

PHYS 314

HOMEWORK #1

Due : 23 Jan. 2017

Now that you've completed more advanced physics and math, let's refresh and review some basic of Newtonian mechanics. Make sure you have read the syllabus and the guidelines for submitting homework.

1. A projectile is launched from level ground. At what angle should it be launched so that its maximum elevation equals its range. (Neglect air friction).
2. A projectile is fired on level ground with initial velocity v and follows a parabolic trajectory (i.e., neglect air friction). It passes through two points that are both a distance h above the horizon. Show that if the gun is adjusted for maximum range, the distance between the two points is :

$$d = \frac{v_0}{g} \sqrt{v_0^2 - 4gh}$$

3. A bead of mass m is initially stationary at the top of a sphere of radius R . The bead begins to slide down the frictionless surface of the sphere. Determine the angle θ with respect to the vertical that the bead leaves the sphere.
4. A boat can travel with a speed of v in still water. If the boat is now in a river flowing with constant current speed of V , show that the time to go a distance D upstream and return to the starting point is :

$$t = \frac{2Dv}{v^2 - V^2}$$

what is the significance of the minus sign if $V > v$? If $V = v$?

5. (This one's a little challenging). The inclined side of a wedge of mass M makes an angle θ with the horizontal. A block of mass m slides down this incline. All surfaces are frictionless (meaning the wedge slides without friction on the surface). Find the acceleration of the small mass m , and the acceleration of the wedge of mass M . Solve this using Newton's laws. We will investigate this problem later using Lagrangian dynamics.