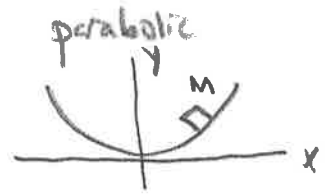


BB 1.8

Small mass M slides along
gully. $y = ax^2$, $a = 0.1$



a) $F = -\frac{dy}{dx}$ ← force is gradient of potential energy

$$F(y) = -mg \frac{dy}{dx}$$

$$F(x) = -2mgxa$$

$$F(x) = -kx, \quad k = +2mga$$

$$m\ddot{x} + kx = 0$$

b) $\omega_0 = \sqrt{\frac{k}{m}} = \sqrt{\frac{2mga}{m}} = \sqrt{2 \cdot 10 \cdot 0.1} = \sqrt{2}$

$$\omega_0 = \sqrt{2} \approx 1.414 \text{ rad/sec}$$

c) Include damping: $F_x = -\left(\frac{2m}{3}\right)\dot{x}$, $\beta = \frac{2}{3}$

$$\ddot{x} + \beta\dot{x} + \omega_0^2 x = 0$$

$$\omega = \sqrt{\omega_0^2 - \left(\frac{\beta}{2}\right)^2}$$

$$\omega = \sqrt{2 - \left(\frac{1}{3}\right)^2} = \sqrt{\frac{17}{3}}$$

$$\omega = \sqrt{\frac{17}{3}} \approx 1.37$$