**ELEC-C9420 Introduction to Quantum Technology, Fall 20**
**Midterm exam 1, part B, 22.10.2020**
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## Problem B1

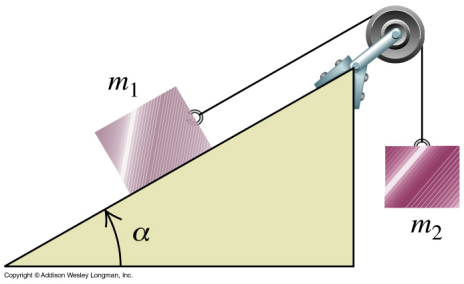


Figure 1: Setup of Problem B1

Two boxes of masses $m_1$ and $m_2$ are attached by a strong line passing through a pulley without slipping as in Figure 1. In addition to the masses of the boxes, the pulley wheel also has mass $m_p$, and is of an approximately cylindrical shape with radius $R$. The boxes are affected by the gravitational acceleration $g$. The mass of the line can be neglected.

**a)** Derive an expression for the inclination angle $\alpha$ of the ramp (in terms of the other given quantities) such that the system is in equilibrium.
**b)** The coefficient of kinetic friction between the box 1 and the ramp is $\mu$. Solve for the acceleration of box 1 in the case that the system is not in equilibrium.

## Problem B2

Two cars A and B (masses $m_A = 800$ kg and $m_B = 1300$ kg) collide with initial speeds $v_A = 70.0$ km/h and $v_B = 80.0$ km/h, so that the angle between their initial velocities is $\alpha = 70.0°$. In the collision, the cars get stuck together, and after the collision they slide together on the road. The coefficient of kinetic friction between the wreckage and the road is $\mu = 0.800$, and the gravitational acceleration $g = 9.81$ m/s$^2$. Assume that the cars move only in the horizontal plane.

**a)** How far from the point of collision do the cars slide?
**b)** How long does it take (in time) for the cars to stop after the collision?