Compute each of the following. Show all of your steps clearly to receive full credit.

1. \[ \int \frac{\sec^2(\ln(x))}{x} \, dx \]

**Solution:** Use the substitution \( u = \ln(x) \), so \( du = (1/x) \, dx \). After making the substitution, the integral becomes

\[ \int \frac{\sec^2(\ln(x))}{x} \, dx = \int \sec^2(u) \, du = \tan(u) + C = \tan(\ln(x)) + C. \]

Note that we have used the fact that \( \sec^2(u) \) is the derivative \( \tan(u) \).

2. \[ \int_0^1 3t\sqrt{1+3t^2} \, dt \]

**Solution:** Substitute \( u = 1 + 3t^2 \) so that \( du = 6t \, dt \), and so \( (1/2) \, du = 3t \, dt \). For the limits of integration, when \( t = 0, u = 1 \), and when \( t = 1, u = 4 \). Now the definite integral becomes

\[ \int_0^1 3t\sqrt{1+3t^2} \, dt = \left[ \frac{1}{2}u^{3/2} \right]_1^4 = \frac{1}{3}4^{3/2} - \frac{1}{3}1^{3/2} = \frac{7}{3}. \]

Note that to compute \( 4^{3/2} \), we take the square root first to make things easier, that is \( 4^{3/2} = (4^{1/2})^3 = 2^3 = 8 \).