1. Suppose that a square of side length s and area A is changing size with $dA/dt = 60$ cm^2 per second at all times t.

1A. At what rate is the length of the side changing at the moment when the area is 25 cm^2? Include the correct units in your answer.

square is getting bigger

so: $A = s^2$

$\therefore \dfrac{dA}{dt} = 2s\dfrac{ds}{dt}$

$60\,\frac{cm^2}{sec} = 2\cdot 5\,cm \cdot \frac{ds}{dt}$; $\frac{60}{10}\,\frac{cm}{sec} = ds/dt$

(when $A = 25$, $s = \sqrt{25} = 5$ here)

$\boxed{ds/dt = 6\ cm/sec}$

1B. When the side reaches 10 cm, what will the rate of change in its length be at that instant?

again, $\dfrac{dA}{dt} = 2s\dfrac{ds}{dt}$ but now $s = 10$ instead of 5;

get $60 = 2\cdot 10\cdot\dfrac{ds}{dt} \Rightarrow \dfrac{ds}{dt} = \dfrac{60}{20} = 3\left(\dfrac{cm}{sec}\right)$

2. Suppose f is a polynomial. Then f is continuous on $[a, b]$ and differentiable on (a, b) for any endpoints a and b. Given a and b then, the Mean Value Theorem says there must be a c in (a,b) for which $f'(c) =$ WHAT EXPRESSION?

$f'(c) = \dfrac{f(b) - f(a)}{b - a}$

2A. Suppose in fact that $f(x) = x^3$ and $[a, b] = [1, 3]$. Find the c that's guaranteed to exist by the MVT. Show all your work and write c to at least five places after the decimal point.

so we need $\boxed{f'(c) = \dfrac{f(3) - f(1)}{3-1}} \Rightarrow 3c^2 = \dfrac{27-1}{3-1} = \dfrac{26}{2} = 13$

$3c^2 = 13$

$c^2 = 13/3$

$c = \pm\sqrt{13/3} = \pm 2.081665\ldots$ but! we need $c \in (1,3) \therefore \boxed{c = 2.081665\ldots}$

3. The graph of a function $f(x)$ is made of straight lines and semicircles is shown at the bottom of the page. Find each of the following integrals.

$\int_2^4 f(x)\,dx$ $6 + \frac{1}{4}\pi 2^2 = 6+\pi$

3 + (2, 2)

$\int_5^6 f(x)\,dx$ $-1/2$

$\int_4^6 f(x)\,dx$ two Δ's are involved here and they contribute $\frac{3}{2} - \frac{1}{2} = 1$

$\int_6^8 f(x)\,dx$ $-(2 + \pi/2)$ (see below)

$\int_8^{10} f(x)\,dx$ $-(2 - \pi/2)$ $= -2 + \pi/2$ see below

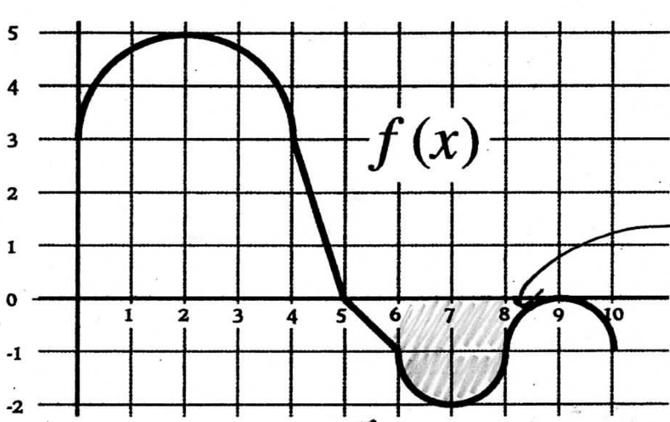
$\int_2^2 f(x)\,dx$ 0

$\int_4^2 f(x)\,dx$ (look carefully at the limits!)

$= -\int_2^4 f(x)dx$

$= -(6 + \pi)$

$\int_4^5 10f(x)\,dx = 10\int_4^5 f(x)dx = 10\cdot\frac{3}{2}$ $= 15$



$= 2$

$= \frac{1}{2}\pi 1^2$ radius 1

half-circle

this little " " has area 1 − area of this ¼ circle

$= 1 - \frac{1}{4}\pi$ (radius is 1)

since there are 2 pieces with this area from 8 to 10, and they are below the axis we get $-2(1 - \pi/4)$

$= -2 + \pi/2$