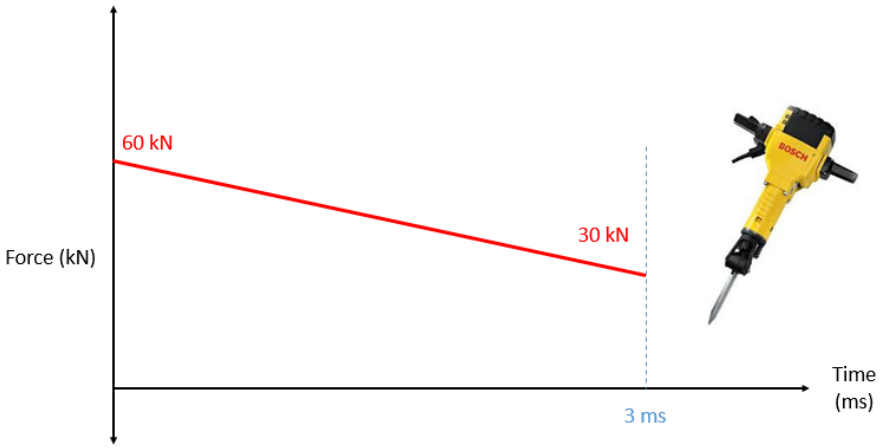
Chapter 11 Homework Problems

Problem 11.1

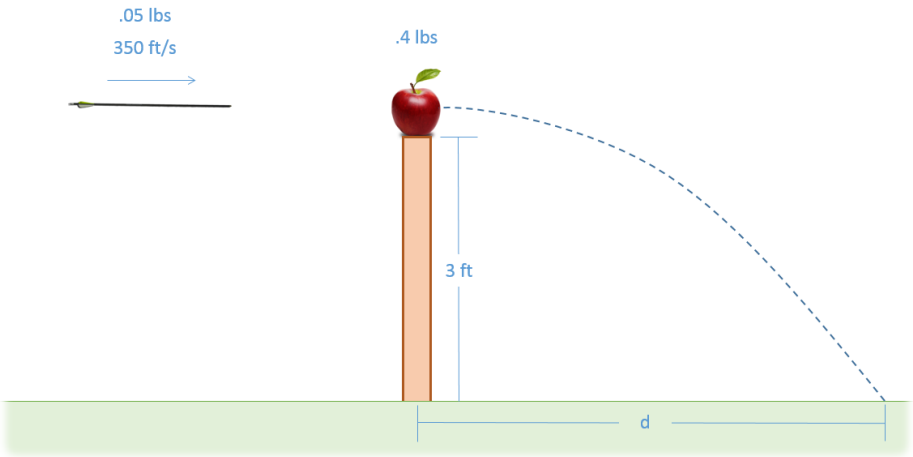
A jackhammer exerts the impulse shown below on the 1.5 kg bit to drive it towards the ground. If the bit starts at rest, what will the expected velocity of the bit be at the end of the impulse?



(Solution: 90 m/s)

Problem 11.2

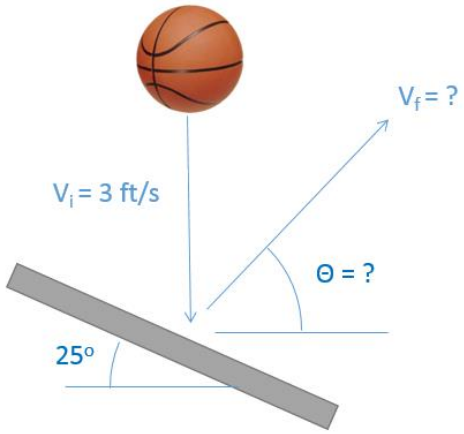
A .05 lb arrow traveling at 350 ft/s impacts a .4 lb apple on the top of a 3 ft post. If the arrow becomes lodged in the apple, how far would we expect the apple to travel (d) before hitting the ground?



(Solution: d = 16.8 ft)

Problem 11.3

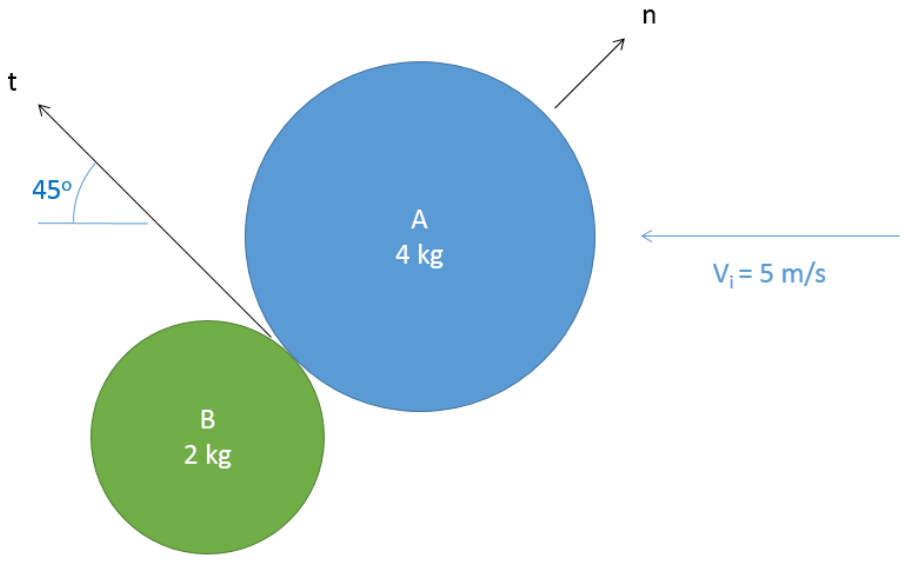
A basketball impacts a metal surface as shown below. If the initial velocity of the basketball was 3 ft/s straight down and the coefficient of restitution is .85, what is the expected speed and direction (θ) of the ball after the impact?



(Solution: v = 2.64 ft/s, θ = 36.25°)

Problem 11.4

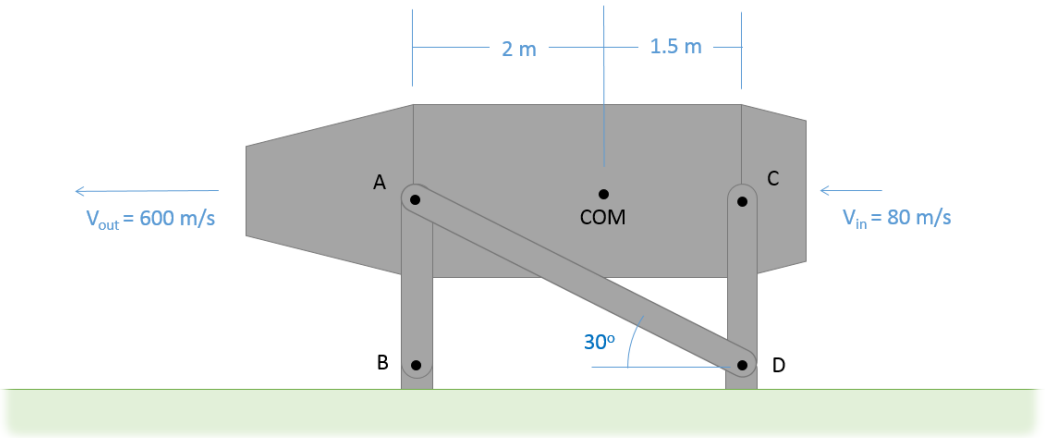
Puck A, traveling with an initial velocity of 5 m/s, strikes Puck B which is stationary. Assuming the collision is elastic, what will the velocity of each puck be immediately after the collision?



(Solution: V_{AF} = [-3.34, 1.67] m/s, V_{BF} = [-3.34, -3.34] m/s)

Problem 11.5

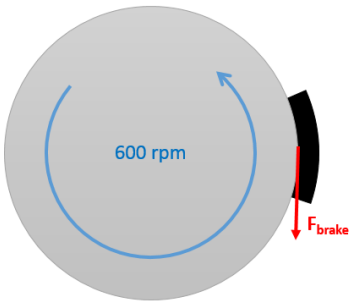
A jet engine with a mass of 700 kg and an air mass flow rate of 50 kg/s is mounted to a stand as shown below (a set of legs on each side, only one half shown). Based on the input and output velocities shown below, determine the thrust force of the engine and the forces in stand members AB, AD, and CD. Be sure to indicate if each member is in tension or compression.



(Solution: $F_t = 26kN, F_{AB} = 6.04\ kN\ T, F_{AD} = 15.01\ kN\ C, F_{CD} = 1.96\ kN\ C$)

Problem 11.6

A flywheel with a diameter of 2 ft and a weight of 60 lbs is rotating at a rate of 600 rpm. A brake applies a friction force to the outer rim of the flywheel, bringing it to a stop is 1.5 seconds. Based on this information, what was the average friction force applied by the brake over this time?

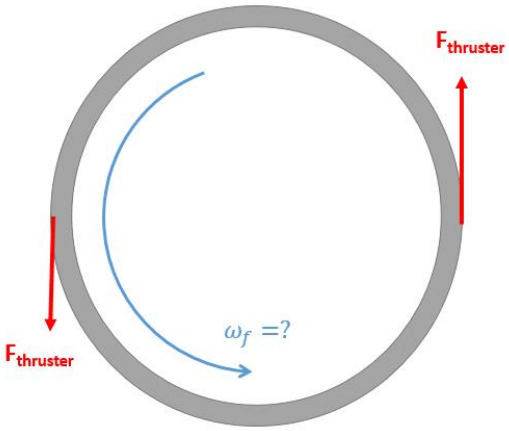


(Solution: $F_{brake} = 39.01\ lbs$)

Problem 11.7

A ring shaped space station can be approximated as a thin ring 60 meters in diameter with a mass of 500,000 kg. Centrifugal acceleration of the spinning station will be used to simulate gravity.

a) To simulate the 9.81 m/s^2 of earth, how fast will the station need to be spinning.
b) If two thrusters each capable of exerting 10 kN of force will be used to get the station up to this speed, how long will we need to run the thrusters?



(Solution:$\omega_f = .571\frac{rad}{s}, t_{thrust} = 428.25\ s$)