7. (14 points) Show your work!

(a) Confirm that

\[ F(x) = \frac{1}{4} x^4 \ln(x) - \frac{1}{16} x^4 + 12 \]

is an antiderivative for \( f(x) = x^3 \ln(x) \), for values of \( x > 0 \). Show your work.

(b) Use the Fundamental Theorem of Calculus to find \( \int_1^2 x^3 \ln(x) \, dx \). Give your answer in exact form—i.e., not a decimal approximation.

(c) Find an equation of the tangent to the graph of \( F \) at \( x = 1 \).