

## Physics 235, Homework Set 02

**Write the following text on the front cover of your homework assignment and sign it. If the text is missing, 20 points will be subtracted from your homework grade.**

### Honor Pledge for Graded Assignments

"I affirm that I have not given or received any unauthorized help on this assignment, and that this work is my own."

---

---

---

Signature \_\_\_\_\_

1. A particle moves in a medium under the influence of a retarding force equal to  $-mk(v^3 + a^2v)$ , where  $k$  and  $a$  are positive constants. Show that for any value of the initial speed the particle will never move a distance greater than  $\pi/2ka$  and that the particle comes to rest only when the time approaches infinity.
2. Show directly that the time rate of change of the angular momentum about the origin for a projectile fired from the origin is equal to the moment of the gravitational force (its torque) about the origin.
3. A particle of mass  $m = 1$  kg is subjected to a one-dimensional force

$$F(t) = kte^{-\alpha t}$$

where  $k = 1$  N/s and  $\alpha = 0.5$  s<sup>-1</sup>. If the particle is initially at rest, calculate and plot with the aid of a computer the position, speed, and acceleration of the particle as a function of time.

4. Consider a particle moving in the region  $x > 0$  under the influence of the potential

$$U(x) = U_0 \left( \frac{a}{x} + \frac{x}{a} \right)$$

where  $U_0 = 1$  J and  $a = 2$  m. Plot the potential, find the equilibrium points, and determine whether they are maxima or minima.

5. Which of the following forces are conservative?

a.  $F_x = ayz + bx + c, F_y = axz + bz, F_z = axy + by$

b.  $F_x = -ze^{-x}, F_y = \ln z, F_z = e^{-x} + \frac{y}{z}$

c.  $\vec{F} = \left( \frac{a}{r} \right) \hat{r}$

In these equations  $a$ ,  $b$ , and  $c$  are constants. For the conservative forces, find the potential energy  $U$ .