1. Compute the following integrals.

   (a) $\int \cos^2 x \sin^3 x \, dx$

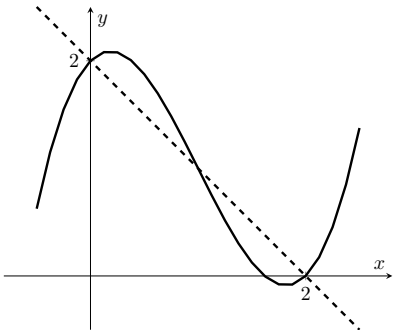
   (b) $\int \frac{dx}{\sqrt{a^2 - x^2}}$

2. (a) Compute $\int_0^4 \frac{dx}{\sqrt{4-x}}$

   (b) Can we use the Comparison Theorem to determine whether the following integral converges or diverges? If we can, then do so. If not, explain why.

   $$\int_1^\infty \frac{\sin x}{x^3 + 1} \, dx$$

3. Set up (but do **not** evaluate) one or more integrals to find the area enclosed by the graphs of $f(x) = 2 - x$ and $g(x) = x^3 - 3x^2 + x + 2$.



4. Suppose $a_1 = 2$ and $a_{n+1} = 2a_n - 1$ for all $n > 1$.

   (a) Prove a_n is increasing.

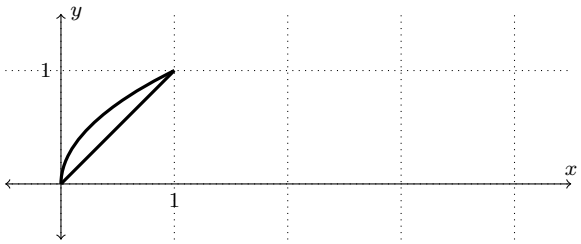
   (b) Determine whether the following statement is true or false, and justify your answer: $\lim_{n\to\infty} a_n = 1$.

5. Determine whether the following statement is true or false, and justify your answer

Given continuous functions $f(x)$ and $g(x)$ defined on $[0,3]$, there is at least one value $c \in [0,3]$ such that $f(c) = \frac{1}{3}\int_0^3 f(x)dx$ and $g(c) = \frac{1}{3}\int_0^3 g(x)dx$.

6. Consider the region bounded by the curves $y = \sqrt{x}$ and $y = x$.

   (a) Use the method of cylindrical shells to set up (but do **not** evaluate) an integral to find the volume of solid obtained by rotating the region about the line $x = 2$.



   (b) Set up (but do **not** evaluate) an integral to find the volume of S, the solid whose base is the given region, and whose cross sections perpendicular to the $x-$axis are squares.