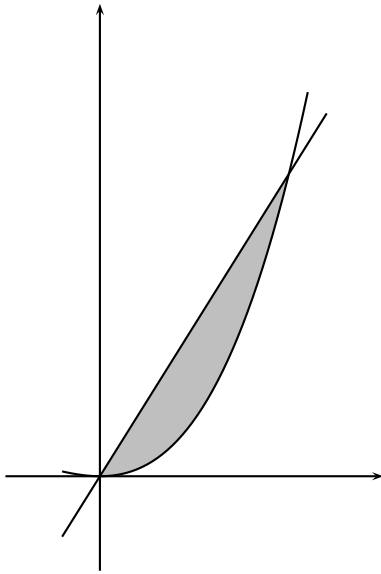


Name: _____ (100 points total)

1. (20 points) A sample of a radioactive substance decays at a rate proportional to the amount present. Suppose that after two hours the amount of the substance decreases to one-third of its initial amount. How long will it take for the substance to be reduced to one-tenth of its initial amount?

2. (35 points) The region R in the first quadrant bounded by the curve $y = x^3 + x^2$ and the line $y = 2x$ is sketched below. Give definite integrals which compute the volume of the solid generated by revolving R about (a) the vertical line $x = 3$ and (b) the horizontal line $y = -1$. Do not evaluate either of these two integrals.



3. (20 points) Consider the curve $y = 3\sqrt{x}$, $1 \leq x \leq 2$. Give integrals which compute (a) the length of the curve and (b) the surface area generated by rotating the curve about the x -axis. Do not evaluate either of the two integrals.

4. (25 points) A 6 pound bucket with water is lifted from the ground to the top of a 30-ft building by pulling in rope which weighs 0.1-lb/ft at a constant speed. The bucket is leaking. It starts with 3 pounds of water, leaks water at a constant rate, and finishes draining just as it reaches the top. How much work is spent lifting the rope, bucket, and water? Hint: you must determine the amount of work required to lift the rope, bucket, and water separately, and then add these three numbers.