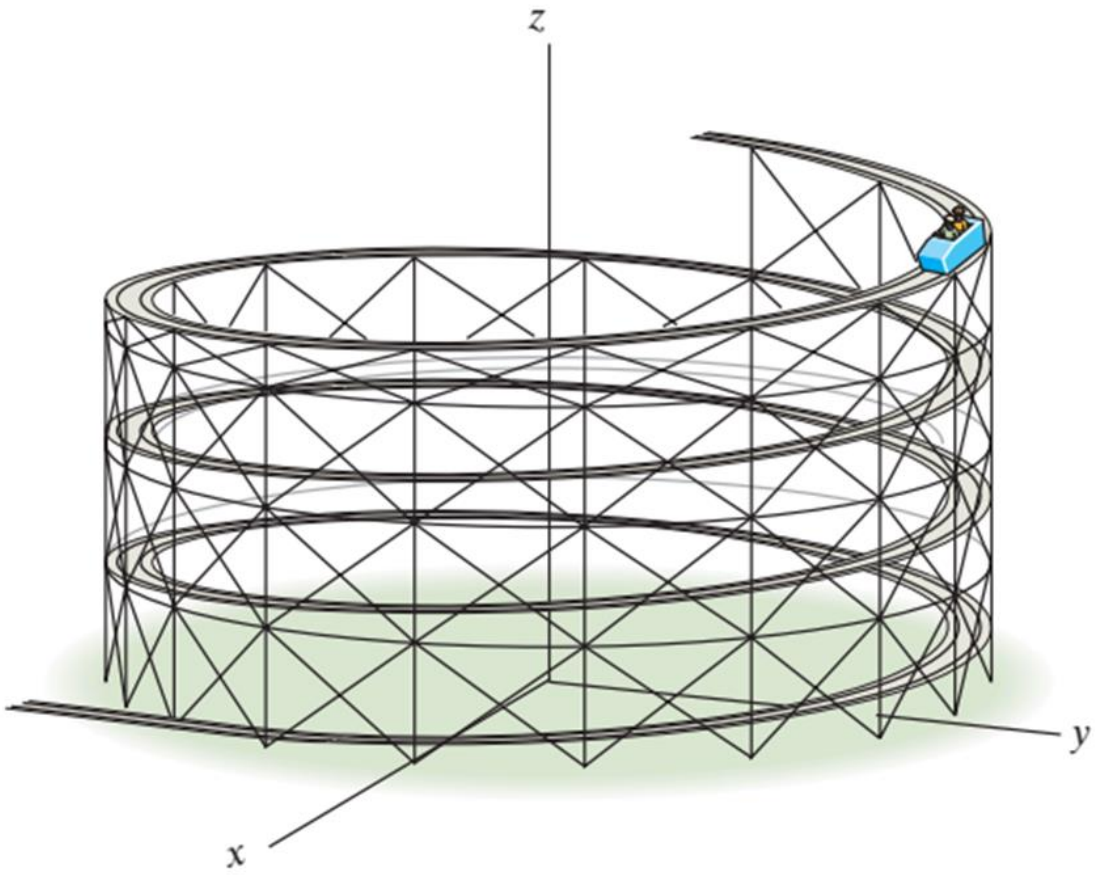
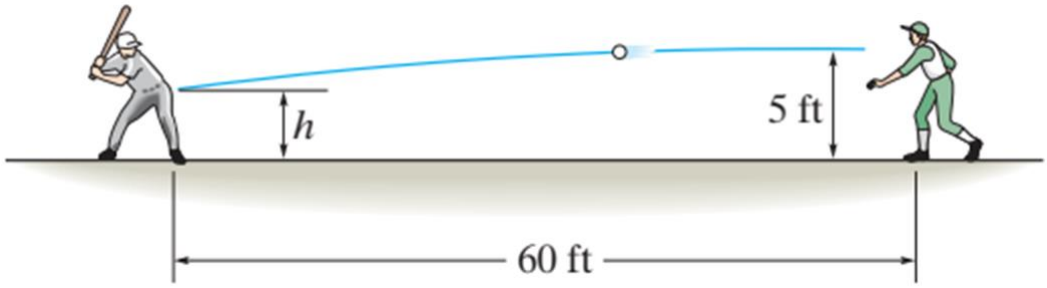
ME 100

ASSIGNMENT 2 – Last Date: 24th March, 2020

Q1) The roller coaster car travels down the helical path at constant speed such that the parametric equations that define its position are $x = c \sin kt$, $y = c \cos kt$, $z = h - bt$, where c, h, and b are constants. Determine the magnitudes of its velocity and acceleration.



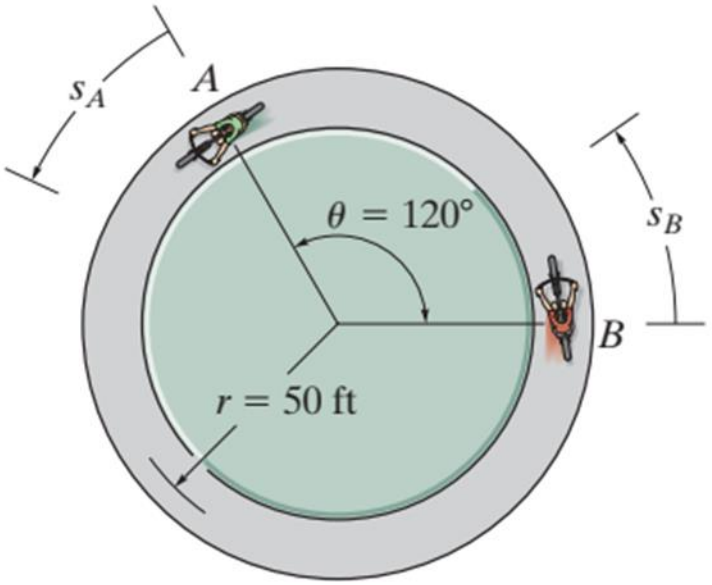
Q2) The pitcher throws the baseball horizontally with a speed of 140 ft/s from a height of 5 ft. If the batter is 60 ft away, determine the time for the ball to arrive at the batter and the height h at which it passes the batter.



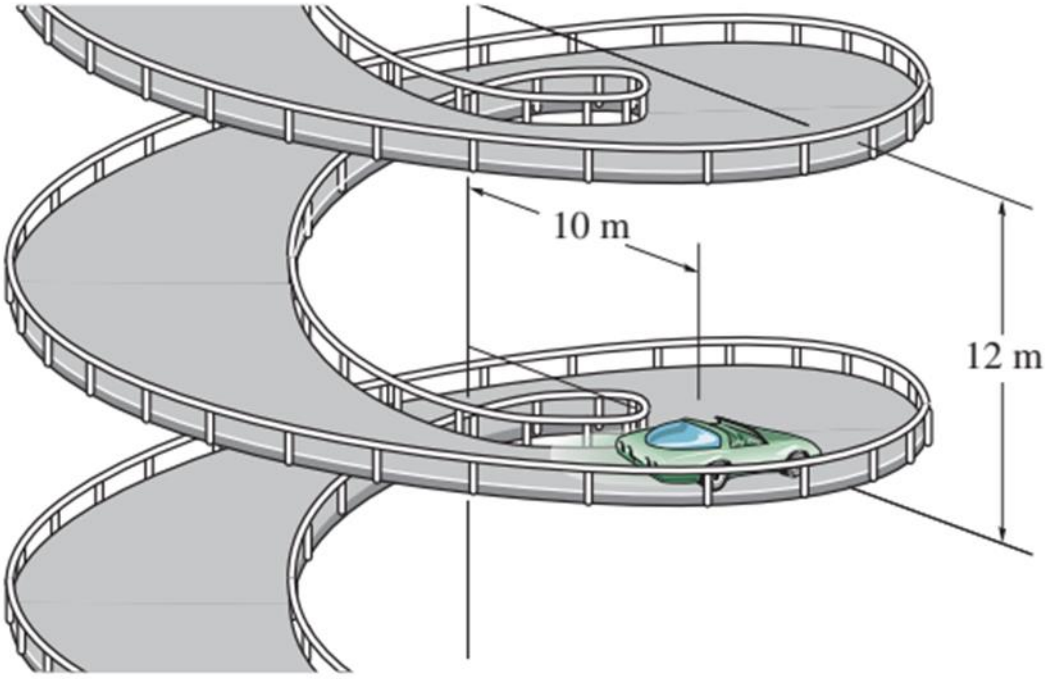
Q3) The position of a particle is defined by $\mathbf{r} = \{2\sin(\frac{\pi}{4})t\mathbf{i} + 2\cos(\frac{\pi}{4})t\mathbf{j} + 3t\mathbf{k}\}$ m, where t is in seconds. Determine the magnitudes of the velocity and acceleration at any instant.

Q4) A particle is traveling along a circular curve having a radius of 20 m. If it has an initial speed of 20 m/s and then begins to decrease its speed at the rate of $a_t = (-0.25s)\,\text{m/s}^2$, determine the magnitude of the acceleration of the particle two seconds later.

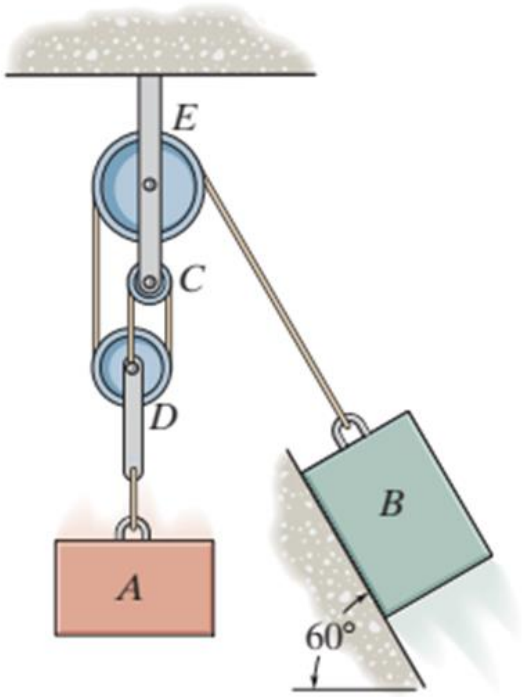
Q5) Two cyclists, A and B, are traveling counterclockwise around a circular track at a constant speed of 8 ft/s at the instant shown. If the speed of A is increased at $(a_t)_A = (s_A)\ \text{ft/s}^2$, where s_A is in feet, determine the distance measured counterclockwise along the track from B to A between the cyclists when $t = 1$ s. What is the magnitude of the acceleration of each cyclist at this instant?



Q6) The automobile travels from a parking deck down along a cylindrical spiral ramp at a constant speed of $v = 1.5$ m/s. If the ramp descends a distance of 12 m for every full revolution, $\theta = 2\pi$ rad, determine the magnitude of the car's acceleration as it moves along the ramp, $r = 10$ m. *Hint:* For part of the solution, note that the tangent to the ramp at any point is at an angle of $\phi = \tan^{-1}(12/[2\pi(10)]) = 10.81°$ from the horizontal. Use this to determine the velocity components v_θ and v_z, which in turn are used to determine $\dot{\theta}$ and $\dot{z}$.



Q8) Determine the required mass of block A so that when it is released from rest it moves the 5-kg block B a distance of 0.75 m up along the smooth inclined plane in $t = 2$ s. Neglect the mass of the pulleys and cords.



Q7) Determine the acceleration of the system and the tension in each cable. The inclined plane is smooth, and the coefficient of kinetic friction between the horizontal surface and block C is $(\mu_k)_C = 0.2$.