Classical Mechanics - PHYS 310 - Fall 2013 HW # 2
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Please return it by the 11th of September 2013

- **Problem 1** Suppose that the force acting on a particle is factorable in to one of the following forms.
  (a) $F(x_i, t) = f(x_i)g(t)$
  (b)$F(\dot{x}_i, t) = f(\dot{x}_i)g(t)$
  (c) $F(x_i, \dot{x}_i) = f(x_i)g(\dot{x}_i)$

  For which cases are the equations of motion are integrable?

  20 points

- **Problem 2:** If a projectile is fired from the origin of the coordinate system with an initial velocity v_0, and in a direction making an angle α with the horizontal, calculate the time required for the projectile to cross a line passing through the origin and making an angle $\beta \leq \alpha$ with the horizontal.

  20 points

- **Problem 3**

  A projectile is fired with a velocity v_0 such that it passes through two points, both a distance above the horizontal. Show that if the gun is adjusted for maximum range, the separation of the points is

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

  20 points

- **Problem 4** Consider a projectile fired vertically in a constant gravitational field. For the same initial velocities, compare the times required for the projectile to reach its maximum height.
  (a) for zero resisting force
  (b) for a resisting force proportional to the instantaneous velocity of the projectile

  20 points

- **Problem 5** A particle is projected vertically upward in a constant gravitational field with an initial speed v_0. Show that if there is a retarding force proportional to the square of the instanttaneous speed, the speed of the particle when it return to the original position is:

  $$\frac{v_0 v_t}{\sqrt{v_0^2 + v_t^2}} \tag{1}$$

  where v_t is the terminal speed.

  20 points