3.4 Differentiation Rules for Exponential Functions Worksheet

This document was composed and formatted by Annie Bernatchez.

The course material originated from www.jensenmath.ca

1)

a) Rewrite the function $y = b^x$ with base e.

b) Find the derivative of your function in part a) and simplify.

2) Differentiate with respect to x.

a) $y = e^{-3x}$

b) $f(x) = e^{4x-5}$

c) $y = e^{2x} - e^{-2x}$

d) $y = 2^x + 3^x$

e) $f(x) = 3e^{2x} - 2^{3x}$

f) $y = 4xe^x$

g) $y = 5^x e^{-x}$

h) $f(x) = xe^{2x} + 2e^{-3x}$

3) Determine the derivative with respect to x for each function.

a) $y = e^{-x}\sin x$

b) $y = e^{\cos x}$

c) $f(x) = e^{2x}(x^2 - 3x + 2)$

d) $g(x) = 2x^2 e^{\cos(2x)}$

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4) Identify the coordinates of any local extrema of the function $y = e^x - e^{2x}$

5) Find an equation for the tangent to the curve $y = 2e^{2x} + 2x + 1$ when $x = 0$.

6) Find the equation of the tangent to $y = x \ln x$ that is parallel to $y = 3x + 7$.

7) Find all local extrema for $y = \frac{1}{2}x(2)^{3x+1}$.

8) Continuous growth or decay follows the formula $A = ce^{kt}$, where c is the initial amount, and k is a rate factor. The mass of a radioactive substance is 1000 g on day 1, and only 100 g after 100 days. Find:

a) k, then write the equation with c and k

b) the half-life,

c) the amount that remains after 300 days, and

d) the rate of decay after 50 days.

Answer Key

1) a) $y = e^{x \ln b}$ b) $\frac{dy}{dx} = (e^{x \ln b}) \ln b$

2) a) $y' = -3e^{-3x}$ b) $f'(x) = 4e^{4x-5}$ c) $y' = 2(e^{2x} + e^{-2x})$ d) $y' = 2^x(\ln 2) + 3^x(\ln 3)$

e) $f'(x) = 6e^{2x} - 3(2^{3x}) \ln 2$ **f)** $y' = 4xe^x + 4e^x$

g) $y' = -(5^x)(e^{-x})(1 - \ln 5)$ **h)** $f'(x) = e^{2x}(2x + 1 - 6e^{-5x})$

3) a) $y' = e^{-x}(\cos x - \sin x)$ b) $y' = -\sin x(e^{\cos x})$ c) $f'(x) = e^{2x}(2x^2 - 4x + 1)$ d) $g'(x) = -4xe^{\cos(2x)}[x \sin(2x) - 1]$

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4) local max of $y = 0.25$ when $x = \ln(0.5)$

5) $y = 6x + 3$

6) $y = 3x - e^2$

7) CN $\cong -0.48$, so the point $(-0.48, -0.18)$ is a local minimum

8) a) $k \cong -0.023$, so the formula is $A = 1000e^{-0.023t}$ b) $t \cong 30$ days c) $A(300) \approx 1\text{g}$ d) $A'(50) \approx -7.3\text{g/day}$

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