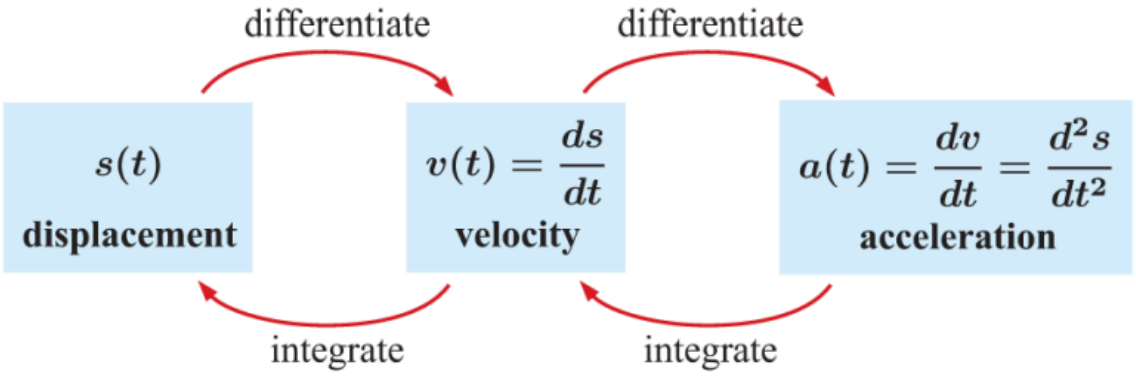
9.1 Kinematics



A train is initially at rest at a station. It begins to accelerate according to the function

$$a(t) = \frac{1}{2}e^{-\frac{t}{100}}\ ms^{-2}$$

a. Find the velocity function of the train.

b. How long will it take for the train to reach a speed of $40\ ms^{-1}$?

c. How far will the train travel during this time?

Solution for a.

$$a(t) = \frac{1}{2}e^{-\frac{t}{100}}$$

$$v(t) = \int a(t)dt = \int \frac{1}{2}e^{-\frac{t}{100}}\,dt$$

$$v(t) = -50e^{-\frac{t}{100}} + c$$

$$v(0) = 0 = -50e^{0} + c \rightarrow c = 50$$

$$s(t) = \int v(t)dt = \int -50e^{-\frac{t}{100}} + 50\ dt$$

$$s(t) = 5000e^{-\frac{t}{100}} + 50t + c$$

$$s(0) = 0 = 5000 + c \rightarrow c = -5000$$

b. using *v(t)*:

$$v(t) = 40 = -50e^{-\frac{t}{100}} + 50 \rightarrow t = 100\ln 5$$

c. using *s(t)*

$$s(100\ln 5) = 5000\ln 5 - 4000$$

Review Set 23A
5,7,8