

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 _____

Problem 1 (20 points)

A particle moves in a medium under the influence of a retarding force F equal to

$$F = -mk(v^3 + a^2v) \quad (1)$$

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.

Problem 2 (20 points)

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.

Problem 3 (20 points)

A particle of mass $m = 1$ kg is subjected to a one-dimensional force

$$F(t) = kte^{-\alpha t} \quad (2)$$

where $k = 1$ N/s and $\alpha = 0.5$ s⁻¹. 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.

Problem 4 (20 points)

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

$$U(x) = U_0 \left(\frac{a}{x} + \frac{x}{a} \right) \quad (3)$$

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

Problem 5 (20 points) Which of the following forces are conservative?

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

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

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

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