Course 141: MECHANICS

Problem Set 4

Date Issued: November 14, 2007

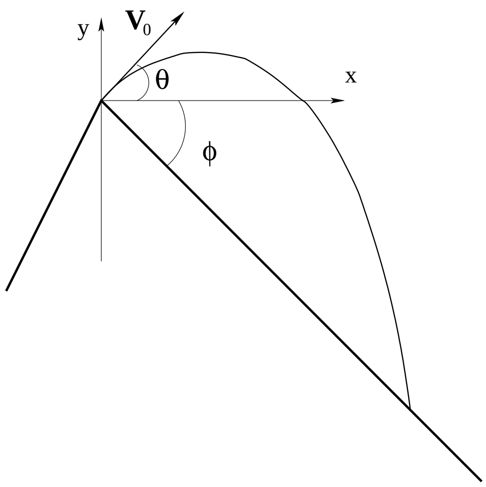
1. A lift ascends from the ground with uniform speed. At time T_1 a person drops a marble through the floor. The marble falls with uniform acceleration $g = 9,81\ m/s^2$ and hits the ground T_2 seconds after T_1. Find the lift's height at time T_1 in terms of T_1, T_2 and g. (Answer clues: If $T_1 = T_2 = 4s$, $h = 39.2\ m$).

2. A particle is moving in a plane with constant radial velocity $\dot{r} = 3\ m/s$. The angular velocity is constant and has magnitude $\dot{\theta} = 2\ rad/s$. When the particle is 4 m from the origin, find

   (a) The magnitude of the velocity and the acceleration.

   (b) Cartesian components x, y of the vector of position $\vec{r}$ (suppose $\theta_0 = 0$).

3. A boy stands at the peak of a hill which slopes downwards uniformly at angle ϕ. At which angle θ from the horizontal should he throw a rock so that it has the greatest range?



4. Mud is thrown from the tyre of a wheel (radius R) of a car travelling at a speed v, where $v^2 > gR$. The tyre is not slipping, i.e., the velocity of the point of contact, P, realtive to road is zero.

   (a) Neglecting air resistance, what is the maximum height mud can rise above the ground?

   (b) At what angle θ does the highest rising mud leave the wheel? (Don't jump to conclusions).