Instructions: No notes or calculators are allowed. Answers must be supported by work on your exam sheets. Answers with little or no supporting work will receive little or no credit. **Work must be neat, organized and easily interpreted.** Simplify all answers unless otherwise indicated. Please circle your final answers.

Practice 1

1. (15 pts) For the function $f(x) = 3x^2$, find a formula for a Riemann sum obtained by dividing the interval $[0, 1]$ into n equal subintervals and using the RIGHT-hand endpoint for each c_k.Then take a limit of these sums as $n \to \infty$ to calculate the area under the curve over $[0, 1]$.
2. (5 pts) Express the limit $\lim_{\|P\|\to 0} \sum_{k=1}^{n} c_k^5 \Delta x_k$, P a partition of [8,11], as a definite integral.
3. Use the Fundamental Theorem of Calculus to:
   a. (5 pts) Find $\frac{dy}{dx}$ for $y = \int_0^x \sqrt{5 + 6t^2}\, dt$.
   b. (5 pts) Find $\frac{dy}{dx}$ for $y = \int_0^{x^2} \sqrt{5 + 6t^2}\, dt$ [**hint**: also use the Chain Rule].
4. Integrate the following indefinite integrals.
   a. (8 pts) $\int x^{1/3} \sin\left(x^{4/3} + 8\right) dx$
   b. (7 pts) $\int \frac{t^3 - t^{5/2}}{t^2} dt$
   c. (8 pts) $\int 3y^5 \sqrt{y^3 + 1}\, dy$
   d. (7 pts) $\int \tan^2\theta \sec^2\theta\, d\theta$
5. Determine the values of the following definite integrals.
   a. (10 pts) $\int_0^1 \frac{e^x}{1+e^x} dx$
   b. (10 pts) $\int_0^{\pi/6} \cos^{-3} 2t \sin 2t\, dt$
   c. (10 pts) $\int_{-1}^{1} \theta^3(1 + \theta^4)^3\, d\theta$
6. (10 pts) Find the area of the region enclosed by the curves $9x^2 + y = 9$ and $x^4 - y = 1$.

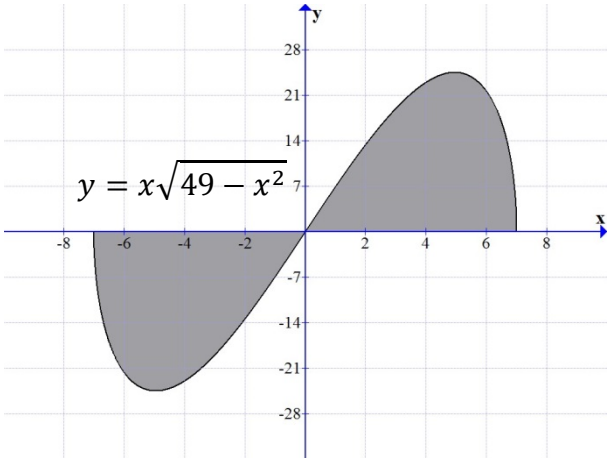
BONUS PROBLEM (8 pts) Evaluate **JUST ONE** of the following definite integrals. If you try both, you must neatly cross out the one you do not want graded, otherwise **neither** problem will receive credit.

A. $\int_0^{4/3} \frac{3}{16+9r^2} dr$

B. $\int_e^{e^2} \frac{2}{z \ln(z)} dz$

Practice 2

1. (10 pts) Use the Midpoint Rule to estimate the area under $y = \frac{5}{x}$ over the interval $[1, 25]$ using six rectangles of equal width. **Do not simplify your answer.**
2. (5 pts) Express the limit $\lim_{\|P\|\to 0} \sum_{k=1}^{n} c_k^9 \Delta x_k$, P a partition of $[3, 5]$, as a definite integral.
3. Use the Fundamental Theorem of Calculus to:
   a. (5 pts) Find $\frac{dy}{dx}$ for $y = \int_0^x \sqrt{3 + 4t^2}\ dt$.
   b. (5 pts) Find $\frac{dy}{dx}$ for $y = \int_0^{\tan x} \sqrt{3 + 4t^2}\ dt$ [**hint**: also use the Chain Rule].
4. Integrate the following indefinite integrals.
   a. (10 pts) $\int (2\theta + 1 + 2\cos(2\theta + 1))\ d\theta$
   b. (10 pts) $\int \frac{(t+1)^2 - 1}{t^4}\ dt$
   c. (10 pts) $\int \frac{(\ln y)^{-3}}{y}\ dy$
5. Determine the values of the following definite integrals.
   a. (15 pts) $\int_{-\pi/3}^{0} \sec x \tan x\ dx$
   b. (15 pts) $\int_0^{\ln 5} e^r (3e^r + 1)^{-3/2}\ dr$
6. (15 pts) Find the total area of the shaded regions.



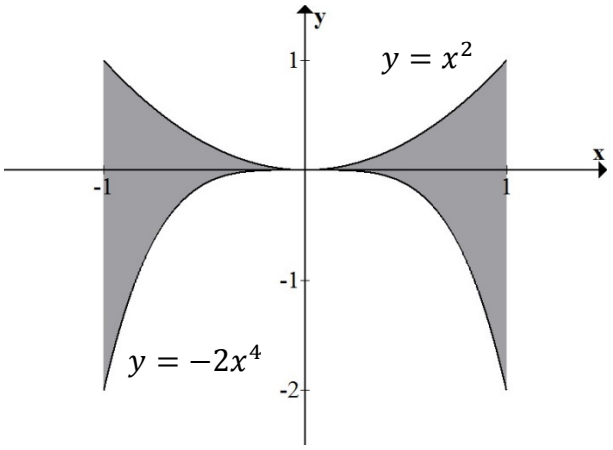
BONUS PROBLEM (8 pts) Evaluate **JUST ONE** of the following definite integrals. If you try both, you must neatly cross out the one you do not want graded, otherwise **neither** problem will receive credit.

A. $\int_{-2}^{2} \frac{3}{4+3t^2}\ dt$

B. $\int_{\sqrt{3}}^{\sqrt{8}} z^3\sqrt{z^2 + 1}\ dz$

Practice 3

1. (10 pts) Use the Midpoint Rule to estimate the area under $y = \frac{3}{x^2}$ over the interval $[2, 22]$ using five rectangles of equal width. **Do not simplify your answer.**
2. (5 pts) Express the limit $\lim_{\|P\|\to 0} \sum_{k=1}^{n} c_k^3 \Delta x_k$, P a partition of [2,8], as a definite integral.
3. Use the Fundamental Theorem of Calculus to:
   a. (5 pts) Find $\frac{dy}{dx}$ for $y = \int_0^x \sqrt{5 + 17t^3}\ dt$.
   b. (5 pts) Find $\frac{dy}{dx}$ for $y = \int_0^{\ln x} \sqrt{5 + 17t^3}\ dt$ [**hint**: also use the Chain Rule].
4. Integrate the following indefinite integrals.
   a. (10 pts) $\int \left(\frac{1}{\sqrt{2\theta - \pi}} + 2\sec^2(2\theta - \pi)\right) d\theta$
   b. (10 pts) $\int \left(t - \frac{2}{t}\right)\left(t + \frac{2}{t}\right) dt$
   c. (10 pts) $\int \frac{\cos(\ln y)}{y}\ dy$
5. Determine the values of the following definite integrals.
   a. (15 pts) $\int_{-\pi/6}^{0} \sec x \tan x\ dx$
   b. (15 pts) $\int_0^{\ln 10} e^r(e^r - 1)^{1/2}\ dr$
6. (15 pts) Find the total area of the shaded regions.



BONUS PROBLEM (8 pts) Evaluate **JUST ONE** of the following definite integrals. If you try both, you must neatly cross out the one you do not want graded, otherwise **neither** problem will receive credit.

A. $\int_{2/3}^{2\sqrt{3}/3} \frac{3}{4+3t^2}\ dt$

B. $\int_{-1}^{0} 3z^5\sqrt{z^3 + 1}\ dz$