4. Consider the function $f(x) = x^3 \ln x$.

   (a) (4 points) Use the general expression for a left-hand sum using 4 subdivisions to write an approximation for

   $$\int_1^3 x^3 \ln x \, dx$$

   —*i.e.,* express each term of the left-hand sum, using the given function. There is no need to evaluate the sum.

   (b) (3 points) Show that $\int x^3 \ln x \, dx = \frac{x^4}{4} \ln x - \frac{x^4}{16} + C$. Show your work.

   (c) (4 points) Use the Fundamental Theorem of Calculus and part (b) to find the exact value of $\int_1^3 x^3 \ln x \, dx$. Leave your answer in *exact* form—in other words, do not convert to a decimal. Again, show your work.