11/29 In Class 12–Waves and Review Ch 2-6

1. A wave on a string undergoes motion described by the equation

$$y = .25\sin(\frac{\pi}{3}x - \pi t)$$

where x and y are in meters and t is in seconds.

(a) What is the amplitude of the wave?

(b) What is the wavelength of the wave?

(c) What is the period of the wave?

(d) What is the speed of the wave?

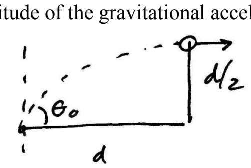
(e) What is the maximum speed of any point on the string? In what direction?

(f) If the string has a mass per unit length of 0.5 kg/m, what is the tension in the string?

2. Shown below is a problem I found on the MIT open courseware site.[1] Try it :) If you want numbers, feel free to use d=39.2m. (A bit large, but it makes for a nice round number in the calculations.)

Problem 6:

A person is a playing a game that requires throwing an object onto a ledge. The ledge is a distance d and a height $d/2$ above the release point. You may neglect air resistance. You may use g for the magnitude of the gravitational acceleration.



(a) At what angle must the person throw the object and with what magnitude of the velocity if the object is to be exactly at the top of its flight when it reaches the ledge? Briefly describe how you will model this problem and your strategy for finding the answer. Express your answer in terms of the given quantities d and g, as needed.

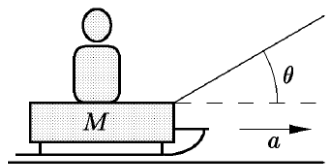
(b) What is the horizontal component of the acceleration? Again briefly describe your model and strategy for solving the problem. Express your answer in terms of the given quantities s, d, and g.

[1] Lewin, Walter, Peter Dourmashkin, Thomas Greytak, Craig Watkins, Andy Neely, Sahana Murthy, J. Litster, and Matthew Strafuss. 8.01SC Physics I: Classical Mechanics, Fall 2010. (MIT OpenCourseWare: Massachusetts Institute of Technology), http://ocw.mit.edu/courses/physics/8-01sc-physics-i-classical-mechanics-fall-2010 (Accessed 3 Dec, 2014). License: Creative Commons BY-NC-SA

3. For this one, if you want numbers, use: $M = 25\text{kg}$, $a = 2m/s^2$, and $\theta = 60°$ If you use symbols, assume M, a, and θ are given and find T and F_N in terms of them. (Also from the MIT site[1])

Problem 2: Towing a Sled

A mother tows her daughter on a sled on level ice. The friction between the sled and the ice is negligible, and the tow rope makes an angle of θ to the horizontal. The combined mass of the sled and the child is M. The sled has an acceleration in the horizontal direction of magnitude a. As we will learn to justify in a few weeks, the child and sled can be treated in this problem as if they comprised a single particle.



a) Calculate the tension, T, in the rope and the magnitude of the normal force, N, exerted by the ice on the sled. Briefly describe how you model the problem and your strategy for solving this problem. Show all relevant free body diagrams.

4. Using what you found in the last problem, calculate the work done by each of the forces if the sled moves a distance $d = 5m$ to the right. (You may use d or numbers.)

   (a) Work done by gravity
   (b) Work done by normal force
   (c) Work done by tension
   (d) If the sled started from rest, what is its speed after it moves the 5m?
   (e) Use kinematics and the acceleration from the last problem to check your answer.

5. A satellite orbits the earth a distance of 1/4 earth radius above the surface of the earth. What speed must it have to keep it in stable, circular orbit at that height?

6. Another one from MIT[1]

An object of mass m is released from rest at a height h above the surface of a table. The object slides along the inside of the loop-the-loop track consisting of a ramp and a circular loop of radius R shown in the figure. Assume that the track is frictionless. When the object is at the top of the track it pushes against the track with a force equal to three times it's weight. What height was the object dropped from?