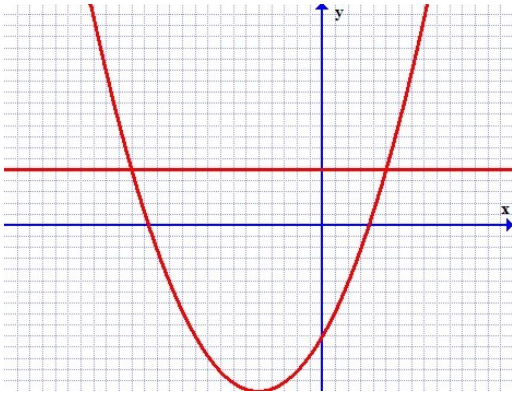
1. Evaluate each integral by making an appropriate substitution.

(a) $\int \frac{x}{x^2+4}dx$

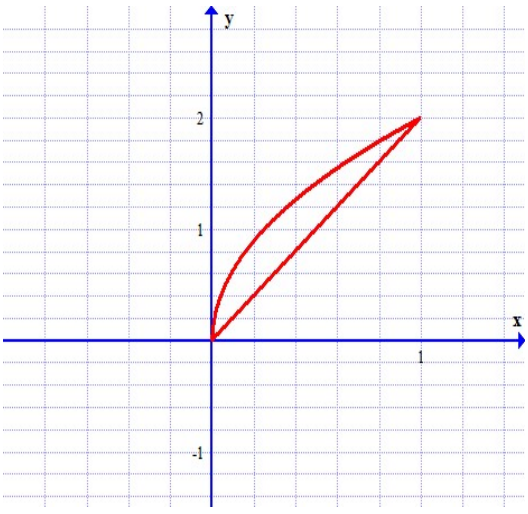
(b) $\int_0^1 \frac{e^x-e^{-x}}{e^x+e^{-x}}dx$

(c) $\int \tan x \sec^4 x dx$

2. Find the area of the region bounded above by the graph of $g(x)=1$ and below by the graph of $f(x)=x^2+2x-2$.



3. Let **R** be the closed region between the graphs of $y=2\sqrt{x}$ and $y=2x$ on the interval [0, 1]. Find the volume **V** of the solid obtained by revolving **R** about the ***x***- axis.



4. Let **R** be the closed region between the graphs of $y=2\sqrt{x}$ and $y=2x$ on the interval [0, 1]. Find the volume **V** of the solid obtained by revolving **R** about the ***y***- axis. (Same graph as for Problem3)

5. Find the **length of arc** on the graph of $f(x)=\frac{2}{3}x^{3/2}$ from $x=1$ to $x=4$

6. Find the **area of the surface** generated by revolving about the *x*-axis the curve $f(x)=\frac{1}{3}x^3$ on $[0,2]$.

7. Fill in the values of $f^{-1}(x)$ and $\left(f^{-1}\right)'(x)$ for $x=1,2,3$. Provide detail to support your answers.

x	$f(x)$	$f'(x)$	$f^{-1}(x)$	$\left(f^{-1}\right)'(x)$
1	2	5		
2	3	-1		
3	1	3		

8. Calculate the derivative for $y=\arctan\left(\sqrt{x^2+1}\right)$

9. Use the definition of an improper integral to evaluate the following integrals. If an integral converges, evaluate its value.

(a) $\int_0^1 \frac{1}{x^{0.9}}dx$

(b) $\int_1^\infty \frac{2x}{x^2+1}dx$

10. Using the indicated techniques to evaluate the following integrals. Show work detail to support your solutions. Solving using other methods or with no detail is not acceptable.

(a) $\int \frac{dx}{\sqrt{1-4x^2}}$ (Trigonometric substitution)

(b) $\int \frac{x^2}{\sqrt{16-x^2}}dx$ (Trigonometric substitution)

(c) $\int x^2 \ln x dx$ (Integration by Parts)

11. Complete the square in the denominator, make appropriate substitution, and integrate.

$$\int \frac{1}{x^2+6x+10}dx$$

12. Find the partial fraction decomposition for the rational function $\frac{5}{(u-2)(u+3)}$ and then evaluate the integral $\int \frac{5}{(u-2)(u+3)}du$

13. State whether the sequence converges or diverges. If it converges, find its **limit**.

$$\left\{\frac{(n+3)^2-n^2}{n}, n=1,2,\cdots\right\}$$

14. Using the **Integral Test** to test the following series for convergence. Solving using other methods or with no detail is not acceptable.

$$\sum_{n=3}^{\infty} \frac{1}{n(\ln n)^2}$$

15. Determine whether the following series converge or diverge. Indicate the test you use.

(a) $\sum_{k=2}^{\infty} \frac{1+\sin^2 k}{k-1}$

(b) $\sum_{n=1}^{\infty} \frac{4n-1}{n^3+2n^2-2}$

16. Determine whether the series $\sum_{n=0}^{\infty} \left[\left(\frac{1}{3}\right)^n - \left(-\frac{3}{4}\right)^n \right]$ converges or diverges. If it converges, find its **sum**.

17. Determine whether the series $\sum_{n=0}^{\infty} \frac{(-1)^n}{\sqrt{n}+3}$ converges conditionally, or converges absolutely, or diverges and give reasons for your conclusions.

18. Find the **interval of convergence** for the power series $\sum_{n=0}^{\infty} \frac{1}{n+2} x^n$

19. Use substitution method and a known power series to find power series for $\frac{e^{3x}-1}{x}$. Please express your answer in **one** sigma notation.