3. (11 points) The following is a graph of the function $f(x)$ on the interval $[0, 6]$.

(a) (2 pts.) Use the graph to estimate $\int_0^6 f(x) \, dx$ using LEFT(3). (Show your work.)

$$\text{LEFT}(3) = 2 \left[ f(0) + f(2) + f(4) \right] = 2 [1 + 2 + 3] = 12.$$ 

(b) (2 pts.) Use the graph to estimate $\int_0^6 f(x) \, dx$ using TRAP(3). (Show your work.)

$$\text{RIGHT}(3) = 2 \left[ f(2) + f(4) + f(6) \right] = 2 [2 + 3 + 4] = 18.$$ 

So,

$$\text{TRAP}(3) = \frac{12 + 18}{2} = 15.$$ 

(c) (4 pts.) The graph given above is reproduced twice for you below. On these graphs, sketch the areas given by the approximations LEFT(3) and TRAP(3). Use the left graph for LEFT(3) and the right graph for TRAP(3).

(d) (3 pts.) Which is a better estimate of $\int_0^6 f(x) \, dx$, LEFT(3) or TRAP(3)? Explain.

LEFT(3) is better. TRAP(3) is an overestimate, because its trapezoids are always above the graph. LEFT(3) cuts through the graph and so balances its over– and underestimates.