Closing **today** at 11pm: HW_1A,1B,1C
Closing next Wed: HW_2A,2B,2C

*Very Quick review of foundations:*

**Definition of Definite Integral**:

If $\Delta x = \frac{b-a}{n}$ and $x_i = a + i\Delta x$, then

$$\int_a^b f(x)\,dx = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i)\Delta x$$

= "signed" area between f(x) and the x-axis from x=a to x=b.

**FTOC(1)**: Areas are antiderivatives!

$$\frac{d}{dx}\left(\int_a^x f(t)dt\right) = f(x)$$

**FTOC(2)**: F(x) <u>any</u> antiderivative of f(x),

$$\int_a^b f(x)dx = F(b) - F(a)$$

*Entry Task*: Use the FTOC (Part 2), to evaluate each definite integral below:

$$\int_0^4 e^x + \sqrt{x^3}\,dx$$

$$\int_3^6 \frac{4}{x} - \frac{2}{x^2}\,dx$$

## 5.4 The Indefinite Integral and Net/Total Change

**Def'n**: An **indefinite integral** of f(x) is defined to be the general antiderivative of f(x). And we write

$$\int f(x)dx = F(x) + C,$$

where F(x) is one antiderivative of f(x).

**Net Change and Total Change**

Assume an object is moving along a straight line (up/down or left/right).

Let s(t) = `location of object at time *t*'

v(t) = `velocity of an object at time t'

positive v(t) means moving up/right

negative v(t) means moving down/left

The FTOC (part 2) says

$$\int_a^b v(t)dt = s(b) - s(a)$$

*i.e.* `integral of rate of change of dist.'

= `net change in distance'

**Displacement** = net change in distance

$$= \int_a^b v(t)dt = s(b) - s(a)$$

This is just the difference between where the object was standing at *t = a* and where it was standing at *t = b*.

**Total Distance** traveled by the object

$$= \int_a^b |v(t)|dt$$

To compute 'total distance' follow these steps:

1. Solve v(t) = 0.
   (This tells you places where v(t) might switch between positive and negative)

2. Break up the problem into separate integrals at the places from step 1.

3. Evaluate each integral (without the absolute values) and **add them up as positive numbers** in the end.