<u>Problem</u> A particle is shot straight upwards from the ground with initial velocity 98 m/s. Its velocity at time t is given by

$$v = -9.8t + 98.$$

When does it reach its maximum height?

What is the maximum ~~the~~ height it achieves?

<u>Sol^n</u>

Maximum height occurs when the velocity is zero. So, it occurs when

$$0 = v = -9.8t + 98$$

So maximum height occurs at time $t = 10$.

From yesterday's lecture we see that

$$\text{maximum height} = \int_0^{10} (-9.8t + 98)\, dt$$

$$= -\frac{9.8}{2} t^2 + 98t \Big|_0^{10}$$

$$= \left(-\frac{9.8 \times 10^2}{2} + 98 \times 10 \right) - \left(\frac{-9.8 \times 0^2}{2} + 98 \times 0 \right)$$

$$= 980 - \frac{980}{2}$$

$$= 490 \text{ m}.$$

Problem The birth rate in a city t years after 1960 was $13+t$ thousands of births per year. How many births occured between 1960 and 1980?

Sol^n

$$\text{Total number of births} = \int_0^{20} 13+t \; dt$$

$$= 13t + \frac{t^2}{2} \Big|_0^{20}$$

$$= 13.20 + \frac{400}{2} - 0$$

$$= 460 \text{ thousand births.}$$

Problem The previous city had a death rate of $5+\frac{t}{2}$ thousands per year t years after 1960. Assuming that net immigration to the city always equals net emigration from the city, what is the increase in population of the city in 1980?

Soln

Increase in Population by 1980 $= \displaystyle\int_0^{20} 13+t-5-\frac{t}{2}\ dt$

$= \displaystyle\int_0^{20} 8+\frac{t}{2}\ dt$

$= 8t+\frac{t^2}{4}\Big|_0^{20}$

$$= 8.20 + \frac{400}{4}$$

$$= 260 \text{ thousand}.$$

<u>Problem</u> The rate of flow of water into an initially empty tank is $100 - 3t$ gallons per minute at time t minutes. How much water flows into the tank between $t = 10$ and $t = 20$ minutes?

<u>Soln</u>

you try it.