

Your solutions should be neat, correct and complete. Same instructions as Mission 1 apply here.

Recommended Homework from Textbook: problems:

Chapter 9 #'s 3, 5, 9, 13, 15, 19, 21, 23, 26, 27, 31, 37, 45

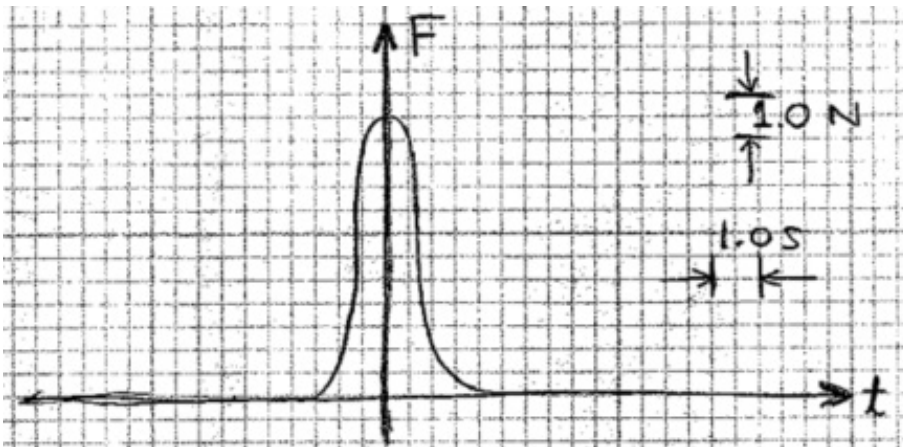
Recommended Homework from Recommended Textbook (Young & Freedman, 9th ed):

Chapter 8 (momentum, impulse and collisions) #'s 3, 5, 7, 9, 11, 13, 15, 19, 21, 23, 25, 29, 31, 32, 33, 35, 39, 43, 45, 59, 61, 63, 64, 69, 71, 73, 81, 83, 91, 100

Suggested Reading the following resources may be helpful:

- (a.) Lectures 21, 22, 24 as posted on the course website,
- (b.) Chapter 8 of the required text.

Problem 61: (2pts) The force of a hammer hitting a nail is graphed below in a force vs. time graph. What is the impulse delivered to the nail ?



Problem 62: (2pts) Suppose $m_1 = 3.0\text{kg}$ is at $\vec{r}_1 = (1.0\text{m})\langle 1, 2, 3 \rangle$ and $m_2 = 4.0\text{kg}$ is at $\vec{r}_2 = (1.0\text{m})\langle -1, 0, 6 \rangle$ and $m_3 = 3.0\text{kg}$ is at $\vec{r}_3 = (1.0\text{m})\langle 4, 4, 4 \rangle$. Find the center of mass for this system of three masses.

Problem 63: (2pts) Suppose the linear mass density of a cone is given by $\lambda = (3.0 \text{ kg/m}^2)x$ for $0 \leq x \leq 30 \text{ cm}$ where $x = 0$ corresponds to the tip of the cone and $x = 30 \text{ cm}$ gives the base. Find the center of mass for this distribution of mass (notice, while a cone is three-dimensional, clearly the center of mass is on the axis so we are able to treat the problem with single-variable calculus)

Problem 64: (2pts) A 3000 kg truck travels past a highway overpass at 20 m/s . A heavy ninja of mass 150 kg runs from a bridge which is nearly level with the top of the truck (we can ignore vertical motion). If the truck driver will notice a change of more than 1% in the speed then what is the minimum speed the ninja must run to jump on the truck without being noticed ?

Problem 65: (2pts) An explosive 100 gram bullet is shot with speed 1000 m/s at an angle of 40 degrees above the horizontal. At the zenith of its trajectory it explodes into two pieces. The first piece has 60 grams of material and it falls directly downward at an initial speed 100 m/s. The second piece has 40 grams and it travels away at an initial angle of 30 degrees above the horizontal.



- (a.) How far does the 40 gram fragment travel horizontally?
- (b.) What is the initial momentum of the bullet?
- (c.) What is the momentum of the bullet just before it explodes?

Problem 66: (2pts) A rubber ball bounces off a vertical brick wall. If the 0.2 kg ball hits the wall horizontally at 10 m/s but bounces off at 6 m/s and an angle of 30 degrees above the horizontal then what was the impulse delivered to the ball by the wall? If the bouncing happened over a duration of 0.01 s then what was the magnitude of the force of the wall on the ball? (assume the force was constant)

Problem 67: (2pts) Two masses collide in a purely inelastic head-on collision. If $M_1 = 2 \text{ kg}$ has an initial speed of 10 m/s to the right and $M_2 = 3 \text{ kg}$ has an initial speed of 5 m/s to the left then what is the final velocity of the masses stuck together?

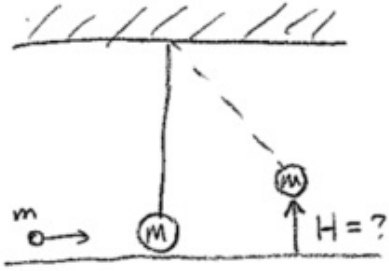
Problem 68: (2pts) A Fiat with a weight of 5000 N collides with a loaded F-150 weighing 25,000 N. Suppose the Fiat gets stuck in the grill of the pick-up truck and the combined mass skids to a stop in 10 m over a road with coefficient of kinetic friction 0.4. Furthermore, suppose the squished Fiat and F-150 travel a straight path deflected 20 degrees from the original direction of the F-150. If the collision happens at perpendicular intersection of two roads then what are the initial speeds of the vehicles?



Problem 69: (2pts) Suppose you shoot a 100 kg stunt man wearing a Kevlar vest with a 10 gram bullet at a speed of 340 m/s. If the bullet sticks then what velocity should the man be given as a result of being shot. Assuming the best possible trajectory for flight what is the maximum distance this bullet could throw him?

Problem 70: (2pts) A bullet is shot through a clay pendulum bob. In the process of the bullets travel through the pendulum bob it loses half of its kinetic energy. The mass of the pendulum is 0.050 kg. How far does the pendulum swing upward?

Problem 71: (2pts) Suppose a bullet of mass m collides with a pendulum of mass M . If the pendulum swings to a height H then what was the initial speed of the bullet given that:



- (a.) the bullet stuck to the pendulum
- (b.) the collision was elastic

Problem 72: (2pts) Suppose an ice puck with velocity 15 m/s collides elastically with another identical puck which is at rest. The collision is off-center and thus the collision is not a head-on collision. If the puck initially at rest glides away with speed 10 m/s then what is the speed of the other puck and what angle is found between their paths after the collision?