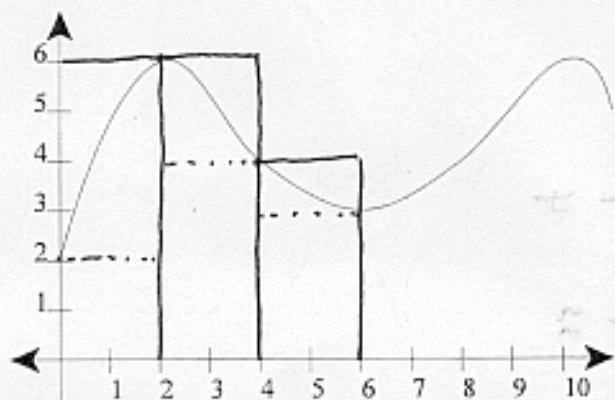Each problem is worth 5 points. Show complete justification for full credit.

1. By reading values from the graph of f(x) below, use three rectangles to find an upper estimate and a lower estimate for the area under the graph of f(x) but above the x axis between x=0 and x=6.

Upper $= 2 \cdot 6 + 2 \cdot 6 + 2 \cdot 4 = 12 + 12 + 8 = \boxed{32}$

Lower $= 2 \cdot 2 + 2 \cdot 4 + 2 \cdot 3 = 4 + 8 + 6 = \boxed{18}$

2. Use the midpoint rule with n=4 to approximate $\int_{2}^{4} \sqrt{64 - x^3}\, dx$. [You don't need to simplify your answer – things like $\sqrt{64 - (2\,\tfrac{1}{4})^3}$ are perfectly acceptable here.]
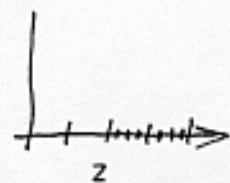
$$f(2\tfrac{1}{4}) \cdot \tfrac{1}{2} + f(2\tfrac{3}{4}) \cdot \tfrac{1}{2} + f(3\tfrac{1}{4}) \cdot \tfrac{1}{2} + f(3\tfrac{3}{4}) \cdot \tfrac{1}{2}$$

$$= \left[\sqrt{64 - (2\tfrac{1}{4})^3} + \sqrt{64 - (2\tfrac{3}{4})^2} + \sqrt{64 - (3\tfrac{1}{4})^2} + \sqrt{64 - (3\tfrac{3}{4})^2} \right] \cdot \tfrac{1}{2}$$