1. Approximate the area under the curve $y = \frac{1}{1+x^2}$ over the interval $[0, 2]$ using a Riemann sum approximation with $n = 4$ rectangles and using a *lower sum estimate*, that is, use the **right endpoint** of each subinterval in the Riemann sum. (12 pts.)

2. Find an upper bound on the error $|E_T|$ of a finite sum approximation of $\int_0^2 \frac{1}{1+2x}\, dx$ using $n = 4$ trapezoids. You may assume that (8 pts.)

$$|E_T| \le \frac{(b-a)^3 M}{12n^2}, \text{ if } |f''(x)| \le M \text{ on } [0, 2].$$

3. Find the general anti-derivative. (6 pts. each)

(a) $\displaystyle\int \sec(3x)\tan(3x)\, dx$

(b) $\displaystyle\int \cos(\pi x) - e^{-x/2} + \pi^3\, dx$

(c) $\displaystyle\int \frac{x-1}{x}\, dx$

(d) $\displaystyle\int p^x\, dx, \quad p > 0.$

4. Find the area bounded by the line $y = x - 6$ and the curve $y = -x^2 + 5x + 6$. (16 pts.)

5. Find $g'(x)$ if (8 pts.)

$$g(x) = \int_1^{x^2 - x} \sin(3t^2)\, dt.$$

6. Integrate. (8 pts. each)

(a) $\displaystyle\int \frac{2e^{\sqrt{1-x}}}{\sqrt{1-x}}\,dx$

(b) $\displaystyle\int_0^{\sqrt{\pi}/2} \sqrt{3}x\sec^2(x^2)\,dx$

(c) $\displaystyle\int_1^{e^2} \frac{\ln(x)}{8x}\,dx$