1. a. Express the Riemann sum as a definite integral from $[-\pi,3\pi]$.
\[
\lim_{n \to \infty} \sum_{k=1}^{n} \frac{\sin(x_k)}{1+x_k} \Delta x
\]

b. Express the following as a Riemann sum using the definition of the definite integral.
\[
\int_{-3}^{5} \frac{x^2}{1+x^3} \, dx
\]

2. a. Approximate the area under $y = x^2 + 1$ from 0 to 3 using three equal subintervals and right endpoints.

b. Approximate the following definite integral using left endpoints and four equal subintervals.
\[
\int_{1}^{5} \ln(x) \, dx
\]

3. a. Use a geometric argument to calculate $\int_{0}^{7} f(x) \, dx$ given the graph of $y = f(x)$.

b. Find the average value of $\frac{1}{x}$ on $[0,7]$.

4. Suppose $f(x) = \ln(x)$ represents the path of a particle.
   a. Setup an integral describing the length of the path that the particle travels, $L(t)$, on $[0,1]$.
   b. Find the instantaneous rate of change, $R(t)$, of $L(t)$ (i.e. $\frac{dL(t)}{dt}$).

5. Find the antiderivatives of the following functions.
   a. $f(x) = \frac{x^2 + 1 + x}{(x^2 + 1)x}$
   b. $g(x) = \frac{1}{2 + 32x^2}$
   c. $h(x) = \frac{1 - x^2}{\sqrt{(1-x^2)^3}} + \csc(x) \cot(x)$
   d. $p(x) = (3e^x)2^{x^2} + e^x e^{-x} + \frac{5}{2} (e^{-x})^5$

6. Find the length of $y^{1/3} = \sqrt{x^2 + \frac{6}{9}}$ from $x = 0$ to $x = 1$

7. Find the area bounded by $y = \cos(x)$ and $y = \frac{2}{\pi}x + 1$.

8. Evaluate the following definite integrals.
   a. $\int_{0}^{\pi/2} \frac{4}{\sqrt{1-x^2}} \, dx$
   b. $\int_{0}^{2} \frac{2}{3x+1} \, dx$
   c. $\int_{0}^{\pi} (\sin(x) + \cos(x)) \, dx$

9. Let $\frac{dL}{dt} = \sqrt{2t^4}$
   a. Find $L(t)$ given $L(0) = 98$.
   b. Find the net change from $[6,16]$. 