1. Six acceleration vectors are shown for the car whose velocity vector is directed forward. For each acceleration vector describe in words the instantaneous motion of the car.
2. The design of a camshaft-drive system of a four-cylinder automobile engine is shown. As the engine is revved up, the belt speed \( v \) changes uniformly from 3 m/s to 6 m/s over a two-second interval. Calculate the magnitudes of the accelerations of points \( P_1 \) and \( P_2 \) halfway through this time interval.
3. A small projectile is fired from point A with an initial velocity $u=500 \text{ m/s}$ at the angle of $60^\circ$ from the horizontal as shown. Neglect atmospheric resistance and any change in $g$ and compute the radius of curvature $\rho$ of the path of the projectile 30 s after the firing.
4. A small particle $P$ starts from point $O$ with a negligible speed and increases its speed to a value $v = \sqrt{2gh}$, where $y$ is the vertical drop from $O$. When $x=15$ m, determine the n-component of acceleration of the particle.
5. The pin P is constrained to move in the slotted guides which move at right angles to one another. At the instant represented, A has a velocity to the right of 0.2 m/s which is decreasing at the rate of 0.75 m/s each second. At the same time, B is moving down with a velocity of 0.15 m/s which is decreasing at the rate of 0.5 m/s each second. For this instant, determine the radius of curvature $\rho$ of the path followed by P.
PROBLEMS (Normal & Tangential Coordinates)

6. A ball is thrown horizontally from the top of a 50 m cliff at A with a speed of 15 m/s and lands at point C. Because of strong horizontal wind the ball has a constant acceleration in the negative x-direction. Determine the radius of curvature $\rho$ of the path of the ball at B where its trajectory makes an angle of 45° with the horizontal. Neglect any effect of air resistance in the vertical direction.
PROBLEMS (Normal & Tangential Coordinates)

7. In the design of a control mechanism, the vertical slotted guide is moving with a constant velocity \( \dot{x} = 150 \text{ mm/s} \) during the interval of its motion from \( x = -80 \text{ mm} \) to \( x = +80 \text{ mm} \). For the instant when \( x = 60 \text{ mm} \), calculate the \( n \)- and \( t \)-components of acceleration of the pin P, which is confined to move in the parabolic groove. From these results, determine the radius of curvature \( \rho \) of the path at this position.