1. False. Sometimes the approximation may be equal to the actual function.
2. True. u-substitution tends to simplify the situation so the integration by parts will not be so difficult.
3. (a) Use u-sub first. Set $u = x^2$. Then $du = 2xdx$, and $\frac{du}{2} = xdx$. So our integral becomes $\int \frac{1}{2}ue^u du = \frac{1}{2}\int ue^u du$. Now we use integration by parts.

   Set $f(u) = u$ and $g'(u) = e^u du$. Then $f'(u) = du$ and $g(u) = e^u$. Now plug everything back in to get $\frac{1}{2}\int ue^u du = \frac{1}{2}(ue^u - \int e^u du) = \frac{1}{2}(ue^u - e^u + C)$.

   Finally, plug back in to get rid of the u's: $\frac{1}{2}(x^2 e^{x^2} - e^{x^2} + C)$.

   (b) The error for midpoint rule E_M is $\frac{C(b-a)^3}{24n^2}$, where $C = \max_{x\in[0,1]} f''(x)$. The second derivative of $2x^4$ is $24x^2$. The maximum occurs at $x = 1$, and the value is 24.

   $b = 1$ and $a = 0$, so $b - a = 1$. Then we want $\frac{24(1)^3}{24n^2} \leq \frac{1}{100}$. Solving for n gives $n \geq 10$.