1. False. There are usually multiple ways to perform integration by parts.
2. True. Sometimes, our approximation may be equal to the function itself.
3. (a) First, we use u-sub to simplify the problem. Let $u = x^3$. Then $du = 3x^2dx$, so $\frac{du}{3} = x^2dx$. Now the problem is $\int \frac{ue^u}{3}du = \frac{1}{3}\int ue^u du$.
   Now we need to solve this problem using integration by parts. Set $f(u) = u$ and $g'(u) = e^u du$. Then we get $f'(u) = du$ and $g(x) = e^u$.
   Then $\frac{1}{3}\int ue^u du = \frac{1}{3}(ue^u - \int e^u du) = \frac{1}{3}(ue^u - e^u + C)$. Now we have to plug back in our substitution: $\frac{1}{3}(x^3e^{x^3} - e^{x^3} + C)$.

   (b) The error E_T for trapezoid rule is bounded by $\left|\frac{C(b-a)^3}{12n^2}\right|$, where $C = \left|\max_{x\in[1,2]} f''(x)\right|$. The second derivative of $\ln(x)$ is $-\frac{1}{x^2}$. The maximum of $\left|-\frac{1}{x^2}\right|$ occurs at $x = 1$, and the value is 1. $a = 1$ and $b = 2$, so $b - a = 1$.
   We want $\frac{1*(1)^3}{12n^2} \leq \frac{1}{12*100}$. Solving for n gives $n \geq 10$.