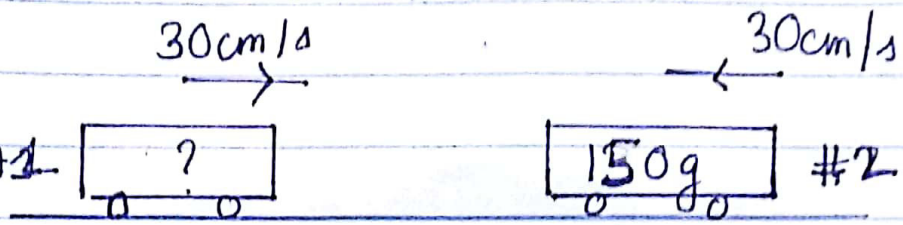
ECE 202
M2

(a)



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

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

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

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

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

$$\Rightarrow V_{1f}m_1 + V_{1f}m_2 = V_{1i}m_1 - V_{1i}m_2 + 2m_2V_{2i}$$

$$\Rightarrow V_{1f}m_2 + V_{1i}m_2 - 2m_2V_{2i} = V_{1i}m_1 - V_{1f}m_1$$

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

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

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

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% Sounak Ghosh
% 9/11/19
% 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

% -------- 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
                                              % conservatio

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

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


% ---------- check answers --------
% (e)
check_p = m1*v1f + m2*v2f - (m1*v1i + m2*v2i)   % The change in the total
                                                  % momentum of the system
                                                  % before & after the
                                                  % collision should be
                                                  % zero.
check_Energy = m1*v1f^2 + m2*v2f^2 - (m1*v1i^2 + m2*v2i^2)
                                                  % The change in the total
                                                  % energy of the system
                                                  % before & after the
                                                  % collision should be
                                                  % zero.

% (f)
v1f = (m1*v1i - m2*v1i + 2*m2*v2i)/ M        % final velocity of cart#1 in cm/s
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50                                                  % should be zero as the cart#1
51                                                  % is stopping after collision.
52 % The design criterion is met as we can see that the velocity of cart#1
53 % after the collsion is zero. Based on the equation of final velocity of
54 % cart#1 from M1.
55
56
57
58
59
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>> M2

m1 =

   450


v2f =

    60


check_p =

     0


check_Energy =

     0


v1f =

     0

>>
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