1. A package is placed on a conveyor belt that is moving up a 30° incline at a constant speed of 10 m/s. The coefficient of kinetic friction between the rubber belt and the package is 0.75.

(a) How far up the conveyor belt will the package move before it stops sliding?
(b) How much time will elapse before the box stops sliding?

*Hint:* The package stops slipping when it has the same velocity as the conveyor belt.

![Diagram of conveyor belt with package](image1.png)

2. A novice swashbuckler of mass $m = 50$ kg swings from the rigging of a ship on a rope of length $l = 15$ m. She starts from rest with the rope horizontal, as pictured. Neglect wind resistance and the mass of the rope.

(a) What is her speed as a function of the angle $\theta$?
(b) What is the tension in the rope as a function of the angle $\theta$?
(c) She makes the classic novice-swashbuckler mistake of not winding the rope around her hands. Each of her hands grasps the rope with a force of 100 N; the coefficient of static friction between the ropes and her hands is 0.3. At what angle $\theta$ does she start to slip?

![Diagram of novice swashbuckler](image2.png)
3. Three identical 40000 kg freight cars are coupled by slamming cars B and C into car A. Car A is initially stationary; cars B and C travel at 1 m/s. After first contact between B and A, the coupling process takes 0.5 seconds. Find:
(a) The final speed of the three cars, and
(b) The average force in each of the two couplers during the coupling.

4. When the two cyclists are in the positions shown, \( v_A = 4 \) m/s, \( v_b = 6 \) m/s, \( \dot{v}_A = 0 \), and \( \dot{v}_b = -3 \) m/s\(^2\). What are the velocity and acceleration vectors of cyclist A relative to cyclist B at the instant shown?