Extensions of FTC

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\# 65

Some applications of $\int_a^b (f(x))\,dx = F(b) - F(a)$ include:

1. Area - Find a constant, k, when the area under the curve is known.
2. Accumulation - Integrate rates of change such as:

$\int_{t_1}^{t_2} (P'(t))\,dt = P(t_2) - P(t_1)$ population rate of plants, people, animals

$\int_{t_1}^{t_2} (R'(t))\,dt = R(t_2) - R(t_1)$ flow rate of water, sand, traffic, etc.

3. Terminal Value - Finding $F(b)$, the terminal value, when given the initial value, $F(a)$. That is, $F(b) = F(a) + \int_a^b (f(x))\,dx$

**1. If $\int_{(-2)}^{2} (x^7 + k)\,dx = 16$, then k =

$\frac{x^8}{8} + kx \Big|_{-2}^{2} = 16 \quad \frac{2^8}{2^3} + 2k - \left(\frac{+2^8}{2^3} + 2k\right) = 16$

$2k + 2k = 4k = 16 \quad \boxed{k=4}$

**(FR) 2. A metal wire of length 8 cm is heated at one end. The table gives selected values of the temperature $T(x)$, in °C, of the wire x cm from the heated end. Find $\int_0^8 (T'(x))\,dx$ and indicate units of measure. Explain the meaning in terms of the temperature of the wire.

Dist. x	0	1	5	6	8
Temp. T(x)	100	93	70	62	55

$\int_0^8 T'(x) = T(8) - T(0)$

$= 55°C - 100°C = -45°C$

The temp drops 45°C from the heated end to 8cm at the other end.

**calc(FR) 3. A particle moves along the y-axis so that $v(t) = t\sin(t^2)$ for $t \geq 0$. Given that $s(t)$ is the position of the particle and that $s(0) = 3$, find $s(2)$.

$\int_0^2 t\sin(t^2)dt = s(2) - s(0) = .8268 + s(0) = s(2)$

$.8268 + 3 = s(2) = \boxed{3.827}$