Physics A300: Classical Mechanics I

Problem Set 1

Assigned 2003 August 28
Due 2003 September 4

Show your work on all problems! Be sure to give credit to any collaborators, or outside sources used in solving the problems.

1 Drill Problem on Dimensional Analysis

1.1 Dimensionally Meaningful Expressions

Which of the following expressions or relations are sensible from a dimensional point of view? For the ones which don't, state the reason why not.

a) $40\,\mathrm{kg} + 15\,\mathrm{N}$

b) $5\,\mathrm{ft} + 1\,\mathrm{km}$

c) $F > 5$ where F is a force

d) $F = mx$ where F is a force, m is a mass, and x is a length

e) $v^2 - 5G\frac{M}{r}$ where M is a mass, r is a length, and $G = 6.67 \times 10^{-11}\,\mathrm{N \cdot m^2/kg^2}$

f) $\ddot{x} = ge^t$ where x is a coördinate distance, $g = 9.8\,\mathrm{m/s^2}$, and t is a time

1.2 Conversion of Units

Convert the following expressions into the units requested

a) $\frac{12\,\mathrm{cm} + 36\,\mathrm{m}}{3 \times 10^8\,\mathrm{m/s}}$ expressed in nanoseconds ($1\,\mathrm{s} = 10^9\,\mathrm{ns}$) (Your answer should be exact)

b) $6.25\,\mathrm{in/yr}$ expressed in centimeters per second. (Your answer should be written to three significant figures.)

2 Projectile Motion

A baseball player hits a popup to the infield. If the ball strikes the bat $0.70\,\mathrm{m}$ above home plate and takes off in a direction making an angle $60°$ with the horizontal, what must its initial speed be in order to land on second base, $40.\,\mathrm{m}$ away? Ignore air resistance, and take the acceleration of gravity to be $9.8\,\mathrm{m/s^2}$.

3 Symon Chapter One Problem 9

4 Symon Chapter One Problem 12