**Practice differentiating the functions below**

Derivatives are always with respect to $x$; all other "letters" denote constants or functions. 1. $f(x) = \sqrt{10x^2 + x + 1}$

$$f'(x) = \frac{20x + 1}{2\sqrt{10x^2+x+1}}$$

2. $f(x) = \frac{1-x^3}{\sin(x)}$

$$f'(x) = \frac{-3x^2\sin(x) - (1-x^3)\cos(x)}{\sin^2(x)}$$

3. $f(x) = \cos(\sin(x))$

$$f'(x) = -\sin(\sin(x))\cos(x)$$

4. $f(x) = \cos^2(x)$

$$f'(x) = -2\cos(x)\sin(x)$$

5. $f(x) = \frac{x^7}{\tan(x)}$

$$f'(x) = \frac{7\tan(x)\cdot x^6 - x^7\sec^2(x)}{\tan^2(x)}$$

6. $f(x) = \frac{x}{\sqrt{1+x^2}}$

$$f'(x) = \frac{3+4x^2}{4(1+x^2)^{3/2}}$$ } simplified

7. $f(x) = 1 + \sin(2x^5 + 5x - 1)$

$$f'(x) = (10x^4+5)\cos(2x^5+5x-1)$$

8. $f(x) = 4\exp(-2x^2)$

$$f'(x) = -16x\,e^{-2x^2}$$

9. $f(x) = \exp(x)\cos(x^2)$ $f'(x) = e^x(\cos(x^2) - 2x\sin(x^2))$

10. $f(x) = x^{-4/3}$ $f'(x) = -\frac{4}{3}x^{-7/3}$

11. $f(x) = \tan^{-4/3}(x)$ $f'(x) = -\frac{4}{3}\tan^{-7/3}(x)\sec^2(x)$

12. $f(x) = \sqrt{1+\sin(3x^4)}$ $f'(x) = \frac{6x^3\cos(3x^4)}{\sqrt{1+\sin(3x^4)}}$

13. $f(x) = 7^{\cos(x)}$ $f'(x) = -\ln(7)\,7^{\cos(x)}\cdot\sin(x)$

14. $f(x) = \frac{1-\sqrt{x}}{1+\sqrt{x}}$ $f'(x) = \frac{-1}{\sqrt{x}(1+\sqrt{x})^2}$ } simplified

15. $f(x) = \exp(\sqrt{x-x^2})$ $f'(x) = \frac{1-2x}{2\sqrt{x-x^2}}e^{\sqrt{x-x^2}}$

16. $f(x) = \sin(\sin(\sin(x)))$ $f'(x) = \cos(\sin(\sin(x)))\cdot\cos(\sin(x))\cdot\cos(x)$

17. $f(x) = \frac{1+\tan(x)}{1+\sin^2(x)}$ $f'(x) = \frac{(1+\sin^2(x))\sec^2(x) - 2(1+\tan(x))\sin(x)\cos(x)}{(1+\sin^2(x))^2}$

18. $f(x) = \frac{6^x}{\exp 2x}$ $= 6^x \cdot e^{-2x}$

$f'(x) = \ln(6) \cdot 6^x \cdot e^{-2x} - 2 \cdot 6^x \cdot e^{-2x}$

19. $f(x) = 3x^3 - \frac{2}{4-x^2}$

$f'(x) = 9x^2 - \frac{4x}{(4-x^2)^2}$

20. $f(x) = c\,a^{g(x)}$

$f'(x) = c \cdot \ln(a) \cdot a^{g(x)} \cdot g'(x)$

21. $f(x) = \sin^n(g(x))$

$f'(x) = n \cdot \sin^{(n-1)}(g(x)) \cdot g'(x) \cdot \cos(g(x))$

22. $f(x) = g(x)^z$

$f'(x) = z \cdot g(x)^{z-1} \cdot g'(x)$

23. $f(x) = 10^{-c/x}$

$f'(x) = \frac{c \cdot \ln(10)}{x^2} \cdot 10^{-c/x}$

24. $f(x) = \cos(2\pi x)$

$f'(x) = -2\pi \sin(2\pi x)$

25. $f(x) = \exp(x^{-1/4})$

$f'(x) = \frac{-1}{4x^{5/4}} \cdot e^{x^{-1/4}}$

26. $f(x) = \sqrt{\frac{2-x^n}{\sin(cx)}}$

$f'(x) = \frac{-n\sin(cx) \cdot x^{n-1} - c(2-x^n) \cdot \cos(cx)}{2\sin^2(cx)\sqrt{\frac{2-x^n}{\sin(cx)}}}$

27. $f(x) = \tan^n(g(x))$ $f'(x) = n\tan^{(n-1)}(g(x)) \cdot \sec^2(g(x)) \cdot g'(x)$

28. $f(x) = \sin(g(x)^n)$ $f'(x) = \cos(g(x)^n) \cdot n\, g(x)^{n-1} \cdot g'(x)$

29. $f(x) = \exp(zg(x))$ $f'(x) = e^{zg(x)} \cdot z\, g'(x)$

30. $f(x) = g(\exp(2x))$ $f'(x) = g'(e^{2x}) \cdot 2e^{2x}$