

**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.

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

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

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