Exercise 1

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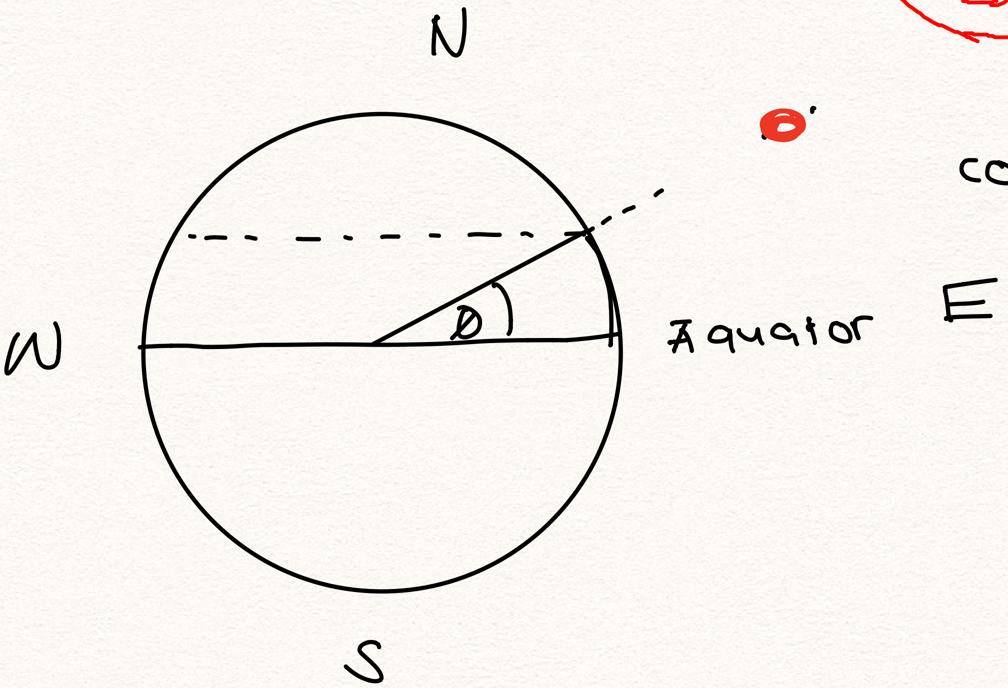

$\cos\theta = \frac{Ad}{Hyp}$

$$\omega = \frac{2\pi \text{ rad}}{1 \text{ day}} \cdot \frac{1 \text{ day}}{24 h} \cdot \frac{1 h}{60 \cdot 60}$$

$\omega = 7.27 \cdot 10^{-5}$ ✓ , $v = r\omega$ ✓

$h = \frac{1}{2} g t_{1/2}^2 \rightarrow t_{\frac{1}{2}} = \sqrt{\frac{2h}{g}}$ ✓

$t = 2\sqrt{\frac{2h}{g}}$ ✓

$s = v \cdot t = 7.27 \cdot 10^{-5} \frac{\text{rad}}{s} \cdot 6.371 \cdot 10^{6} \text{ m} \cdot 2\sqrt{\frac{2h}{g}}$

you need to take R'

→ O.K. this will give you the expression of Coriolis force...

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Exercise 2

$$\rho = \frac{m}{V} \Rightarrow m = \rho \cdot V$$

f below sea level?

$\rho_{obj} < \rho_{LIQ}$ Object will float

$W_{DISPL\,LIQ} = W_{object}$ ✓

$m_L g = m_o g$ ✓

$\rho_L \cdot \underbrace{V_L}_{\text{volume displaced liquid}} \cdot \cancel{g} = \rho_o \cdot V_o \cdot \cancel{g}$ ✓

$$\frac{V_L}{V_o} = \frac{\rho_o}{\rho_e} \Rightarrow f = \frac{V_L}{V_o} = \frac{\rho_o}{\rho_L}$$ ✓

$$f = \frac{\rho_o}{\rho_L} = \frac{920}{1025} = \underline{90\%}$$ ✓

$\rho_o = 920 \ \frac{kg}{m^3}$ (ice)

$\rho_L = 1025$ (sea water)

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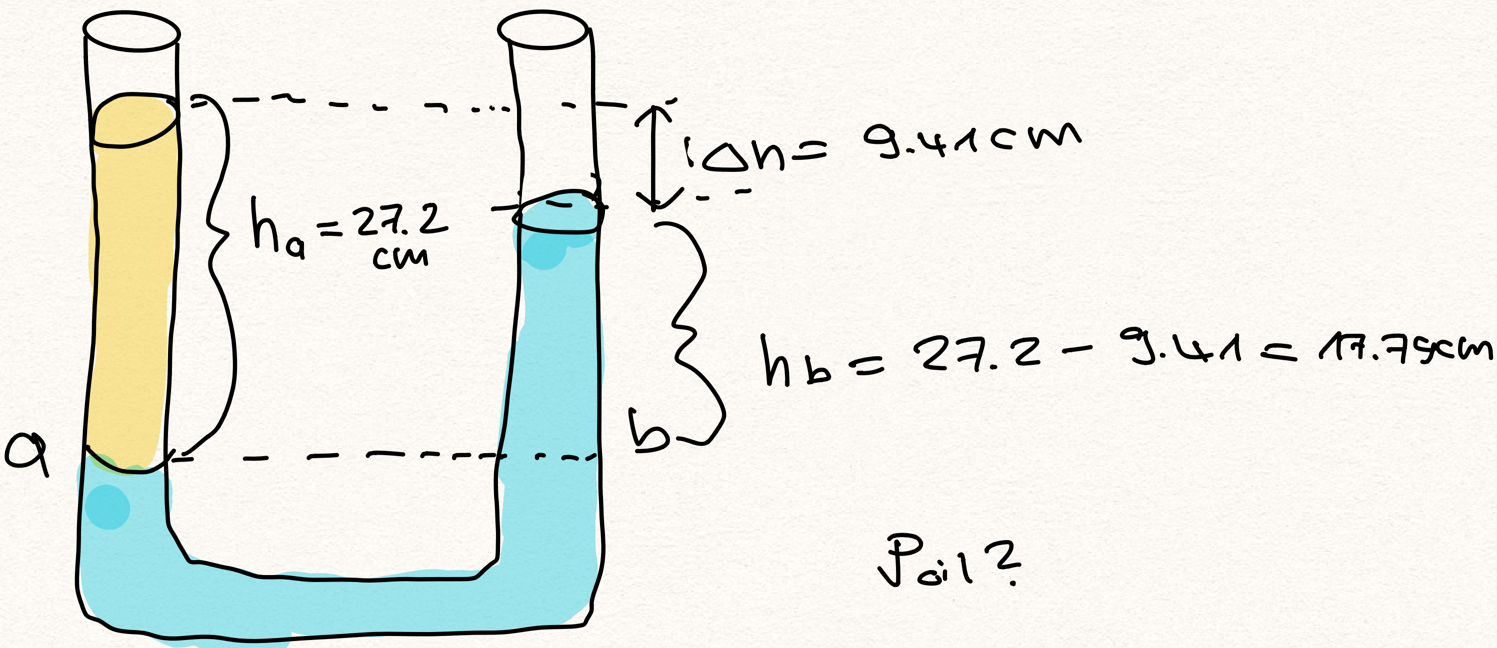
Exercise 3



$$P_a = P_b \quad ✓$$

$$\rho_{oil}\, \cancel{g}\, h_a = \rho_{water}\, \cancel{g}\, h_b \quad ✓$$

$$\rho_{oil} = \frac{\rho_{water} \cdot h_b}{h_a} = \frac{1000 \frac{kg}{m^3} \cdot 0.1779 m}{0.272 m} \quad ✓$$

$$\rho_{oil} = 654 \frac{kg}{m^3} \quad ✓$$

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Exercise 4

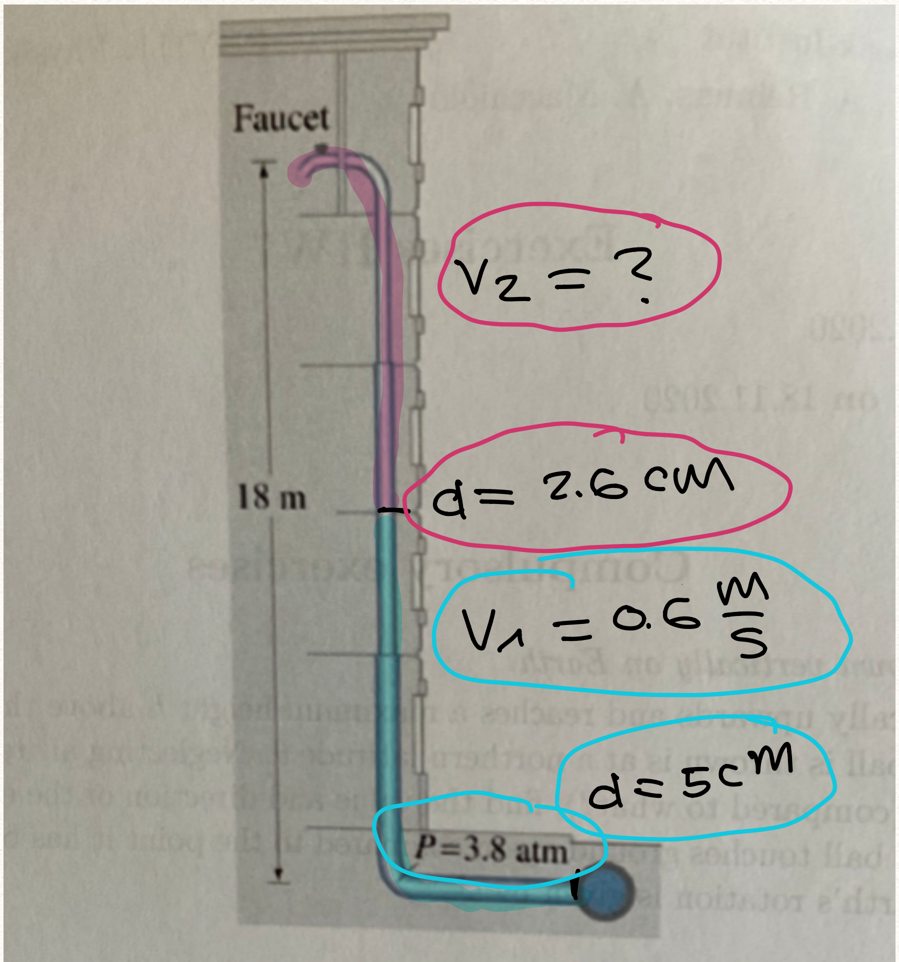

Figure 2: Pipe of decreasing diameter in a building

$\rho_{water} = 1000\,\frac{kg}{m^3}$

$$P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho V_2^2 \quad ✓$$

$$\frac{\Delta V}{\Delta t} = \text{constant} \quad , \quad \frac{\Delta V}{\Delta t} = v A = \text{constant}$$

$$v_1 A_1 = v_2 \cdot A_2 \quad ✓$$

$$v_2 = \frac{v_1 A_1}{A_2} = \frac{v_1 \cancel{\pi} R_1^2}{\cancel{\pi} R_2^2} = \frac{v_1 R_1^2}{R_2^2}$$

$$= \frac{\left(0.6\,\frac{m}{s}\right)(0.025\,m)^2}{(0.013\,m)^2}$$

$$v_2 = \underline{2.2\,\frac{m}{s}}$$ ✓

$$P_2 = P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 - \rho g h_2 - \frac{1}{2}\rho v_2^2$$

$$P_2 = P_1 + \rho g(\cancel{h_1}^{0} - h_2) + \frac{1}{2}\rho v_1^2 - \frac{1}{2}\rho v_2^2$$

$$P_2 = 3.8\,(101\,325\ Pa) - 1000$$

$$P_2 = 3.8(101\,325\ Pa) - 1000\left[\frac{kg}{m^3}\right] 9.8\left[\frac{m}{s^2}\right] 18\,[m] + \frac{1}{2}\cdot 1000\left[\frac{kg}{m^3}\right]\cdot 0.6\,\frac{m}{s}$$
$$- \frac{1}{2}\cdot 1000\left[\frac{kg}{m^3}\right]\cdot 2.2\,\frac{m}{s}$$

$$P_2 = 207\,825.5\left(\frac{1}{101325\,Pa}\right) = \underline{2.1\ ATM}$$ ✓

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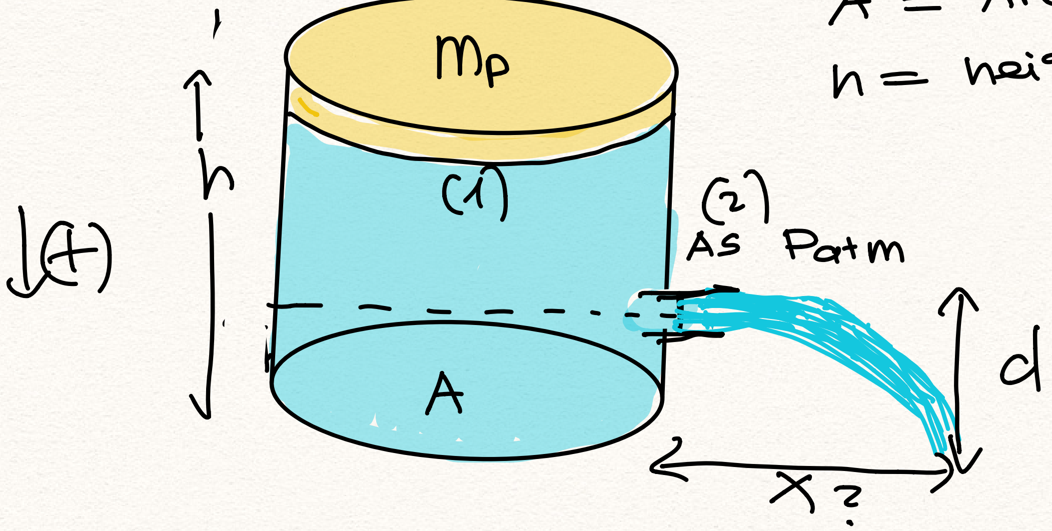
Exercise 5

$\rho_L = \rho$

A = Area

h = height



$$\underset{(1)}{P_1 + \rho g h + \cancel{\tfrac{1}{2}\rho v_1^2}^{\,0}} = \underset{(2)}{P_2 + \rho g d + \tfrac{1}{2}\rho v_2^2}$$

$$P_1 + \rho g(h-d) = P_2 + \tfrac{1}{2}\rho v_2^2$$

can simplify

$$\sqrt{\frac{2}{\rho}\Big(\underbrace{P_1 - P_2}_{\cancel{P_{atm}} + P_{piston} - \cancel{P_{atm}} \,=\, P_{piston}} + \rho g(h-d)\Big)} = v_2$$

$$P_{piston} = \frac{F}{A} = \left(\frac{m_p g}{A}\right)$$

$$\Rightarrow \boxed{v_2 = \sqrt{\frac{2}{\rho}\left(\frac{m_p g}{A} + \rho g (h-d)\right)}}$$

$$x(t) = v_0 t + \frac{1}{2} a t^2$$

$$y(t) = \frac{1}{2} a t^2$$

$$d = \frac{1}{2} g t^2$$

$$\boxed{\sqrt{\frac{2d}{g}} = t}$$ ✓

$$x = v_2 \cdot t$$ ✓

$$x = \sqrt{\frac{2}{\rho}\left(\frac{mg}{A} + \rho g(h-d)\right)} \cdot \sqrt{\frac{2d}{g}}$$

$$x = \sqrt{\frac{4d}{\rho g}\left(\frac{mg}{A} + \rho g(h-d)\right)}$$

$$x = 2\sqrt{\frac{md}{\rho A} + dh - d^2}$$ ✓

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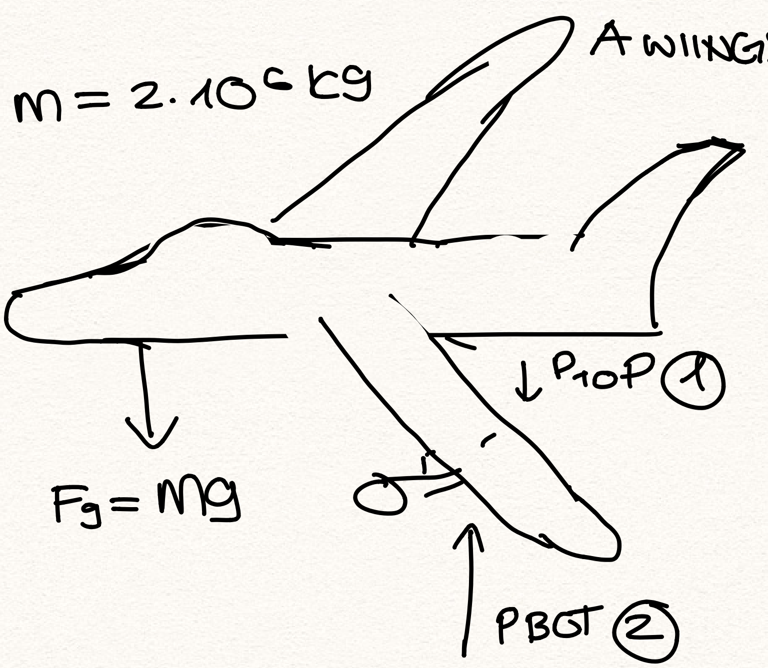
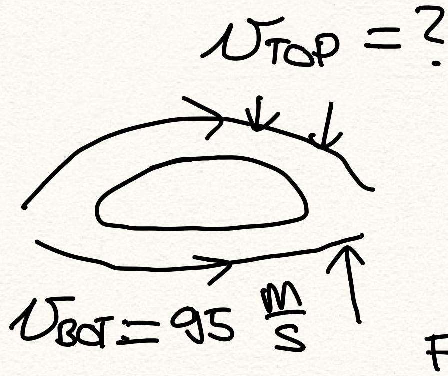
Exercise 6





$P_{BOT} > P_{TOP}$

$F = \Delta P \cdot A$

to stay in air: $mg = \Delta P \cdot A$

$$\frac{mg}{A} = \Delta P$$

$$P_1 + \rho \cancel{g h_1}^{0} + \frac{1}{2}\rho v_1^2 = P_2 + \rho \cancel{g h_2}^{0} + \frac{1}{2}\rho v_2^2$$

$$\underbrace{P_2 - P_1}_{\Delta P} = \frac{1}{2}\rho v_1^2 - \frac{1}{2}\rho v_2^2$$

$$2\frac{mg}{A} = \rho(v_1^2 - v_2^2) \quad ✓$$

$$\frac{2mg}{\rho A} = v_1^2 - v_2^2 \quad ✓$$

$$\sqrt{\frac{2mg}{\rho A} + v_2^2} = v_1$$

$$v_f = \sqrt{\frac{(2)(2 \cdot 10^6\ kg)(9.8\ \frac{m}{s^2})}{(1200\ m^2)(1.29\ \frac{kg}{m^3})} + 95\frac{m}{s}^2}$$

$$v_1 = \underline{185\ \frac{km}{h}}$$

minimum Velocity at top at wing ✓

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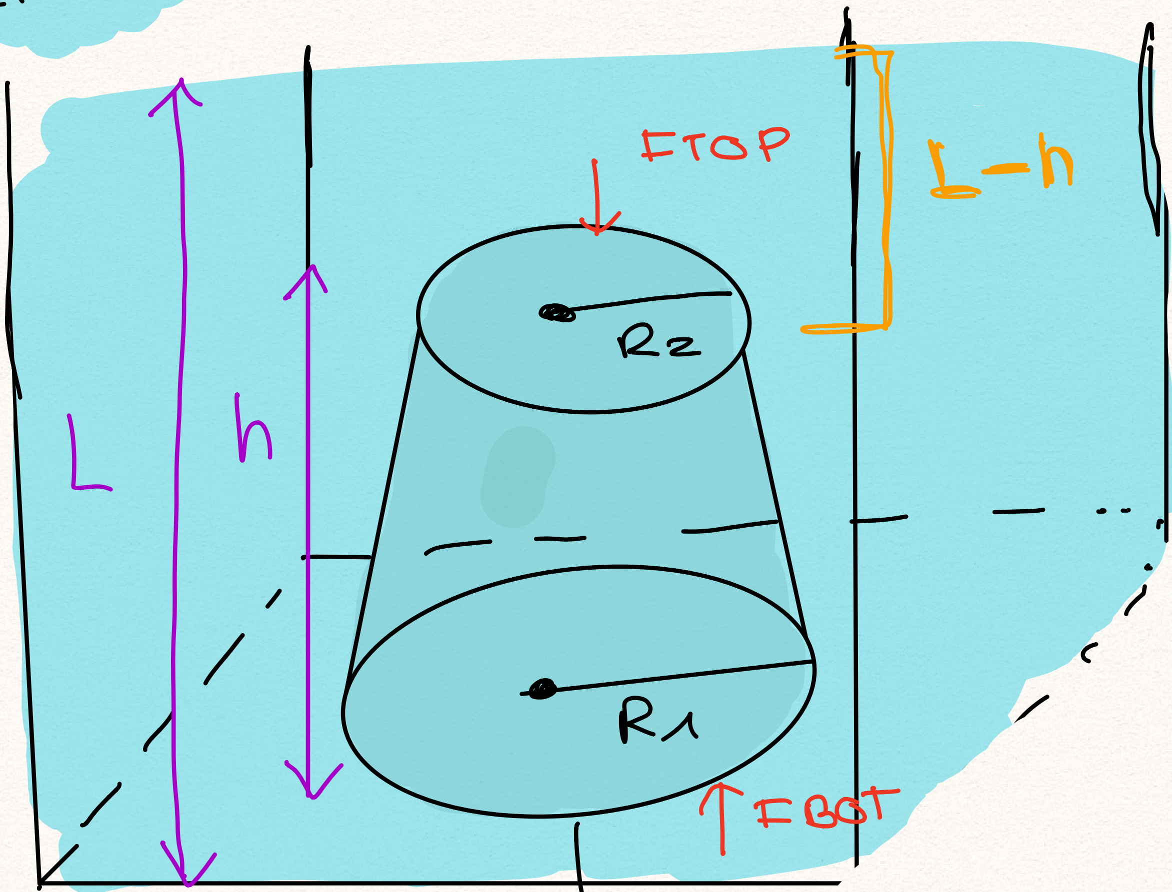
Exercise 7

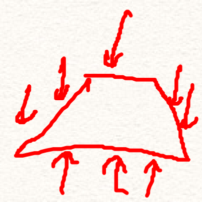


$$V_c = \frac{h\pi}{3}(R_1^2 + R_1R_2 + R_2^2)$$

$\rho_L > \rho_C$

$\rho = \frac{m}{V}$

$\Sigma P = 0$



$$F_B = F_{BOT} - F_{TOD}$$

$$P = \frac{F}{A} \to F = P \cdot A \quad , \quad P = \rho g y$$

not exactly... there is also P on the walls

$$F_B = P_{BOT}A_{BOT} - P_{TOP}\cdot A_{TOP}$$

$$F_B = (\rho_L g L)(\pi R_1^2) - (\rho_L g (L-h))(\pi R_2^2)$$

$$F_B = \rho_L g L \pi R_1^2 - (\rho_L g L - \rho_L g h)(\pi R_2^2)$$

$$F_B = \rho_L g L \pi R_1^2 - \rho_L g L \pi R_2^2 - \rho_L g h \pi R_2^2$$

$$F_B = \rho_L g \pi (L R_1^2 - L R_2^2 - h R_2^2)$$

$\to$ Use Archimede

Stays at bottom if.

$W_{object} \geq F_B$

$\rho_c V_c g \geq F_B$

$\rho_c \frac{h\pi}{3} (R_1^2 + R_1 R_2 + R_2^2) g \geq F_B$

$\rho_c \frac{\pi}{3} (R_1^2 + R_1 R_2 + R_2^2) \cancel{g} \geq \rho_L \cancel{g} \cancel{\pi} (L R_1^2 - L R_2^2 - h R_2^2)$

$\frac{1}{3} \rho_c (R_1^2 + R_1 R_2 + R_2^2) \geq \rho_L (L R_1^2 - L R_2^2 - h R_2^2)$

?

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