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% *** Aidan Chin, 9/22/23, etc.

    %   *** Label carts from left to right as 1, 2, 3
    %   *** Label "collisions" A, B, C, etc. until everything is final
    %   *** do not use loops or functions
    %   *** use arrays to keep track of everything
    %   *** Formulas from M1, http://hyperphysics.phy-astr.gsu.edu/hbase/elacol2.html

clear

% ----- Getting Started -----

% givens

m = [ 300 60 240 ] % mass of cars in g from left to right
v0 = [ 36 9 -45 ] % velocity of cars in cm/s from left to right

% set up total masses for two types of collisions

m23 = m(2)+m(3); % total mass of carts 2 and 3 in g
m12 = m(1)+m(2); % total mass of carts 1 and 2 in g

% set up the checks by computing total energy and momentum

KE0 = sum(.5.*m.*v0.^2); %calculates the total kenetic energy
P0 = sum(m.*v0);         %calculates the total potential energy


% ----- Collision #1 -----

% *** carts 2 and 3 will collide

vA = [ 0 0 0 ];   % initialize vA

vA(1) = v0(1);  %no interaction - velocity remains constant in cm/s
vA(2) = (m(2)-m(3))/m23*v0(2) + (2*m(3)/m23)*v0(3); %resultant velocity of cart 2 in↙
cm/s
vA(3) = (2*m(2)/m23)*v0(2) - (m(2)-m(3))/m23*v0(3)  %resultant velocity of cart 3 in↙
cm/s

% check energy and momentum (expectations)

KEA = sum(.5.*m.*vA.^2);
checkKE_A = KEA-KE0 % Should be zero because no kenetic energy
                                    % is added or removed
PA = sum(m.*vA);
checkP_A = PA-P0          % should be zero because no potential energy
                                    % added or removed

% check to see if there is another collision and output result

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50      %   *** check BOTH pairs of adjacent carts, even if you know which is next
51      %   *** use IF/ELSE to output something simple yet meaningful.
52      %   *** end the IF/ELSE statement before starting the next collision
53
54  if vA(1) <= vA(2) && vA(3) >= vA(2)
55      fprintf("There are no more collisions")
56  elseif vA(1) > vA(2)
57      fprintf("Carts 1 and 2 will collide\n")
58  elseif vA(3) < vA(2)
59      fprintf("Carts 2 and 3 will collide\n")
60  end
61
62
63  % ----- Collision #2 -----
64
65  % *** cart 1 and 2 will collide
66
67  vB = [ 0 0 0 ];
68
69  vB(1) = (m(1)-m(2))/m12*vA(1) + (2*m(2))/m12*vA(2);
70  vB(2) = (2*m(1)/m12)*vA(1) - (m(1)-m(2))/m12*vA(2);
71  vB(3) = vA(3)
72
73  % check energy and momentum (expectations)
74
75  KEB = sum(.5.*m.*vB.^2);
76  checkKE_B = KEB-KEA % Should be zero because no kenetic energy
77                                          % is added or removed
78  PB = sum(m.*vB);
79  checkP_B = PB-PA          % should be zero because no potential energy
80                                          % added or removed
81
82  % check to see if there is another collision and output result
83
84  if vB(1) <= vB(2) && vB(3) >= vB(2)
85      fprintf("There are no more collisions")
86  elseif vB(1) > vB(2)
87      fprintf("Carts 1 and 2 will collide\n")
88  elseif vB(3) < vB(2)
89      fprintf("Carts 2 and 3 will collide\n")
90  end
91
92
93  % ----- Collision #3 -----
94
95  % *** carts 2 and 3 will collide
96
97  vC = [ 0 0 0 ];   % initialize vC
98
99  vC(1) = vB(1);
100 vC(2) = (m(2)-m(3))/m23*vB(2) + (2*m(3)/m23)*vB(3);
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vC(3) = (2*m(2)/m23)*vB(2) - (m(2)-m(3))/m23*vB(3)

% check energy and momentum (expectations)

KEC = sum(.5.*m.*vC.^2);
checkKE_C = KEC-KE0 % Should be zero because no kenetic energy
                                    % is added or removed
PC = sum(m.*vC);
checkP_C = PC-P0          % should be zero because no potential energy
                                    % added or removed

% check to see if there is another collision and output result

if vC(1) <= vC(2) && vC(3) >= vC(2)
    fprintf("There are no more collisions")
elseif vC(1) > vC(2)
    fprintf("Carts 1 and 2 will collide\n")
elseif vC(3) < vC(2)
    fprintf("Carts 2 and 3 will collide\n")
end

% ----- Collision #4 -----

% *** cart 1 and 2 will collide

vD = [ 0 0 0 ];

vD(1) = (m(1)-m(2))/m12*vC(1) + (2*m(2))/m12*vC(2);
vD(2) = (2*m(1)/m12)*vC(1) - (m(1)-m(2))/m12*vC(2);
vD(3) = vC(3)

% check energy and momentum (expectations)

KEB = sum(.5.*m.*vD.^2);
checkKE_B = KEB-KEA % Should be zero because no kenetic energy
                                    % is added or removed
PB = sum(m.*vD);
checkP_B = PB-PA          % should be zero because no potential energy
                                    % added or removed

% check to see if there is another collision and output result

if vD(1) <= vD(2) && vD(3) >= vD(2)
    fprintf("There are no more collisions")
elseif vD(1) > vD(2)
    fprintf("Carts 1 and 2 will collide\n")
elseif vD(3) < vD(2)
    fprintf("Carts 2 and 3 will collide\n")
end


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152
153 % *** Keep adding similar code until there are no more collisions
154
155 % *** Add a comment saying how many collisions there are
```