Integration by Substitution

Date________________ Pe

Evaluate each indefinite integral. Use the provided substitution.

1) $\int \frac{20x^4}{4x^5 + 3}\, dx;\ u = 4x^5 + 3$

$\ln \left|4x^5 + 3\right| + C$

2) $\int 36x^2 e^{4x^3 + 3}\, dx;\ u = 4x^3 + 3$

$3e^{4x^3 + 3} + C$

3) $\int 80x^3 \cdot 3^{5x^4 - 2}\, dx;\ u = 5x^4 - 2$

$\frac{4 \cdot 3^{5x^4 - 2}}{\ln 3} + C$

4) $\int \frac{2}{x(-1 + \ln 4x)}\, dx;\ u = -1 + \ln 4x$

$2\ln \left|-1 + \ln 4x\right| + C$

Evaluate each indefinite integral.

5) $\int \frac{12x^2}{x^3 + 2}\, dx$

$4\ln \left|2x^3 + 4\right| + C$

6) $\int \frac{20e^{5x}}{e^{5x} + 3}\, dx$

$4\ln \left|e^{5x} + 3\right| + C$

7) $\int 10\sin -2x \cdot e^{\cos -2x}\, dx$

$5e^{\cos -2x} + C$

8) $\int \frac{5e^{-3 + \ln 3x}}{x}\, dx$

$5e^{-3 + \ln 3x} + C$

Differentiation - Natural Logs and Exponentials

Date________________ Period____

Differentiate each function with respect to x.

1) $y = \ln x^3$

$$\frac{dy}{dx} = \frac{1}{x^3} \cdot 3x^2$$
$$= \frac{3}{x}$$

2) $y = e^{2x^3}$

$$\frac{dy}{dx} = e^{2x^3} \cdot 6x^2$$

3) $y = \ln \ln 2x^4$

$$\frac{dy}{dx} = \frac{1}{\ln 2x^4} \cdot \frac{1}{2x^4} \cdot 8x^3$$
$$= \frac{4}{x \ln 2x^4}$$

4) $y = \ln \ln 3x^3$

$$\frac{dy}{dx} = \frac{1}{\ln 3x^3} \cdot \frac{1}{3x^3} \cdot 9x^2$$
$$= \frac{3}{x \ln 3x^3}$$

5) $y = \cos \ln 4x^3$

$$\frac{dy}{dx} = -\sin \ln 4x^3 \cdot \frac{1}{4x^3} \cdot 12x^2$$
$$= -\frac{3\sin \ln 4x^3}{x}$$

6) $y = e^{e^{3x^2}}$

$$\frac{dy}{dx} = e^{e^{3x^2}} e^{3x^2} \cdot 6x$$
$$= 6xe^{e^{3x^2} + 3x^2}$$

7) $y = e^{(4x^3+5)^2}$

$$\frac{dy}{dx} = e^{(4x^3+5)^2} \cdot 2(4x^3 + 5) \cdot 12x^2$$
$$= 24x^2 e^{(4x^3+5)^2} (4x^3 + 5)$$

8) $y = \ln 4x^2 \cdot (-x^3 - 4)$

$$\frac{dy}{dx} = \ln 4x^2 \cdot -3x^2 + (-x^3 - 4) \cdot \frac{1}{4x^2} \cdot 8x$$
$$= \frac{-3x^3 \ln 4x^2 - 2x^3 - 8}{x}$$

9) $y = \ln \left(-\frac{4x^4}{x^3 - 3}\right)^5$

$$\frac{dy}{dx} = 5\left(\frac{1}{-4x^4} \cdot -16x^3 - \frac{1}{x^3 - 3} \cdot 3x^2\right)$$
$$= \frac{5(x^3 - 12)}{x(x^3 - 3)} \text{ (Rules of logarithms used)}$$

10) $y = \frac{e^{5x^4}}{e^{4x^2+3}}$

$$\frac{dy}{dx} = e^{5x^4 - (4x^2+3)} (20x^3 - 8x)$$
$$= 4xe^{5x^4 - 4x^2 - 3} (5x^2 - 2) \text{ (Rules of exponents used)}$$