Chapter 3.2 Practice Problems

EXPECTED SKILLS:

- Be able to compute the derivatives of logarithmic functions.

- Know how to use logarithmic differentiation to help find the derivatives of functions involving products and quotients.

PRACTICE PROBLEMS:

For problems 1-16, calculate $\dfrac{dy}{dx}$.

1. $y = \ln\left(x^2\right)$

2. $y = \dfrac{1}{\ln\left(3x\right)}$

3. $y = x^2 \ln x$

4. $y = \ln\left(\dfrac{1}{x}\right)$

5. $y = \ln\left|x^3\right|$

6. $y = \ln\left(x^2 + 1\right)^2$

7. $y = \left[\ln\left(x^2 + 1\right)\right]^2$

8. $y = \sqrt{\ln 2x}$

9. $y = \log_2\left(3x - 1\right)$

10. $y = \tan\left(\ln x\right)$

11. $y = \ln\left(\ln x\right)$

12. $y = \dfrac{\log x}{2 - \log x}$

13. $y = \ln\left|\sec x\right|$

14. $y = \ln\left|\sec x + \tan x\right|$

15. $y = \ln\left(x^x\right)$

16. $y = \ln\left(\dfrac{2x + 1}{\sqrt{x}(3x - 4)^{10}}\right)$

17. Use logarithmic differentiation to calculate $\dfrac{dy}{dx}$ if $y = \dfrac{2x+1}{\sqrt{x}(3x-4)^{10}}$

18. Recall the change of base formula: $\log_b x = \dfrac{\ln x}{\ln b}$

   (a) Remind yourself of why this is true.

   (b) Compute y' if $y = \log_{x^2}(e)$

   (c) Compute $\dfrac{dy}{dx}$ if $y = \log_{3x}(x)$

19. Compute an equation of the line which is tangent to the graph of $f(x) = \ln(x^2 - 3)$ at the point where $x = 2$.

20. Find the value(s) of x at which the tangent line to the graph of $y = \ln(x^2 + 11)$ is perpendicular to $y = -6x + 5$.

21. Find the value(s) of x at which the tangent line to the graph of $y = -\ln x$ passes through the origin.

22. Calculate $\dfrac{d^2 y}{dx^2}$ if $y = \ln(3x^2 + 2)$.

23. **Multiple Choice:** Let $y = \ln(\cos x)$. Which of the following is $\dfrac{dy}{dx}$?

   (a) $(\ln x)(-\sin x) + (\cos x)(\ln x)$

   (b) $-\tan x$

   (c) $\cot x$

   (d) $\sec x$

   (e) $\dfrac{1}{\ln(\cos x)}$

24. **Multiple Choice:** Let $h(x) = \ln[(f(x))^2 + 1]$. Suppose that $f(1) = -1$ and $f'(1) = 1$. Find $h'(1)$.

   (a) -2

   (b) -1

   (c) 0

   (d) 1

   (e) 2

25. Consider the triangle formed by the tangent line to the graph of $y = -\ln x$ at the point $P(t, -\ln t)$, the horizontal line which passes through P, and the y-axis. Find a function $A(t)$ which gives the area of this triangle.