5.2 The Derivative of the General Exponential

These problems taken from the Nelson Text – Pg. 240.

1. Differentiate each of the following functions:

   a. $y = 2^{3x}$

   b. $y = 3.1^x + x^3$

   c. $s = 10^{3t-5}$

   d. $w = 10^{(5-6n+n^2)}$

   e. $y = 3^{x^2+2}$

   f. $y = 400(2)^{x+3}$

2. Determine the derivative of each function.

   a. $y = x^5 \times (5)^x$

   b. $y = x(3)^{x^2}$

   c. $v = \dfrac{2^t}{t}$

   d. $f(x) = \dfrac{\sqrt{3^x}}{x^2}$

3. If $f(t) = 10^{3t-5} \times e^{2t^2}$, determine the values of t so that $f'(t) = 0$.

4. Determine the equation of the tangent to $y = 3(2^x)$ at $x = 3$.

5. Determine the equation of the tangent to $y = 10^x$ at $(1, 10)$.

6. A certain radioactive material decays exponentially. The percent, P, of the material left after t years is given by $P(t) = 100(1.2)^{-t}$.

   a. Determine the half-life of the substance.

   b. How fast is the substance decaying at the point where the half-life is reached?

Answers to Selected Problems

1. a. $3(2^{3x})\ln 2$
   b. $\ln 3.1(3.1)^x + 3x^2$
   c. $3(10^{3t-5})\ln 10$
   d. $(-6 + 2n)(10^{5-6n+n^2})\ln 10$
   e. $2x(3^{x^2+2})\ln 3$
   f. $400(2)^{x+3}\ln 2$

2. a. $5^x[(x^5 \times \ln 5) + 5x^4]$
   b. $(3)^{x^2}[(2x^2 \ln 3) + 1]$
   c. $-\dfrac{2^t}{t^2} + \dfrac{2^t \ln 2}{t}$
   d. $\dfrac{3^{\frac{x}{2}}[x \ln 3 - 4]}{x^3}$

3. $-\dfrac{3 \ln 10}{4}$
4. $-16.64x + y + 25.92 = 0$
5. $-23.03x + y + 13.03 = 0$
6. a. about 3.80 years
   b. about -9.12%/year