Full Name: SOLUTIONS   Student # :_____

TA: Maddie_____

Please provide detailed solutions to the problems below. Correct responses without justification may not receive full credit. The use of a calculator is permitted.

[6 marks]   (1.) Find an approximation to the integral $\int_0^1 e^x dx$ using a Riemann sum with left endpoints and $n = 4$.
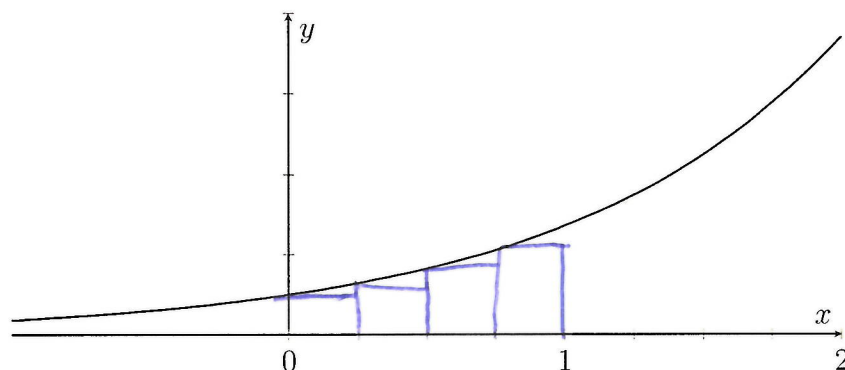
$$\Delta x = \frac{1-0}{4} = 0.25 \qquad x_0 = 0 \quad x_1 = 0.25 \quad x_2 = 0.5 \quad x_3 = 0.75$$

$$\sum_{i=0}^{3} \Delta x \, f(x_i)$$

$$= 0.25 \left[f(x_0) + f(x_1) + f(x_2) + f(x_3) \right]$$
$$= 0.25 \left(e^0 + e^{0.25} + e^{0.5} + e^{0.75} \right) = 1.51$$

[1 marks]   (2.) Sketch on the graph below the rectangles you used in part (a).

[3 marks]   (3.) Is the result you found in (a) greater than, less than, or equal to the actual area under e^x between $x = 0$ and $x = 1$? Explain.

The area in (a) is less than the true area. For an increasing function, using left endpoints will underestimate. We can also see in (b) the area under the graph that is not accounted for in (a).