Name_____

Differentiation - Product Rule

Date_____ Period_____

Differentiate each function with respect to x.

1) $y = -x^3(3x^4 - 2)$

2) $f(x) = x^2(-3x^2 - 2)$

3) $y = (-2x^4 - 3)(-2x^2 + 1)$

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

5) $f(x) = (5x^5 + 5)(-2x^5 - 3)$

6) $f(x) = (-3 + x^{-3})(-4x^3 + 3)$

7) $y = (-2x^4 + 5x^2 + 4)(-3x^2 + 2)$

8) $y = (x^4 + 3)(-4x^5 + 5x^4 + 5)$

Name_____

Differentiation - Quotient Rule

Date_____ Period____

Differentiate each function with respect to x.

1) $y = \dfrac{2}{2x^4 - 5}$

2) $f(x) = \dfrac{2}{x^5 - 5}$

3) $f(x) = \dfrac{5}{4x^3 + 4}$

4) $y = \dfrac{4x^3 - 3x^2}{4x^5 - 4}$

5) $y = \dfrac{3x^4 + 2}{3x^3 - 2}$

6) $y = \dfrac{4x^5 + 2x^2}{3x^4 + 5}$

7) $y = \dfrac{4x^5 + x^2 + 4}{5x^2 - 2}$

8) $y = \dfrac{3x^4 + 5x^3 - 5}{2x^4 - 4}$

Name_____

Differentiation - Product Rule

Date_____ Period____

Differentiate each function with respect to *x*.

1) $y = -x^3(3x^4 - 2)$

$$\frac{dy}{dx} = -x^3 \cdot 12x^3 + (3x^4 - 2) \cdot -3x^2$$
$$= -21x^6 + 6x^2$$

2) $f(x) = x^2(-3x^2 - 2)$

$$f'(x) = x^2 \cdot -6x + (-3x^2 - 2) \cdot 2x$$
$$= -12x^3 - 4x$$

3) $y = (-2x^4 - 3)(-2x^2 + 1)$

$$\frac{dy}{dx} = (-2x^4 - 3) \cdot -4x + (-2x^2 + 1) \cdot -8x^3$$
$$= 24x^5 - 8x^3 + 12x$$

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

$$f'(x) = (2x^4 - 3) \cdot 2x + (x^2 + 1) \cdot 8x^3$$
$$= 12x^5 + 8x^3 - 6x$$

5) $f(x) = (5x^5 + 5)(-2x^5 - 3)$

$$f'(x) = (5x^5 + 5) \cdot -10x^4 + (-2x^5 - 3) \cdot 25x^4$$
$$= -100x^9 - 125x^4$$

6) $f(x) = (-3 + x^{-3})(-4x^3 + 3)$

$$f'(x) = (-3 + x^{-3}) \cdot -12x^2 + (-4x^3 + 3) \cdot -3x^{-4}$$
$$= 36x^2 - \frac{9}{x^4}$$

7) $y = (-2x^4 + 5x^2 + 4)(-3x^2 + 2)$

$$\frac{dy}{dx} = (-2x^4 + 5x^2 + 4) \cdot -6x + (-3x^2 + 2)(-8x^3 + 10x)$$
$$= 36x^5 - 76x^3 - 4x$$

8) $y = (x^4 + 3)(-4x^5 + 5x^4 + 5)$

$$\frac{dy}{dx} = (x^4 + 3)(-20x^4 + 20x^3) + (-4x^5 + 5x^4 + 5) \cdot 4x^3$$
$$= -36x^8 + 40x^7 - 60x^4 + 80x^3$$

Name_____

Differentiation - Quotient Rule

Date_____ Period____

Differentiate each function with respect to x.

1) $y = \dfrac{2}{2x^4 - 5}$

$$\dfrac{dy}{dx} = -\dfrac{2 \cdot 8x^3}{(2x^4 - 5)^2}$$

$$= -\dfrac{16x^3}{4x^8 - 20x^4 + 25}$$

2) $f(x) = \dfrac{2}{x^5 - 5}$

$$f'(x) = -\dfrac{2 \cdot 5x^4}{(x^5 - 5)^2}$$

$$= -\dfrac{10x^4}{x^{10} - 10x^5 + 25}$$

3) $f(x) = \dfrac{5}{4x^3 + 4}$

$$f'(x) = -\dfrac{5 \cdot 12x^2}{(4x^3 + 4)^2}$$

$$= -\dfrac{15x^2}{4x^6 + 8x^3 + 4}$$

4) $y = \dfrac{4x^3 - 3x^2}{4x^5 - 4}$

$$\dfrac{dy}{dx} = \dfrac{(4x^5 - 4)(12x^2 - 6x) - (4x^3 - 3x^2) \cdot 20x^4}{(4x^5 - 4)^2}$$

$$= \dfrac{-8x^7 + 9x^6 - 12x^2 + 6x}{4x^{10} - 8x^5 + 4}$$

5) $y = \dfrac{3x^4 + 2}{3x^3 - 2}$

$$\dfrac{dy}{dx} = \dfrac{(3x^3 - 2) \cdot 12x^3 - (3x^4 + 2) \cdot 9x^2}{(3x^3 - 2)^2}$$

$$= \dfrac{9x^6 - 24x^3 - 18x^2}{9x^6 - 12x^3 + 4}$$

6) $y = \dfrac{4x^5 + 2x^2}{3x^4 + 5}$

$$\dfrac{dy}{dx} = \dfrac{(3x^4 + 5)(20x^4 + 4x) - (4x^5 + 2x^2) \cdot 12x^3}{(3x^4 + 5)^2}$$

$$= \dfrac{12x^8 - 12x^5 + 100x^4 + 20x}{9x^8 + 30x^4 + 25}$$

7) $y = \dfrac{4x^5 + x^2 + 4}{5x^2 - 2}$

$$\dfrac{dy}{dx} = \dfrac{(5x^2 - 2)(20x^4 + 2x) - (4x^5 + x^2 + 4) \cdot 10x}{(5x^2 - 2)^2}$$

$$= \dfrac{60x^6 - 40x^4 - 44x}{25x^4 - 20x^2 + 4}$$

8) $y = \dfrac{3x^4 + 5x^3 - 5}{2x^4 - 4}$

$$\dfrac{dy}{dx} = \dfrac{(2x^4 - 4)(12x^3 + 15x^2) - (3x^4 + 5x^3 - 5) \cdot 8x^3}{(2x^4 - 4)^2}$$

$$= \dfrac{-5x^6 - 4x^3 - 30x^2}{2x^8 - 8x^4 + 8}$$