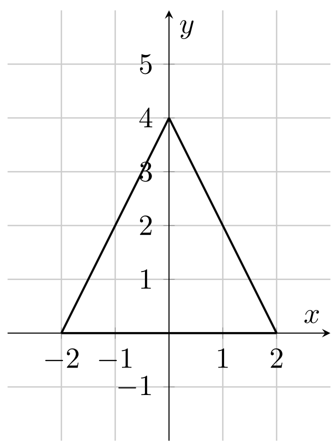
4. [5 points] Find the derivative of $f(x) = 3e^{-2x}\cos(5x)$. You do not need to simplify your answer.

Solution: We use the chain rule and the product rule:

$$\begin{aligned} f'(x) &= 3\frac{d}{dx}(e^{-2x}\cos(5x)) \\ &= 3\Big[-2e^{-2x}\cos(5x) - 5e^{-2x}\sin(5x)\Big] \\ &= -6e^{-2x}\cos(5x) - 15e^{-2x}\sin(5x). \end{aligned}$$

5. [7 points] Nzinga is going rock climbing at a local climbing gym. The gym building is shaped as follows. Its base is the triangular region shown in the figure below. The cross sections of the gym perpendicular to the y-axis are semicircles.



Write, but do not evaluate, an integral which gives the volume enclosed by the building.

Solution: The equation describing the right slanted line segment in the diagram is $y = -2x + 4$, and the equation describing the left slanted line segment is $y = 2x + 4$. The base of a semicircular slice which is at a height y above the x-axis is given by the difference in x-coordinate of the two slanted segments at the height y. This is $\frac{4-y}{2} - \frac{y-4}{2} = 4 - y$.
The radius of the semicircular slice is then $(4-y)/2$, so the area is $\frac{1}{2}\pi((4-y)/2)^2 = \frac{\pi(4-y)^2}{8}$.
So the volume of the slice, with thickness Δy, is $\frac{\pi(4-y)^2}{8}\Delta y$. Therefore the volume is

$$\int_0^4 \frac{\pi(4-y)^2}{8}\,dy.$$