

```
1 % Sounak Ghosh
2 % 9/19/19
3 % ECE 202 - Fall 2019 - MATLAB Exercise M3
4 % Equation source: http://www.convertalot.com/elastic\_collision\_calculator.html
5 % MATLAB script to determine the number of collisions in a system of carts.
6
7 clear % clears all variables in the workplace; avoids common errors
8 clc % clears all previous outputs in the command window
9
10 % ----- given information -----
11
12 M = [240 120 360]; % mass of the carts in g
13 Vi = [30 15 -45]; % initial velocity of carts in cm/s
14 m12 = M(1) + M(2); % mass of the carts in cart#1 & cart#2 in g
15 m23 = M(2) + M(3); % sum of the masses of cart#1 & cart#2 in g
16
17 % ----- calculations -----
18
19 Momentum_i = sum(M.*Vi); % Initial Momentum of the total system.
20 Energy_i = sum(0.5*M.*Vi.^2); % Initial Energy of the total system.
21
22 % From the diagram M2 & M3 are going to collide first.
23 % After Collision A
24
25 VfA(2) = (M(2)*Vi(2) - M(3)*Vi(2) + 2*M(3)*Vi(3))/ m23;
26
27 VfA(3) = (2*M(2)*Vi(2) - M(2)*Vi(3) + M(3)*Vi(3))/ m23;
28
29 VfA(1) = Vi(1) % final velocities of Carts after Collision A.
30
31 CheckMomentum_A = sum(M.*VfA) - Momentum_i % The change in total energy
32 % momentum of the system before
33 CheckEnergy_A = sum(0.5*M.*VfA.^2) - Energy_i % & after the collision should
34 % be zero.
35
36 % The velocities after collision A indicate carts #1 & #2 are going to collide.
37 % After Collision B.
38
39 VfB(1) = (M(1)*VfA(1) - M(2)*VfA(1) + 2*M(2)*VfA(2))/ m12;
40
41 VfB(2) = (2*M(1)*VfA(1) - M(1)*VfA(2) + M(2)*VfA(2))/ m12;
42
43 VfB(3) = VfA(3) % Energy of the total system after collision B.
44
45 CheckMomentum_B = sum(M.*VfB) - Momentum_i % The change in total energy
46 % momentum of the system before
47 CheckEnergy_B = sum(0.5*M.*VfB.^2) - Energy_i % & after the collision should
48 % be zero.
49
```

```

50 % The velocities after collision B indicate carts #2 & #3 are going to collide.
51 % After Collision C.
52
53 VfC(2) = (M(2)*VfB(2) - M(3)*VfB(2) + 2*M(3)*VfA(3))/ m23;
54
55 VfC(3) = (2*M(2)*VfB(2) - M(2)*VfA(3) + M(3)*VfA(3))/ m23;
56
57 VfC(1) = VfB(1)          % Energy of the total system after collision C.
58
59 CheckMomentum_C = sum(M.*VfC) - Momentum_i % The change in total energy
60                                     % momentum of the system before
61 CheckEnergy_C = sum(0.5*M.*VfC.^2) - Energy_i % & after the collision should
62                                     % be zero
63
64 % The velocities after collision C indicate carts #1 & #2 are going to collide.
65 % After Collision D.
66
67 VfD(1) = (M(1)*VfC(1) - M(2)*VfC(1) + 2*M(2)*VfC(2))/ m12;
68
69 VfD(2) = (2*M(1)*VfC(1) - M(1)*VfC(2) + M(2)*VfC(2))/ m12;
70
71 VfD(3) = VfC(3)          % Energy of the total system after collision D.
72
73 CheckMomentum_D = sum(M.*VfD) - Momentum_i % The change in total energy
74                                     % momentum of the system before
75 CheckEnergy_D = sum(0.5*M.*VfD.^2) - Energy_i % & after the collision should
76                                     % be zero
77
78 Total_P = sum(M .* VfD) - Momentum_i % Total momentum of system after all ✓
collisions
79 Total_E = sum( 0.5.*M.* VfD.^2) - Energy_i % Total energy of system after all ✓
collisions
80
81 % The final velocities of the carts 1, 2 and 3 after collision D are -50
82 % cm/s, -35 cm/s and 25 cm/s respectively, which indicate that cart#1 adn
83 % cart#2 are moving in the same direction with cart#1 moving faster than
84 % cart 2, hence carts #1 and #2 will never collide, and cart#3 is moving in
85 % the opposite direction of cart#1 and cart#2, therefore cart#3 won't have
86 % a collision with either of the other carts. In conclusion,
87 % we can determine that the carts will not have any further collisions.
88
89
90

```

```
1
2 VfA =
3
4     30    -75    -15
5
6
7 CheckMomentum_A =
8
9     0
10
11
12 CheckEnergy_A =
13
14     0
15
16
17 VfB =
18
19    -40     65    -15
20
21
22 CheckMomentum_B =
23
24     0
25
26
27 CheckEnergy_B =
28
29     0
30
31
32 VfC =
33
34    -40    -55     25
35
36
37 CheckMomentum_C =
38
39     0
40
41
42 CheckEnergy_C =
43
44     0
45
46
```

```
47 VfD =  
48  
49     -50    -35     25  
50  
51  
52 CheckMomentum_D =  
53  
54         0  
55  
56  
57 CheckEnergy_D =  
58  
59         0  
60  
61  
62 Total_P =  
63  
64         0  
65  
66  
67 Total_E =  
68  
69         0  
70  
71 >>
```