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Finally I get this ebook, thanks for all these I can get now!

#Rio

Cool! I'am really happy

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I did not think that this would work, my best friend showed me this website, and it does! I get my most wanted eBook

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My friends are so mad that they do not know how I have all the high quality ebook which they do not!

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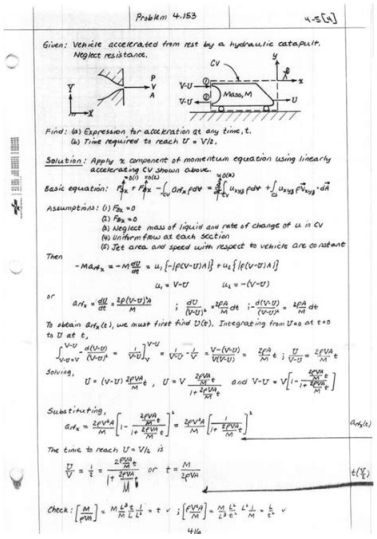
so many fake sites. this is the first one which worked! Many thanks



Problem 4.153

Given: Vehicle accelerated from rest by a hydraulic catapult. Neglect resistance.

Find: (a) Expression for acceleration at any time, t.
(b) Time required to reach U = V/2.

Solution: Apply x component of momentum equation using linearly accelerating CV shown above.

Basic equation: $F_{Sx} + F_{Bx} = -\int_{CV} a_{rel_x}\rho\,dV = \frac{\partial}{\partial t}\int_{CV} u_{xyz}\rho\,dV + \int_{CS} u_{xyz}\rho\vec{V}_{xyz}\cdot d\vec{A}$

Assumptions: (1) $F_{Sx} = 0$
(2) $F_{Bx} = 0$
(3) Neglect mass of liquid and rate of change of u in CV
(4) Uniform flow at each section
(5) Jet area and speed with respect to vehicle are constant

Then $-Ma_{rel_x} = -M\frac{dU}{dt} = u_1\left[-\rho(V-U)A\right] + u_2\left[\rho(V-U)A\right]$

$u_1 = V-U \qquad u_2 = -(V-U)$

or $a_{rel} = \frac{dU}{dt} = \frac{2\rho(V-U)^2A}{M}$; $\frac{dU}{(V-U)^2} = \frac{2\rho A}{M}dt$; $\frac{-d(V-U)}{(V-U)^2} = \frac{2\rho A}{M}dt$

To obtain $a_{rel}(t)$, we must first find U(t). Integrating from U=0 at t=0 to U at t,

$\int_{V-0}^{V-U}\frac{-d(V-U)}{(V-U)^2} = \int_0^t \frac{2\rho A}{M}dt$; $\left[\frac{1}{V-U}\right]_{V-0}^{V-U} = \frac{1}{V-U} - \frac{1}{V} = \frac{V-(V-U)}{V(V-U)} = \frac{U}{V(V-U)} = \frac{2\rho A}{M}t$

Solving, $U = (V-U)\frac{2\rho A}{M}t$, $U = V\frac{\frac{2\rho A}{M}t}{1+\frac{2\rho A}{M}t}$ and $V-U = V\left[1-\frac{\frac{2\rho A}{M}t}{1+\frac{2\rho A}{M}t}\right]$

Substituting, $a_{rel} = \frac{2\rho V^2A}{M}\left[1-\frac{\frac{2\rho A}{M}t}{1+\frac{2\rho A}{M}t}\right]^2 = \frac{2\rho V^2A}{M}\left[\frac{1}{1+\frac{2\rho A}{M}t}\right]^2$ $a_{rel}(t)$

The time to reach U = V/2 is

$\frac{U}{V} = \frac{1}{2} = \frac{\frac{2\rho A}{M}t}{1+\frac{2\rho A}{M}t}$ or $t = \frac{M}{2\rho VA}$ $t(\frac{V}{2})$

Check: $\left[\frac{M}{\rho VA}\right] = M\frac{L^3}{M}\frac{1}{L^2}\frac{1}{L} = T$; $\left[\frac{\rho V^2A}{M}\right] = \frac{M}{L^3}\frac{L^2}{T^2}\frac{L^3}{M} = \frac{1}{T^2}$ ✓

4/16

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