Problem Sheet No. 3

1. A particle P moves in a circular path of 3-m radius. At the instant considered, the speed of the particle is increasing at the rate of 6 m/s^2, and the magnitude of its total acceleration is 10 m/s^2. Determine the speed v of the particle at this instant.
   Ans. v = 4.90 m/s

2. A minivan starts from rest on the road whose constant radius of curvature is 40 m and whose bank angle is 10°. The motion occurs in a horizontal plane. If the constant forward acceleration of the minivan is 1.8 m/s^2, determine the magnitude a of its total acceleration 5 s after starting.
   Ans.a = 2.71 m/s^2

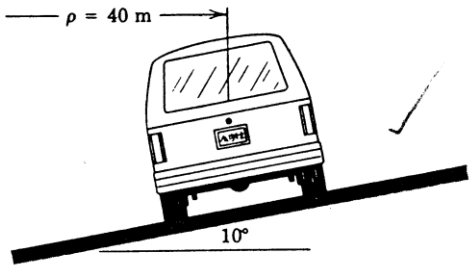

Figure-2

3. A baseball player releases a ball with the initial conditions shown in the figure. Determine the radius of the curvature of the trajectory (a) just after release and (b) at the apex. For each case, compute the time rate of change of the speed.
   Ans.
   $(a)p = 105.9m, v = -4.91m/s^2$
   $(b)p = 68.8m, v = 0$

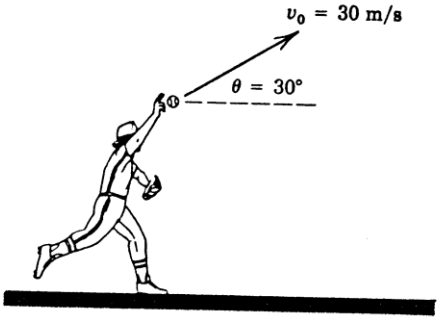

Figure-3

4. The motion of the pin A in the fixed circular slot is controlled by the guide B, which is being elevated by its lead screw with a constant upward velocity v_0 = 2 m/s for an interval of its motion. Calculate both the normal and tangential components of acceleration of pin A as it passes the position for which θ =30°.
   Ans.
   $a_n = 21.3m/s^2, a_t = -12.32m/s^2$

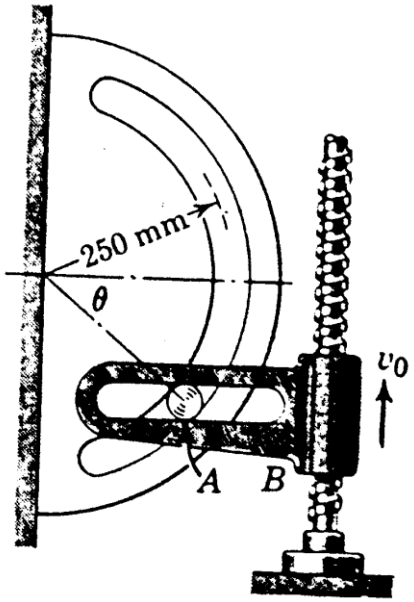

Figure-4

5. Race car A follows path a-a while race car B follows path b-b on the unbanked track. If each car has a constant speed limited to that corresponding to a lateral (normal) acceleration of 0.8g,determine the times t_A and t_B for both cars to negotiate the turn as delimited by the line C-C.
   Ans. $t_A = 10.52$ s, $t_B = 10.86$ s

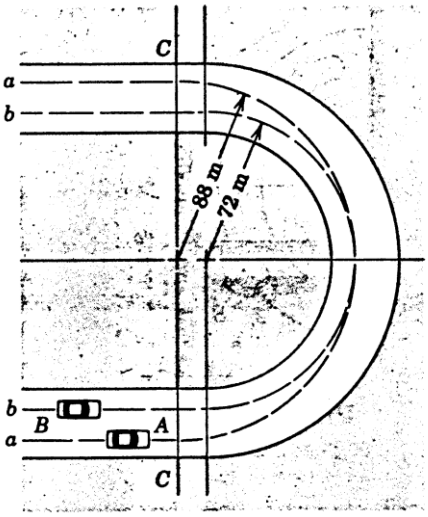

Figure -5

6. The pin P is constrained to move in slotted guide that move at right angles to one another. At the instant represented, guide 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 ρ of the path followed by P. Is it possible to determine also the time rate of change of ρ?
   Ans. $\rho = 1.25$ m

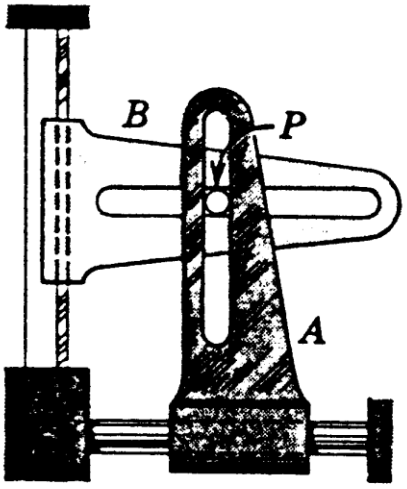

Figure -6