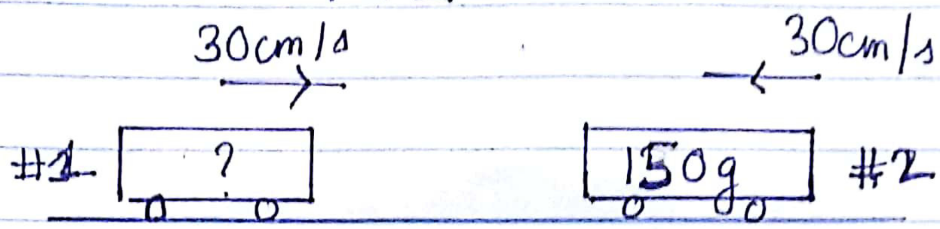
ECE 202

M2

(a)



$V_{1i} = 30\,cm/s$ $\qquad$ $V_{2i} = -30\,cm/s$

$V_{1f} = 0\,cm/s$ $\qquad$ $m_1 = ?$

$m_2 = 130\,g$ $\qquad$ $V_{2f} = ?$

(b)

$$V_{1f} = \left(V_{1i}(m_1 - m_2) + 2m_2V_{2i}\right) / m_1 + m_2$$

$$\Rightarrow V_1f(m_1 + m_2) = \left(V_1i(m_1 - m_2) + 2m_2V_2i\right)$$

$$\Rightarrow V_1f\,m_1 + V_1f\,m_2 = V_1i.m_1 - V_1i.m_2 + 2m_2V_2i$$

$$\Rightarrow V_1fm_2 + V_1im_2 - 2m_2V_2i = V_1im_1 - V_1fm_1$$

$$\Rightarrow m_2\left(V_1f + V_1i - 2V_2i\right) = m_1(V_1i - V_1f)$$

$$\Rightarrow \frac{m_2\left(V_1f + V_1i - 2V_2i\right)}{V_1i - V_1f} = m_1$$

$$\Rightarrow m_1 = \frac{m_2\left(V_1f + V_1i - 2V_2i\right)}{V_1i - V_1f}$$

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% Sounak Ghosh
% 9/17/19
% ECE 202 - Fall 2019 - MATLAB Exercise M2 - Design Problem
% Equation source: http://www.convertalot.com/elastic_collision_calculator.html
% MATLAB script to determine the mass of a cart.


clear % clears all variables in the workplace; avoids common errors
clc % clears all previous outputs in the command window

% -------- given information --------

m2 = 150;  % mass of the cart#2 in g
v1i = 30;  % initial velocity of cart#1 in cm/s
v2i = -30; % initial velocity of cart#2 in cm/s
v1f = 0;  % final velocity of cart#1 in cm/s

% --------- calculations ----------
% (c)

m1 = m2*(v1f + v1i - 2*v2i) / (v1i - v1f)     % Mass of cart#1 in g using v1f
                                             % from M1 that uses
                                             % momentum conservation
                                             % and kinetic energy
                                             % conservation

M = m1 + m2;                         % total mass of cart#1 and cart#2 in g

v2f = (m1*(2*v1i - v2i) + m2*v2i)/ M   % final velocity of cart#2 in cm/s
                                             % using momentum conservation
                                             % and kinetic energy
                                             % conservation


% ---------- check answers --------
% (e)
p1i = m1*v1i;  % Initial Momentum Cart#1
p2i = m2*v2i;  % Initial Momentum Cart#2
p1f = m1*v1f;  % Final Momentum Cart#1
p2f = m2*v2f;  % Final Momentum Cart#2

check_p = p1f + p2f - (p1i + p2i)                % The change in the total
                                                 % momentum of the system
                                                 % before & after the
                                                 % collision should be
                                                 % zero.

e1i = 0.5*m1*v1i^2;   % Initial Energy Cart#1
e2i = 0.5*m2*v2i^2;   % Initial Energy Cart#2
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e1f = 0.5*m1*v1f^2;   % Final Energy Car1#1
e2f = 0.5*m2*v2f^2;   % Final Energy Car1#2

check_Energy = e1f + e2f - (e1i + e2i)
                                                  % The change in the total
                                                  % energy of the system
                                                  % before & after the
                                                  % collision should be
                                                  % zero.


% (f)
v1f = (m1*v1i - m2*(v1i - 2*v2i))/ M        % final velocity of cart#1 in cm/s
                                             % should be zero as the cart#1
                                             % is stopping after collision.
% The design criterion is met as we can see that the velocity of cart#1
% after the collsion is zero. Based on the equation of final velocity of
% cart#1 from M1.
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m1 =

   450


v2f =

    60


check_p =

     0


check_Energy =

     0


v1f =

     0

>>
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