SPH3U1 - Test 3

Time: 1 hour

November 18, 2022

There are a total of 4 questions + a bonus. Please answer all questions as detailed as possible.
A total of 100 points will be awarded for all the questions.
Please ignore any aerodynamic effects unless specified.

Questions

Q1 A wedge has a 20°incident to the ground. The surface has a $\mu = 0.05$. A block that has a mass of 3.5 kg is placed on the wedge.

(a) Would this block move under the influence of gravity? (15pts)

(b) If the block moves, what extra force parallel to the surface of the wedge is required for it to be stationary? If the block does not move, what extra force parallel to the surface of the wedge is required for it to start moving? (15pts)

Q2 Lewis drove his F1 car that weighs 0.8 tons around the bend, changing his velocity from 320km[E 10°N] to 280km[N 40°W] in just 2s. Assuming his acceleration is constant, what is the net force that Lewis experiences?

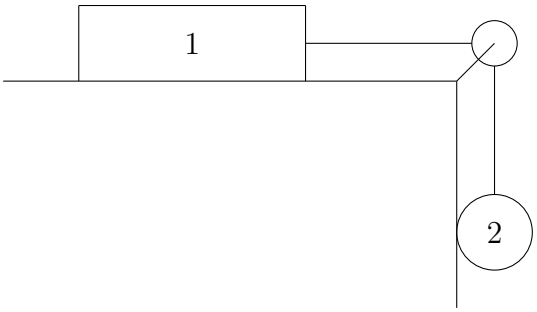
Q3 A railgun is a device that accelerates metallic projectiles using magnetic fields. A sub-scale railgun that has a length of 1 m is angled 30 degrees above the ground, and can provide 500 N of force on the pellet. A pellet that has a mass of 30 g. Assume there is no friction along the railgun.

(a) What is the airbourne time of the pellet? (hint: the tip of the rail gun has a height too)

(b) How high is the apex of the trajectory?

(c) How far can the pellet travel horizontally?

Q4 A block ($m = 1$ kg, labeled as mass 1) is being dragged by a weight ($m = 0.5$ kg, labeled as mass 2) illustrated below. The surface that mass 1 lies on has a coefficient of friction of 0.2.



(a) Will mass 1 move?

(b) If mass 1 moves, what is the acceleration on mass 1? If mass 1 does not move, how much more mass would mass 2 need in order to move mass 1?

Bonus Which Christopher Nolan movie uses the famous poem *Do Not Go Gentle Into That Good Night* by Dylan Thomas?