Unit 1 (Chapters 11 & 12)

Solve the following problems, show your work.

1. The speed of a jogger can be expressed by \( v = 7.5(1 - 0.04x)^{0.3} \), where \( v \) and \( x \) are expressed in mph and miles. Knowing that \( x = 0 \) at \( t = 0 \), determine the runner's acceleration at 6 mi.

2. The pitcher in a softball game throws a ball with an initial velocity \( \vec{v}_0 = 72 \) kph \( \angle \alpha \). If the height of the ball at point \( B \) is 0.68 m, determine the angle \( \alpha \).
3. During a hammer thrower's practice swing, the 7.1-kg head A of the hammer revolves at a constant speed \( v \) in the horizontal circle. If \( \rho = 0.93 \, m \) and \( \theta = 60^\circ \), determine the speed of the hammer head and the tension in the cable.

4. Rod \( OA \) oscillates about \( O \) in a horizontal plane. The motion of the 5-lb collar \( B \) is defined by \( r = \frac{10}{t+4} \) and \( \theta = \frac{2}{\pi} \sin \pi t \) where \( r \) and \( t \) are expressed in feet and seconds respectively. \( \theta \) is expressed in radians. Determine the radial and transverse components of the force exerted on the collar at \( t = 6 \, s \).