DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY OF CALIFORNIA AT BERKELEY

Fall Semester 2006

ME104
MIDTERM # 1

1. Consider a particle P moving in a plane, and introduce polar coordinates (r, θ). Show that the velocity and acceleration of P can be written as

$$v = \dot{r}\mathbf{e}_r + r\dot{\theta}\mathbf{e}_\theta,$$

$$\mathbf{a} = (\ddot{r} - r\dot{\theta}^2)\mathbf{e}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\,\mathbf{e}_\theta.$$

2. A projectile P is launched from a point O with speed 130 m/s and angle of projection 40 degrees (Fig.1). It is being tracked by radar at O.

(a) Find the location of the point M at which P attains its maximum height.

(b) Calculate the values that P has for the following quantities as it passes through M: $\dot{r}, \dot{\theta}, \ddot{r}, \ddot{\theta}$.

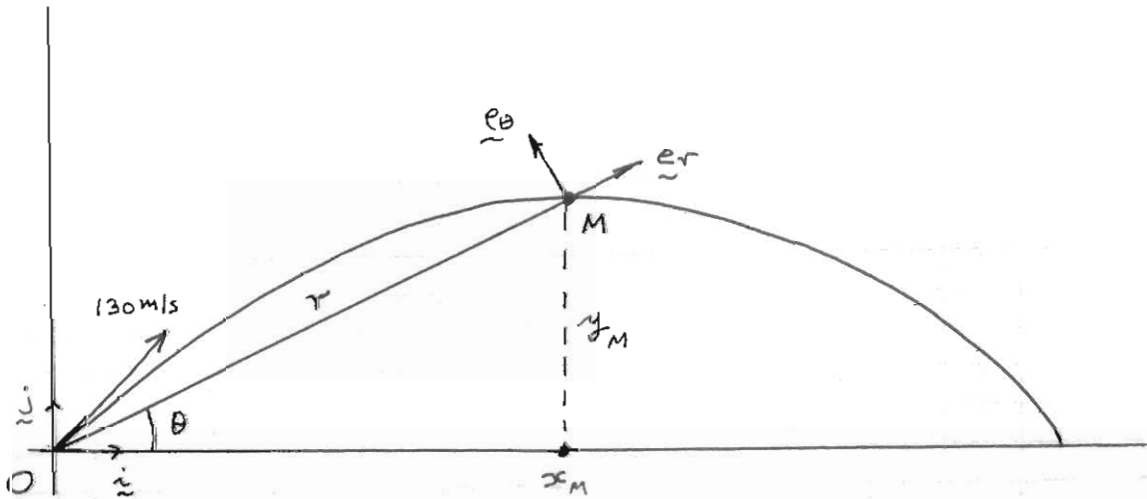Fig. 1