Problem Lab #2

Lab due Thursday September 14, 2006! Clarity of presentation counts!

I. QUADRATIC FORMULA

Solve the following using the quadratic formula

$$-10t^2 - 20t + 3 = 0 \quad (1)$$
$$-4.9t^2 + 30t - 3 = 0 \quad (2)$$

II. BASIC 2D PROBLEM PRACTICE

Practice using the steps given in the handout.

- Joe is initially $10m$ 45^o northeast of Sue – call Sue the origin. Sue moves with a constant velocity of $20m/s$ at an angle of 15^o north of east. Joe moves a constant velocity of of $10m/s$ at 30^o north of east.
  - Sketch Joe and sues trajectories and write their velocity vectors in $\hat{\mathbf{i}}$ and $\hat{\mathbf{j}}$.
  - Write Joe and sues position vector after $2s$ and find the distance between them and the angle between them.
    - Draw a sketch of both position vectors and the vector joining them. Try to draw it to scale.
    - On your sketch show the vector between them and resolve it into x and y components
  - After 2s Joe switch direction and starts going 15^o north of west at the same $10m/s$. After an additional second what are the position vectors of the Joe and sue and what is the distance between them.
- A rock is thrown from the top of a cliff (of height $45m$) up at an angle of 30^o relative to the horizon. The speed of the rock is 20 m/s.
  - Make a sketch and indicate the velocity and acceleration vectors on your sketch.
  - Resolve the initial velocity into an upward and and outward velocity.
  - As time marches on the position $(x(t), y(t))$ are functions of time. What are these functions?
  - As time marches on the velocity in the x and y directions are also functions of the time, $(v_x(t), v_y(t))$. What are these functions?
  - When does the rock hit the bottom? At a time which is half of this time what is the position of the rock?

- What is the velocity in the x and y directions when the rock hits the ground? What is the speed of the rock and its angle relative to the horizon? What is its velocity at half of this time.
- Plot the $x(t)$ and $y(t)$ as a function of time
- Plot $v_x(t)$ and $v_y(t)$ as a function of time.
- When does the rock reach the top of its arc?
- What is its velocity $\mathbf{v}$ and speed at the top of its arc?

- A helicopter is traveling over head at a level height of $181m$ with speed 40 m/s. He wishes to drop supplies to a stranded backpackers. The question is really how far from from the backpackers should he drop the supplies. Do these questions to work out the answer. Lets agree to make the backpackers the origin.
  - What is the velocity of the supplies initially?
  - The supplies are released from the helicopter . How long are they in the air.
  - Calculate the distance that the supplies travel in that time.
  - As time marches on the position $(x(t), y(t))$ of the supplies are functions of time. What are these functions?
  - As time marches on the velocity in the x and y directions are also functions of the time, $(v_x(t), v_y(t))$. What are these functions?
  - At a time which is half the time that the supplies hit the bottom where are the supplies.
  - What is the velocity in the x and y directions when the supplies hit the ground? What is the speed of the supplies and its angle relative to the horizon? What is its velocity at half of this time.
  - Plot the $x(t)$ and $y(t)$ as a function of time
  - Plot $v_x(t)$ and $v_y(t)$ as a function of time.