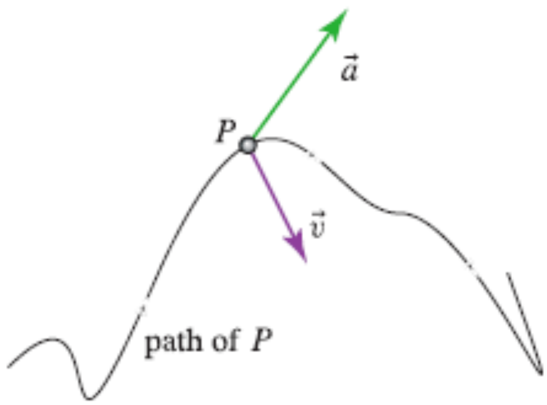
MEC 262 Homework 2 Due Date 2/13/2017 (8:30 am)

Problem 2.1

If $\vec{v}_{\text{avg}}$ is the average velocity of a point *P* over a given time interval, is $|\vec{v}_{\text{avg}}|$, the magnitude of the average velocity, equal to the average speed of *P* over the time interval in question?

Problem 2.3

Is it possible for the vector $\vec{v}$ shown to represent the velocity of the point *P*?



Problem 2.7

A city bus covers a 15 km route in 45 min. If the initial departure and final arrival points coincide, determine the average velocity and the average speed of the bus over the entire duration of the ride. Express the answers in m/s.

Figure P2.7

Problem 2.11

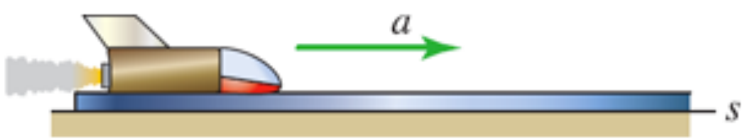
The position of a car as a function of time t, with $t > 0$ and expressed in seconds, is

$$\vec{r}(t) = \left[\left(5.98t^2 + 0.139t^3 - 0.0149t^4\right)\hat{\imath} + \left(0.523t^2 + 0.0122t^3 - 0.00131t^4\right)\hat{\jmath}\right] \text{ft}.$$

Determine the velocity, speed, and acceleration of the car for $t = 15$ s.

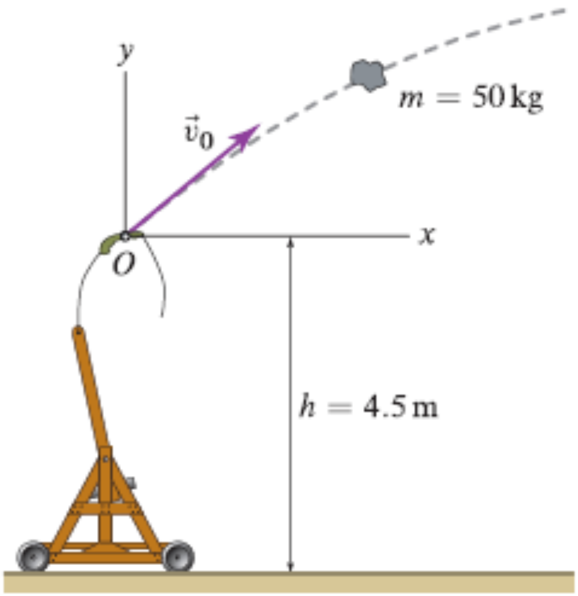
Problem 2.43

The acceleration of a sled is prescribed to have the following form: $a = \beta\sqrt{t}$, where t is time expressed in seconds, and β is a constant. The sled starts from rest at $t = 0$. Determine β in such a way that the distance traveled after 1 s is 25 ft.



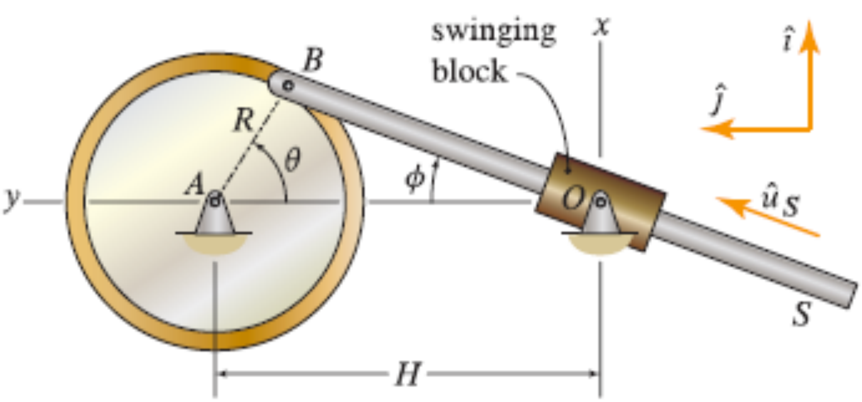
Problem 2.96

A trebuchet releases a rock with mass $m = 50$ kg at point O. The initial velocity of the projectile is $\vec{v}_0 = (45\,\hat{\imath} + 30\,\hat{\jmath})\,\mathrm{m/s}$. Neglecting aerodynamic effects, determine where the rock will land and its time of flight.



Problem 2.138

The mechanism shown is called a *swinging block* slider crank. First used in various steam locomotive engines in the 1800s, this mechanism is often found in door-closing systems. If the disk is rotating with a constant angular velocity $\dot{\theta} = 60\,\mathrm{rpm}$, $H = 4$ ft, $R = 1.5$ ft, and r is the distance between B and O, compute $\dot{r}$ and $\dot{\phi}$ when $\theta = 90°$. *Hint:* Apply Eq. (2.48) to the vector describing the position of B relative to O.



Problem 2.132

The end *B* of a robot arm is moving vertically down with a constant speed $v_0 = 2$ m/s. Letting $d = 1.5$ m, apply Eq. (2.48) to determine the rate at which r and θ are changing when $\theta = 37°$.