VICTORIA
UNIVERSITY OF WELLINGTON
TE WHARE WĀNANGA
O TE ŪPOKO O TE IKA A MĀUI

ENGR142 2018, 2nd Trimester

Lecturers: B. Ruck, F. Natali, and C. Hollitt

Assignment 2

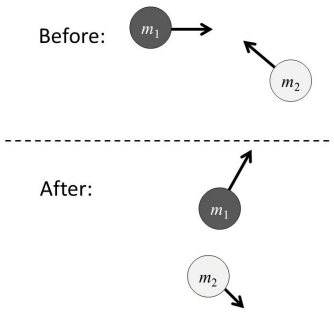
Due date: 11:59 PM, Thursday 2nd August, 2018

Problem 1: Projectile motion *(6 Marks)*

Famous American football player Cam Newton throws a football at a speed of 27 ms^{-1} and at an angle of 10° above the horizontal. He releases it at a height of 2 m above the ground. A defender 10 m away jumps to intercept the ball. If the defender can reach to 3.5 m above the ground are they able to intercept the pass? Assume the only force on the ball is gravity.

Problem 2: Air hockey table *(7 Marks)*

Two pucks, with masses $m_1 = 0.1$ kg and $m_2 = 0.1$ kg, slide without friction on an air hockey table. They approach each other and collide, as shown below. Before the collision the velocity vector of m_1 is $\vec{v}_{1i} = (5\hat{i} + 0\hat{j})$ ms^{-1} and the velocity vector of m_2 is $\vec{v}_{2i} = (-2\hat{i} + 2\hat{j})$ ms^{-1}. After the collision the velocity vector of m_1 is $\vec{v}_{2f} = (2\hat{i} + 3\hat{j})$ ms^{-1}.



(a) Find the final velocity vector for m_2.

(b) Was the collision elastic or inelastic?

Problem 3: Terminal velocity *(7 Marks)*

A hailstone of mass $m = 5 \times 10^{-4}$ kg falls under the effect of gravity. It also experiences a drag force of magnitude $F_D = \eta v^2$, where v is the hailstone's velocity and the coefficient η for the particular hailstone under consideration is equal to $\eta = 2 \times 10^{-5}$ kg/m.

(a) Calculate the terminal velocity of the hailstone.

(b) If the hailstone falls from a height $h = 500$ m, starting at rest, calculate the velocity it would have when it reaches the ground in the absence of drag ($F_D = 0$).

(c) Assuming that in the presence of drag the hailstone reaches the ground with terminal velocity, calculate the amount of energy that has been lost due to drag.