AP Calculus AB
Power, Exponential, Product and Quotient Rules Worksheet

Name: _____
Date: _____ Block: ___

Part 1 – Power and Exponential Rules Only. Complete Problems 1 – 18 using Power and Exponential Rules Only.

1.) $f(x) = x^8$

2.) $f(x) = \sqrt[3]{x}$

3.) $f(x) = x^{-\frac{2}{5}}$

4.) $f(x) = 5e^x + 3$

5.) $f(x) = x^2 - 10x + 100$

6.) $f(x) = x^{100} + 50x + 1$

7.) $f(x) = \frac{4}{3}\pi x^3$

8.) $f(x) = x^8 + 6x^7 - 18x^2 + 2x$

9.) $f(x) = 6x^{-9}$

10.) $f(x) = \frac{\sqrt{10}}{x^7}$

11.) $f(x) = (16x)^3$

12.) $f(x) = \sqrt[3]{x}(x + 2)$

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

14.) $f(x) = \sqrt{x} - \frac{1}{\sqrt{x}}$

15.) $f(x) = \frac{x^2+4x+3}{\sqrt{x}}$

16.) $f(x) = \frac{x^2-2\sqrt{x}}{x}$

17.) $f(x) = 3x + 2e^x$

18.) $f(x) = e^{x+1} + 1$

Part 2 – Product and Quotient Rules. Complete Problems 1 – 16 using Product and Quotient Rules.

1.) $f(x) = x^2e^x$

2.) $f(x) = \sqrt{x}e^x$

3.) $f(x) = \frac{e^x}{x^2}$

4.) $f(x) = \frac{e^x}{1+x}$

5.) $f(x) = \frac{x+2}{x-1}$

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

7.) $f(x) = (x^2 + x + 1)(x^2 + 2)$

8.) $f(x) = \left(1 + \sqrt{x}\right)(x - x^3)$

9.) $f(x) = \frac{x^2+4x+3}{\sqrt{x}}$

10.) $f(x) = \frac{\sqrt{x}-1}{\sqrt{x}+1}$

11.) $f(x) = (x^2 - 2x)e^x$

12.) $f(x) = \frac{x^2-x-2}{x+1}$

13.) $f(x) = \frac{1}{x^4+x^2+1}$

14.) $f(x) = \frac{e^x}{x+e^x}$

15.) $f(x) = \frac{x}{x+\frac{c}{x}}$

16.) $f(x) = \frac{ax+b}{cx+d}$

Answer Key

Part 1 – Power and Exponential Rules Only. Complete Problems 1 – 18 using Power and Exponential Rules Only.

1.) $f(x) = x^8$

$f'(x) = 8x^7$

2.) $f(x) = \sqrt[3]{x}$

$f(x) = x^{\frac{1}{3}}$

$f'(x) = \frac{1}{3}x^{-\frac{2}{3}} = \frac{1}{3\sqrt[3]{x^2}}$

3.) $f(x) = x^{-\frac{2}{5}}$

$f'(x) = -\frac{2}{5}x^{-\frac{7}{5}}$

4.) $f(x) = 5e^x + 3$

$f'(x) = 5e^x$

5.) $f(x) = x^2 - 10x + 100$

$f'(x) = 2x - 10$

6.) $f(x) = x^{100} + 50x + 1$

$f'(x) = 100x^{99} + 50$

7.) $f(x) = \frac{4}{3}\pi x^3$

$f'(x) = 3\left(\frac{4}{3}\pi x^2\right) = 4\pi x^2$

8.) $f(x) = x^8 + 6x^7 - 18x^2 + 2x$

$f'(x) = 8x^7 + 7(6x^6) - 2(18x) + 2 = 8x^7 + 42x^6 - 36x + 2$

9.) $f(x) = 6x^{-9}$

$f'(x) = -54x^{-10}$

10.) $f(x) = \frac{\sqrt{10}}{x^7}$

$f(x) = \sqrt{10}x^{-7}$

$f'(x) = -7\left(\sqrt{10}x^{-8}\right) = -\frac{7\sqrt{10}}{x^8}$

11.) $f(x) = (16x)^3$

$f(x) = 4096x^3$

$f'(x) = 3(4096x^2) = 12288x^2$

12.) $f(x) = \sqrt[3]{x}(x+2)$

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

$f'(x) = \frac{4}{3}x^{\frac{1}{3}} + \left(\frac{1}{3}\right)\left(2x^{-\frac{2}{3}}\right) = \frac{4}{3}\sqrt[3]{x} + \frac{2}{3\sqrt[3]{x^2}}$

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

$f(x) = x^2 + x^{-1}$

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

14.) $f(x) = \sqrt{x} - \frac{1}{\sqrt{x}}$

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

$f'(x) = \frac{1}{2}x^{-\frac{1}{2}} - \left(-\frac{1}{2}\right)x^{-\frac{3}{2}} = \frac{1}{2\sqrt{x}} + \frac{1}{2\sqrt{x^3}}$

15.) $f(x) = \frac{x^2+4x+3}{\sqrt{x}}$

$f(x) = (x^2 + 4x + 3)\left(x^{-\frac{1}{2}}\right) = x^{\frac{3}{2}} + 4x^{\frac{1}{2}} + 3x^{-\frac{1}{2}}$

$f'(x) = \frac{3}{2}x^{\frac{1}{2}} + \left(\frac{1}{2}\right)\left(4x^{-\frac{1}{2}}\right) + \left(-\frac{1}{2}\right)\left(3x^{-\frac{3}{2}}\right) = \frac{3}{2}\sqrt{x} + \frac{2}{\sqrt{x}} - \frac{3}{2\sqrt{x^3}}$

16.) $f(x) = \frac{x^2-2\sqrt{x}}{x}$

$f(x) = \left(x^2 - 2x^{\frac{1}{2}}\right)x^{-1} = x - 2x^{-\frac{1}{2}}$

$f'(x) = 1 - \left(-\frac{1}{2}\right)\left(2x^{-\frac{3}{2}}\right) = 1 + \frac{1}{\sqrt{x^3}}$

17.) $f(x) = 3x + 2e^x$

$f'(x) = 3 + 2e^x$

18.) $f(x) = e^{x+1} + 1$

$f'(x) = e^{x+1}$

Part 2 – Product and Quotient Rules. Complete Problems 1 – 16 using Product and Quotient Rules.

1.) $f(x) = x^2e^x$

$f'(x) = (x^2)(e^x) + (e^x)(2x) = x^2e^x + 2xe^x$

2.) $f(x) = \sqrt{x}e^x$

$f(x) = x^{\frac{1}{2}}e^x$

$f'(x) = \left(x^{\frac{1}{2}}\right)(e^x) + (e^x)\left(\frac{1}{2}x^{-\frac{1}{2}}\right) = \sqrt{x}e^x + \frac{e^x}{2\sqrt{x}}$

3.) $f(x) = \frac{e^x}{x^2}$

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

4.) $f(x) = \frac{e^x}{1+x}$

$f'(x) = \frac{(1+x)(e^x)-(e^x)(1)}{(1+x)^2} = \frac{e^x+xe^x-e^x}{(1+x)^2} = \frac{xe^x}{(1+x)^2}$

5.) $f(x) = \frac{x+2}{x-1}$

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

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

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

7.) $f(x) = (x^2 + x + 1)(x^2 + 2)$

$f'(x) = (x^2 + x + 1)(2x) + (x^2 + 2)(2x + 1) = 2x^3 + 2x^2 + 2x + 2x^3 + x^2 + 4x + 2 = 4x^3 + 3x^2 + 6x + 2$

8.) $f(x) = \left(1 + \sqrt{x}\right)(x - x^3)$

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

$f'(x) = \left(1 + x^{\frac{1}{2}}\right)(1 - 3x^2) + (x - x^3)\left(\frac{1}{2}x^{-\frac{1}{2}}\right) = 1 - 3x^2 + x^{\frac{1}{2}} - 3x^{\frac{5}{2}} + \frac{1}{2}x^{\frac{1}{2}} - \frac{1}{2}x^{\frac{5}{2}} = 1 - 3x^2 + \frac{3}{2}\sqrt{x} - \frac{7}{2}\sqrt{x^5}$

9.) $f(x) = \frac{x^2+4x+3}{\sqrt{x}}$

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

$$f'(x) = \frac{\left(x^{\frac{1}{2}}\right)(2x+4) - (x^2+4x+3)\left(\frac{1}{2}x^{-\frac{1}{2}}\right)}{\left(x^{\frac{1}{2}}\right)^2} = \frac{2x^{\frac{3}{2}} + 4x^{\frac{1}{2}} - \frac{1}{2}x^{\frac{3}{2}} - 2x^{\frac{1}{2}} - \frac{3}{2}x^{-\frac{1}{2}}}{x} = \frac{2x^{\frac{1}{2}} + \frac{3}{2}x^{\frac{3}{2}} - \frac{3}{2}x^{-\frac{1}{2}}}{x}$$

$$= 2x^{-\frac{1}{2}} + \frac{3}{2}x^{\frac{1}{2}} - \frac{3}{2}x^{-\frac{3}{2}} = \frac{3}{2}\sqrt{x} + \frac{2}{\sqrt{x}} - \frac{3}{2\sqrt{x^3}}$$

10.) $f(x) = \frac{\sqrt{x}-1}{\sqrt{x}+1}$

$f(x) = \frac{x^{\frac{1}{2}}-1}{x^{\frac{1}{2}}+1}$

$$f'(x) = \frac{\left(x^{\frac{1}{2}}+1\right)\left(\frac{1}{2}x^{-\frac{1}{2}}\right)-\left(x^{\frac{1}{2}}-1\right)\left(\frac{1}{2}x^{-\frac{1}{2}}\right)}{\left(x^{\frac{1}{2}}+1\right)^2} = \frac{\frac{1}{2}+\frac{1}{2}x^{-\frac{1}{2}}-\frac{1}{2}+\frac{1}{2}x^{-\frac{1}{2}}}{\left(x^{\frac{1}{2}}+1\right)^2} = \frac{x^{-\frac{1}{2}}}{\left(x^{\frac{1}{2}}+1\right)^2} = \frac{1}{\sqrt{x}\left(\sqrt{x}+1\right)^2}$$

11.) $f(x) = (x^2 - 2x)e^x$

$$f'(x) = (x^2 - 2x)(e^x) + (e^x)(2x - 2) = x^2e^x - 2xe^x + 2xe^x - 2e^x = x^2e^x - 2e^x$$

12.) $f(x) = \frac{x^2-x-2}{x+1}$

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

13.) $f(x) = \frac{1}{x^4+x^2+1}$

$$f'(x) = \frac{(x^4+x^2+1)(0)-(1)(4x^3+2x)}{(x^4+x^2+1)^2} = \frac{-4x^3-2x}{(x^4+x^2+1)^2}$$

14.) $f(x) = \frac{e^x}{x+e^x}$

$$f'(x) = \frac{(x+e^x)(e^x)-(e^x)(1+e^x)}{(x+e^x)^2} = \frac{xe^x+e^{2x}-e^x-e^{2x}}{(x+e^x)^2} = \frac{xe^x-e^x}{(x+e^x)^2}$$

15.) $f(x) = \frac{x}{x+\frac{c}{x}}$

$$f(x) = \frac{x}{x+cx^{-1}}$$

$$f'(x) = \frac{(x+cx^{-1})(1)-(x)(1+(-1)cx^{-2})}{(x+cx^{-1})^2} = \frac{x+cx^{-1}-x+cx^{-1}}{(x+cx^{-1})^2} = \frac{2cx^{-1}}{(x+cx^{-1})^2} = \frac{\frac{2c}{x}}{\left(x+\frac{c}{x}\right)^2}$$

16.) $f(x) = \frac{ax+b}{cx+d}$

$$f'(x) = \frac{(cx+d)(a)-(ax+b)(c)}{(cx+d)^2} = \frac{acx+ad-acx-bc}{(cx+d)^2} = \frac{ad-bc}{(cx+d)^2}$$