26.1 In-Class Examples

1. A skier, starting from rest, skis down a slope with an acceleration given by

$$a(t) = \frac{600t}{(60 + 0.5t^2)^2} \text{ m/s}^2.$$

Find the skier's velocity as a function of time.

2. (a) What is the displacement at time t for an object moving in a straight line with a constant acceleration of -9.8 m/s^2, starting with an initial velocity of 10 m/s?

   (b) What is the displacement at time t for an object moving in a straight line with a constant acceleration of a, starting with an initial velocity of v_0?

3. Let $m(t)$ be the mass of sugar (in g) that has dissolved t seconds after being dumped into a coffee mug. The sugar dissolves at a rate of change given by

$$\frac{dm}{dt} = \frac{10}{\sqrt[3]{t+1}} \text{ g/s}.$$

   (a) Find the mass m as a function of time.

   (b) If 30g of sugar were initially dumped into the coffee, how long will it take for all of the sugar to dissolve?

4. Consider a rotating object, where the angle θ is changing over time t. The **angular velocity** is defined as

$$\omega(t) = \frac{d\theta}{dt}$$

and the **angular acceleration** is

$$\alpha(t) = \frac{d\omega}{dt}.$$

Given that the angular acceleration of a helicopter blade is $\alpha(t) = \sqrt{8t+1}$ and that both $\omega(0) = 0$ and $\theta(0) = 0$, find $\theta(t)$.

5. Consider a tank full of saltwater with a hose coming in which is adding fresh water to the tank and an outlet which is draining the mixture. The mass m of salt in the tank has a rate of change of

$$\frac{dm}{dt} = -\frac{t}{\sqrt[3]{t^2 + 1000}} \text{ g/min}.$$

At time $t = 0$, $m = 100$. How long does it take for m to be 0?