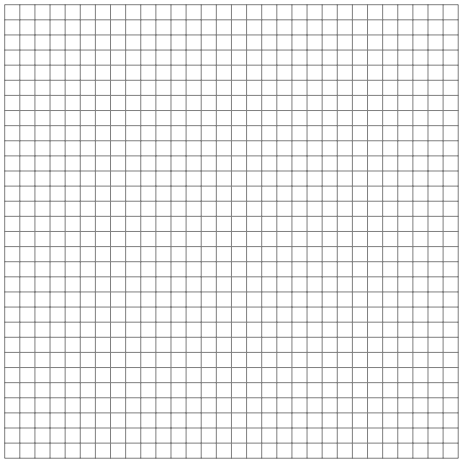
1. a) Sketch the two curves $y = x^2 - 4$ and $y = 3x$ and find the points of intersection by solving the equation $x^2 - 4 = 3x$.



b) Use the values of the definite integrals $\int_{-1}^{0} x^2 - 4 \; dx$ and $\int_{-1}^{0} 3x \; dx$ to find the area between the two curves over the interval $[-1, 3]$ (remember that areas are always positive).

c) Find the area between the two curves over the interval $[0, 4]$ (again your answer should be a positive number).

d) What is the total area of the region enclosed by the two curves?

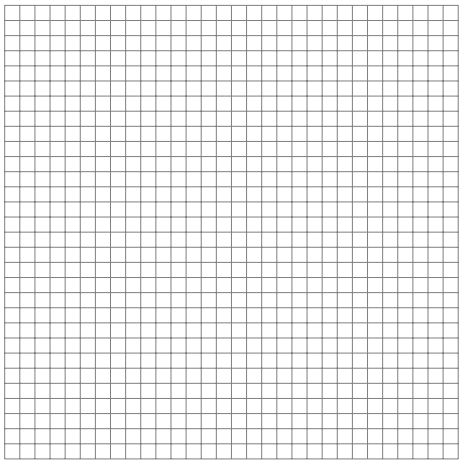
e) Evaluate the integral $\int_{-1}^{4} 3x - \left(x^2 - 4\right) \; dx$.

Theorem 1. *Suppose that f and g are functions such that $f(x) \geq g(x)$ for x in the interval $[a, b]$. Then the area between the graphs of f and g over the interval $[a, b]$ is*

$$\int_a^b [f(x) - g(x)] \; dx.$$

2. Let $f(x) = x^2 - 2x - 1$ and $g(x) = -e^x - 1$. Use your calculator (or your neighbor's) to verify that $f(x) \geq g(x)$ over $[-1, 1]$ and then find the area between the graphs of the two functions over $[-1, 1]$.

3. a) Sketch the curves $y = x^2$ and $y = \sqrt{x}$, clearly labeling their points of intersection.



b) Find the area between the curves over the interval $[0, 2]$.

c) Explain why neither of the integrals $\int_0^2 x^2 - \sqrt{x} \; dx$ or $\int_0^2 \sqrt{x} - x^2 \; dx$ is the area between the curves.

4. Economists have concluded that a country's oil consumption over the next 5 years will grow according to the formula $c(t) = 20e^{0.08t}$ unless the government creates incentives for conservation. If the conservation incentives are adopted, then oil consumption is projected to grow according to the formula $c_1(t) = 20e^{0.05t}$. Using these models, determine how much oil would be conserved over the next 5 years if the conservation incentives are adopted.