**11.** [12 points]    For each of the following, sketch a graph or figure as indicated. (There is more than one correct answer for each.)  Your sketches do not have to be detailed, but should clearly illustrate the characteristics described.
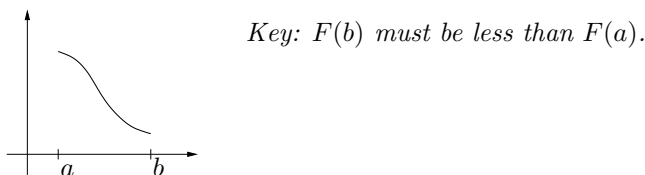
**(a)** [3 points of 12] Sketch a non-constant function $f(x)$ such that neither of the left- or right-hand estimates for $\int_a^b f(x)\,dx$ are overestimates.
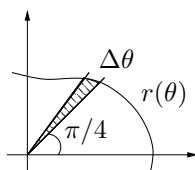
*Solution*:



Or, e.g.,
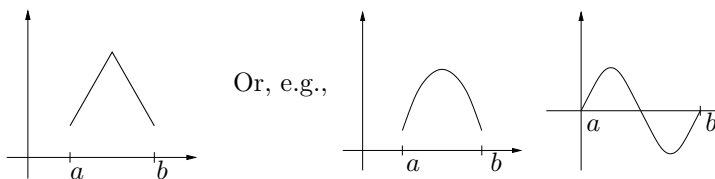
**(b)** [3 points of 12] Sketch the antiderivative of a function $f(x)$, on the interval $a \le x \le b$, if $\int_a^b f(x)\,dx < 0$.

*Solution*:



*Key: $F(b)$ must be less than $F(a)$.*

**(c)** [3 points of 12] Sketch a function given in polar coordinates as $r = f(\theta)$, and the area represented by $\frac{1}{2}\left(f(\frac{\pi}{4})\right)^2 \Delta\theta$.

*Solution*:



**(d)** [3 points of 12] Sketch a sequence $S_n$ of partial sums for a convergent series $\Sigma\, a_n$ if $\Sigma\, a_n = L$.

*Solution*:



*Other figures are also ok, e.g.,*