

PHYS 3344

Fall 2017

TE Coan

Due: 15 Sep '17 6:00 pm

Homework 3

1. A pesky student drops a water-filled balloon from the roof of a tall building on campus trying to hit her roommate on the ground (who is, unfortunately, too quick). The first student ducks back but hears the water splash 4.021 s after dropping the balloon. If the speed of sound is 331 m/s, find the height of the building, neglecting air resistance.

2. The speed v of some strangely shaped projectile of mass m varies with distance x as $v(x) = \alpha x^{-n}$. Assume that at $t = 0$, $v(x = 0) = 0$.

a) What is force $F(x)$ responsible for this state of affairs?

b) What is $x(t)$?

c) Finally, what is $F(t)$?

3. This is a bit of review from the remote, misty land of PHYS 1303. A DART train moves along the tracks at a constant speed u . A woman on the train throws a ball, for reasons mysterious to this day, of mass m straight ahead with a speed v with respect to *herself*.

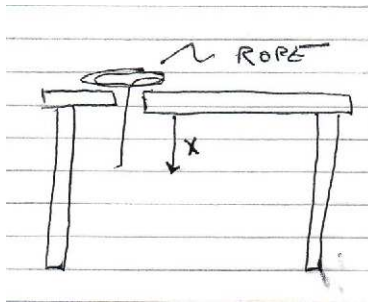
a) What is the kinetic energy gain ΔKE_{train} of the ball as measured by a person on the train?

b) Compute the same quantity as in (a) but for a person standing by the *track*?

c) How much work W_{woman} is done by the woman throwing the ball?

d) How much work W_{train} is done by the train?

4. A smooth rope is placed above a hole in a table. See the figure and measure positive x downwards starting from the hole. One end of the rope falls through the hole at $t = 0$, pulling steadily on the remainder of the rope. The total length of the rope is L and you can ignore air friction.



- a) Find the velocity $v(x)$ of the rope as a function of the distance to the end of the rope.
- b) Find the acceleration $a(x)$ of the rope as a function of the distance to the end of the rope.