$$
$$= m(D-h)\left(\frac{2\pi}{T}\right)^2$$

where D is the earth-sun distance and T is the earth orbital period.

$$\frac{Gm_s \cancel{m}}{(D-h)^2} - \frac{Gm_e \cancel{m}}{h^2} = \cancel{m}(D-h)\left(\frac{2\pi}{T}\right)^2$$

With $G = 3.439(10^{-8})\dfrac{ft^4}{lb\text{-}sec^4}$, $m_s = 333{,}000\, m_e$, $m_e = 4.095(10^{23})$ slugs, $D = 92.96(10^6)(5280)$ ft, and $T = 365.26(24)(3600)$ sec, solve numerically for h as $h = 4.87(10^9)$ ft or $\underline{922{,}000 \text{ mi}}$