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% *** Aidan Chin ***
% *** 9/15/23 ***
% ECE 202 MATLAB exercise M2

% *** citation: http://hyperphysics.phy-astr.gsu.edu/hbase/elacol2.html

% *** description: the goal of this code is to determine the mass of object
% 2 and final velocity of object 1 in elastic collision


clear   % clears the registers, which helps catch typos


% ----- givens -----

% Left cart is #1; right cart is #2

m1 = input("Input value for mass of car (g): " ); % mass for car 1 in g
v1i = input("Input value for intial velocity of car (cm/s): "); % initial velocity in cm/s
v2i = -v1i; % initial veloctiy in cm/s
v2f = 0; % final velocity in cm/s


% ----- calculation -----


m2 =  m1*(2*v1i - v2i - v2f) / (v2f - v2i) % mass for car 2 in g

        % *** expression for m2 must depend on all 4 givens

M = m1 + m2; %total mass of the 2 cars in g

v1f = ((m1-m2)/M)*v1i + ((2*m2)/M)*v2i   % final velocity of cart 1, in cm/s

        % *** expressions for v1f (below) and v2f are from M1 ***




% ----- check conservation of momentum and energy -----

checkP = (m1*v1i + m2*v2i) - (m1*v1f + m2*v2f)   % *** should be zero, checks concervation of momentum


% initial and final kinetic energies, in *** J/100000 ***

KEi = (.5*m1*v1i^2) + (.5*m2*v2i^2);
KEf = (.5*m1*v1f^2) + (.5*m2*v2f^2);

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```
50 checkKE = KEi - KEf   % *** should be zero, kinetic energy must be conserved
51
52
53 % ----- check that design is successful -----
54
55 check_v2f = v2f - (((2*m1)/M)*v1i + ((m2-m1)/M)*v2i)   % should be equal to v2f,↙
difference should = 0
56
57 % *** Alternatively, compute v2f_new = ... using expression from M1
58
59 % *** this code is successful because the checks all came out as expected,
60 % and the values are logical.
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```
>> M2template_Fa23
Input value for mass of car (g): 250
Input value for intial velocity of car (cm/s): 30

m2 =

   750


v1f =

   -60


checkP =

     0


checkKE =

     0

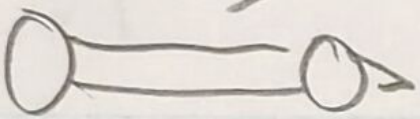

check_v2f =

     0

>>
```

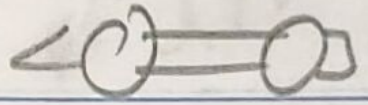
$m_1 = 250$ $V_{1f} = ?$

30 cm/s



$m_2 = ?$ $V_{2f} = 0$

30 cm/s



$$v_{1f} = \frac{m_1 - m_2}{M} v_{1i} + \frac{2m_2}{M} v_{2i} \qquad M = m_1 + m_2$$

$$v_{2f} = \frac{2m_1}{m_1 + m_2} v_{1i} + \frac{m_2 - m_1}{m_1 + m_2} v_{2i}$$

$$v_{2f}(m_1 + m_2) = 2m_1 v_{1i} + (m_2 - m_1) v_{2i}$$

$$v_{2i} m_2 - v_{2i} m_1$$

$$v_{2f} m_1 + v_{2f} m_2 - v_{2i} m_2 = 2m_1 v_{1i} - v_{2i} m_1$$

$$v_{2f} m_2 - v_{2i} m_2 = 2m_1 v_{1i} - v_{2i} m_1 - v_{2f} m_1$$

$$\frac{m_2(v_{2f} - v_{2i})}{v_{2f} - v_{2i}} = \frac{2m_1 v_{1i} - v_{2i} m_1 - v_{2f} m_1}{v_{2f} - v_{2i}}$$

$$\boxed{m_2 = \frac{2m_1 v_{1i} - v_{2i} m_1 - v_{2f} m_1}{v_{2f} - v_{2i}}}$$

$$m_2 = \frac{m_1(2v_{1i} - v_{2i} - v_{2f})}{v_{2f} - v_{2i}}$$

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M2