some basic substitution problems

1.

$$\int e^{4x+3}\,dx = \frac{1}{4}e^{4x+3} + C$$

2. Differentiate your answer to #1.

$$\frac{d}{dx}\left[\frac{1}{4}e^{4x+3} + C\right] = \frac{1}{4}e^{4x+3} \cdot \frac{d}{dx}[4x+3] + 0 = \left(\frac{1}{4}e^{4x+3}\right) \cdot 4 = e^{4x+3}$$

3.

$$\int 3x^2 \cos x^3\,dx = \sin x^3 + C$$

4. Differentiate your answer to #3.

$$\frac{d}{dx}\left[\sin x^3 + C\right] = (\cos x^3) \cdot \frac{d}{dx}\left[x^3\right] + 0 = 3x^2 \cos x^3$$

5.

$$\int e^{\sin x} \cos x\,dx = e^{\sin x} + C$$

6. Differentiate your answer to #5.

$$\frac{d}{dx}\left[e^{\sin x} + C\right] = e^{\sin x} \cdot \frac{d}{dx}[\sin x] + 0 = e^{\sin x} \cos x$$

7.

$$\int \frac{2}{x} \ln x \, dx = (\ln x)^2 + C$$

8. Differentiate your answer to #7.

$$\frac{d}{dx}\left[(\ln x)^2 + C\right] = 2(\ln x)^1 \cdot \frac{d}{dx}[\ln x] + C = 2\left(\frac{1}{x}\right)\ln x = \frac{2}{x}\ln x$$

9.

$$\int \frac{2x}{x^2+1}\, dx = \ln(x^2+1) + C$$

10. Differentiate your answer to #9.

$$\frac{d}{dx}\left[\ln(x^2+1) + C\right] = \frac{1}{x^2+1} \cdot \frac{d}{dx}\left[x^2+1\right] + 0 = \frac{2x}{x^2+1}$$

11.

$$\int \frac{2x}{(x^2+1)^2}\, dx = -\frac{1}{x^2+1} + C$$

12. Differentiate your answer to #11.

$$\frac{d}{dx}\left[-\frac{1}{x^2+1} + C\right] = \frac{d}{dx}\left[-(x^2+1)^{-1}\right] + 0$$

$$= -(-1)(x^2+1)^{-2} \cdot \frac{d}{dx}\left[x^2+1\right] = \frac{2x}{(x^2+1)^2}$$