1. (30) A projectile is launched with a speed $v_0 = 5$ m/s from the floor of a 25-m-high tunnel as shown. Determine the maximum horizontal range $R$ of the projectile and the corresponding launch angle $\theta$. 
Ans. 2.55 m, 45°

2. (30) If block B is given an upward vertical velocity of 6 m/s, determine the velocity and acceleration of A. 
Ans. 18 m/s, 0 m/s²

3. (40) The 2-kg slider $S$ fits loosely on the inclined rod which is spinning about the $z$-axis. If the coefficient of friction is $\mu = 0.2$, and the slider is located 0.25 m from A, determine the minimum constant angular velocity such that the slider does not slip down the rod. 
Ans. 4.84 rad/s

Useful equations

$$v = \frac{dx}{dt}$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = v \frac{dv}{dx}$$

Uniform rectilinear motion: $x = x_0 + vt$

Uniformly accelerated rectilinear motion: $v = v_0 + at$, $x = x_0 + v_0t + \frac{1}{2}at^2$, $v^2 = v_0^2 + 2a(x - x_0)$

Acceleration components:

Tangential & normal $a_t = \frac{dv}{dt}$, $a_n = \frac{v^2}{\rho}$

Radial and transverse $a_r = \ddot{r} - r\dot{\theta}^2$, $a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$