

5. (4+6+3 points) Your uncle Harry absolutely LOVES eggnog around the holidays. The rate at which he drinks it at your family holiday party is given by the function $r(t)$ where t is measured in hours and $r(t)$ is in liters/hour. Suppose $t = 0$ corresponds to 6 pm when the party begins.

(a) Write a definite integral that represents the total amount of eggnog uncle Harry consumes between 8 pm and 2 am the next morning.

$$\int_2^8 r(t) dt$$

(b) If Uncle Harry's rate of eggnog drinking is given by $r(t) = e^{-t} + 1$, use a left hand sum with three (3) subdivisions to estimate the amount of nog Harry drinks in the first four hours of the party. Show all of your work.

$$r(0)\frac{4}{3} + r\left(\frac{4}{3}\right)\frac{4}{3} + r\left(\frac{8}{3}\right)\frac{4}{3} = 2 \cdot \frac{4}{3} + (e^{-\frac{4}{3}} + 1)\frac{4}{3} + (e^{-\frac{8}{3}} + 1)\frac{4}{3}.$$

(c) Should your estimate in part (b) be an underestimate or an overestimate? Explain.

It is an overestimate because the function $r(t)$ is a decreasing function.