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Where Minds Pollinate

Class 12
Mathematics

Chapter 2
Exercise 2.5
Handwritten Solution

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Exercise 2.5

Concept: Constant: $\frac{d}{dx}(C) = 0$

• Power:

$$\frac{d}{dx}(x^n) = nx^{n-1} \left(\frac{d}{dx} \right) x$$

• Product rule: $\frac{d}{dx}(f \cdot g) = f \cdot g' + g \cdot f'$ when f and g are any functions w.r.t x

• Quotient rule: $\frac{d}{dx}\left(\frac{f}{g}\right) = \frac{g \cdot f' - f \cdot g'}{g^2}$

Q1: $y = \frac{1}{x}$

Sol: $y = x^{-1}$

$$\frac{dy}{dx} = -1x^{-1-1} = -1x^{-2}$$

$$\boxed{\frac{dy}{dx} = -\frac{1}{x^2}}$$

OR

$$\begin{aligned} \frac{dy}{dx} &= x \cdot \frac{d}{dx}(1) - 1 \cdot \frac{d}{dx}(x) \\ &= x(0) - 1(1) \\ &= -1 \end{aligned}$$

$$\boxed{\frac{dy}{dx} = -\frac{1}{x^2}}$$

Q2: $y = (x^2 - 7)(x^2 + 4x + 2)$

Sol: $y = x^4 + 4x^3 + 2x^2 - 7x^2 - 28x - 14$

$$y = x^4 + 4x^3 - 5x^2 - 28x - 14$$

$$\frac{dy}{dx} = 4x^3 + 4(3x^2) - 5(2x) - 28(1) - 0$$

$$\boxed{\frac{dy}{dx} = 4x^3 + 12x^2 - 10x - 28}$$

Q3: $y = \underbrace{(7x+1)}_f \underbrace{(x^4-x^3-9x)}_g$

Sol:

$$\frac{dy}{dx} = (7x+1) \cdot \frac{d}{dx}(x^4-x^3-9x) +$$

$$(x^4-x^3-9x) \frac{d}{dx}(7x+1)$$

$$\frac{dy}{dx} = (7x+1)(4x^3-3x^2-9) + (x^4-x^3-9x)(7)$$

$$\frac{dy}{dx} = 28x^4 - 21x^3 - 63x + 4x^3 - 3x^2 - 9 + 7x^4 - 7x^3 - 63x$$

$$\boxed{\frac{dy}{dx} = 35x^4 - 24x^3 - 3x^2 - 126x - 9}$$

Answer

$$\textcircled{4} y = \frac{3x+4}{x^2+1}$$

$$\text{for } \frac{dy}{dx} = \frac{(x^2+1) \cdot \frac{d}{dx}(3x+4) - (3x+4) \cdot \frac{d}{dx}(x^2+1)}{(x^2+1)^2}$$

$$\frac{dy}{dx} = \frac{(x^2+1) \cdot (3(1)+0) - (3x+4)(2x+0)}{(x^2+1)^2}$$

$$\frac{dy}{dx} = \frac{3x^2+3 - (6x^2+8x)}{(x^2+1)^2}$$

$$\frac{dy}{dx} = \frac{3x^2+3-6x^2-8x}{(x^2+1)^2} = \boxed{\frac{-3x^2-8x+3}{(x^2+1)^2}} \text{ Answer}$$

$$\textcircled{5} y = \frac{x-2}{x^4+x+1}$$

$$\text{for } \frac{dy}{dx} = \frac{(x^4+x+1) \cdot \frac{d}{dx}(x-2) - (x-2) \cdot \frac{d}{dx}(x^4+x+1)}{(x^4+x+1)^2}$$

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

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

$$= \frac{x^4+x+1-4x^4-x+8x^3+2}{(x^4+x+1)^2}$$

$$\left| \frac{dy}{dx} = \frac{-3x^4+8x^3+3}{(x^4+x+1)^2} \right| \text{ Answer}$$

$$\textcircled{6} y = \frac{3x^2+5}{3x-1}$$

$$\text{for } \frac{dy}{dx} = \frac{(3x-1) \cdot \frac{d}{dx}(3x^2+5) - (3x^2+5) \cdot \frac{d}{dx}(3x-1)}{(3x-1)^2}$$

$$\frac{dy}{dx} = \frac{(3x-1)(3(2x)+0) - (3x^2+5)(3(1)-0)}{(3x-1)^2}$$

$$\frac{dy}{dx} = \frac{6x(3x-1) - 3(3x^2+5)}{(3x-1)^2} = \frac{18x^2 - 6x - 9x^2 - 15}{(3x-1)^2}$$

$$\boxed{\frac{dy}{dx} = \frac{9x^2 - 6x - 15}{(3x-1)^2}} \text{ Answer:-}$$

7) $y = \left(\frac{1}{x} + \frac{1}{x^2}\right)(3x^3 + 27)$

sol: $\frac{dy}{dx} = \left(\frac{1}{x} + \frac{1}{x^2}\right) \cdot \frac{d}{dx}(3x^3 + 27) + (3x^3 + 27) \frac{d}{dx}\left(x^{-1} + x^{-2}\right)$

$$\frac{dy}{dx} = \left(\frac{x+1}{x^2}\right)(3(3x^2)) + (3x^3 + 27)(-1x^{-1-1} + (-2x^{-3}))$$

$$\frac{dy}{dx} = 9x + 9 + (3x^3 + 27)\left(\frac{-1x}{x^2 \cdot x} - \frac{2}{x^3}\right)$$

$$\frac{dy}{dx} = 9x + 9 + (3x^3 + 27)\left(\frac{-(x+2)}{x^3}\right)$$

$$\frac{dy}{dx} = 9x + 9 + \frac{(3x^4 + 27x + 6x^3 + 54)}{x^3}$$

$$\frac{dy}{dx} = 9x + 9 - \frac{3x^4}{x^3} - \frac{27x}{x^3} - \frac{6x^3}{x^3} - \frac{54}{x^3}$$

$$\frac{dy}{dx} = 9x + 9 - 3x - \frac{27}{x^2} - 6 - \frac{54}{x^3}$$

$$\boxed{\frac{dy}{dx} = 6x + 3 - \frac{27}{x^2} - \frac{54}{x^3}} \text{ Answer:-}$$

8) $y = \frac{2-3x}{7-x}$

sol: $\frac{dy}{dx} = \frac{(7-x) \frac{d}{dx}(2-3x) - (2-3x) \frac{d}{dx}(7-x)}{(7-x)^2}$

$$\frac{dy}{dx} = \frac{(7-x)(0-3) - (2-3x)(0-1)}{(7-x)^2}$$

$$= \frac{-21 + 3x + 2 - 3x}{(7-x)^2}$$

$$\frac{dy}{dx} = \frac{-19}{(7-x)^2}$$

here

$$99) y = \frac{x^2 - 10x + 2}{x^3 - x}$$

$$\text{Sol: } \frac{dy}{dx} = \frac{(x^3 - x) \frac{d}{dx}(x^2 - 10x + 2) - (x^2 - 10x + 2) \frac{d}{dx}(x^3 - x)}{(x^3 - x)^2}$$

$$\frac{dy}{dx} = \frac{(x^3 - x)(2x - 10) - (x^2 - 10x + 2)(3x^2 - 1)}{(x^3 - x)^2}$$

$$\frac{dy}{dx} = \frac{2x^4 - 2x^2 - 10x^3 + 10x - (3x^4 - 30x^3 + 6x^2 - x^2 + 10x - 2)}{(x^3 - x)^2}$$

$$\frac{dy}{dx} = \frac{2x^4 - 10x^3 - 2x^2 + 10x - 3x^4 + 30x^3 - 5x^2 - 10x + 2}{(x^3 - x)^2}$$

$$\boxed{\frac{dy}{dx} = \frac{-x^4 + 20x^3 - 7x^2 + 2}{(x^3 - x)^2}} \quad \text{Answer}$$

$$10) y = \frac{x^4 + 2x^3 - 1}{x^2}$$

$$\text{Sol: } \frac{dy}{dx} = \frac{x^2 \frac{d}{dx}(x^4 + 2x^3 - 1) - (x^4 + 2x^3 - 1) \frac{d}{dx}(x^2)}{(x^2)^2}$$

$$\frac{dy}{dx} = \frac{x^2(4x^3 + 6x^2) - (x^4 + 2x^3 - 1)(2x)}{x^4}$$

$$= \frac{4x^5 + 6x^4 - (2x^5 + 4x^4 - 2x)}{x^4}$$

$$\frac{dy}{dx} = \frac{4x^5 + 6x^4 - 2x^5 - 4x^4 + 2x}{x^4}$$

$$\frac{dy}{dx} = \frac{2x^5 + 2x^4 + 2x}{x^4}$$

$$\boxed{\frac{dy}{dx} = \frac{2x + 2 + 2}{x^3}} \quad \text{Answer}$$

$$\textcircled{11} y = \frac{10}{(x^3-10)^9}$$

$$\text{Sol } \frac{dy}{dx} = \frac{(x^3-10)^9 \frac{d}{dx}(10) - 10 \frac{d}{dx}(x^3-10)^9}{[(x^3-10)^9]^2}$$

$$\frac{dy}{dx} = \frac{(x^3-10)(0) - 10 \left[9(x^3-10)^8 \frac{d}{dx}(x^3-10) \right]}{(x^3-10)^{18}}$$

$$\frac{dy}{dx} = \frac{-90(x^3-10)^8(3x^2)}{(x^3-10)^{18}}$$

$$\therefore \frac{dy}{dx} = \frac{-270x^2}{(x^3-10)^{10}} \quad \text{Ans}$$

$$\textcircled{12} y = \frac{(x^2+1)^2}{3x-2}$$

$$\text{Sol } \frac{dy}{dx} = \frac{(3x-2) \frac{d}{dx}(x^2+1)^2 - (x^2+1)^2 \frac{d}{dx}(3x-2)}{(3x-2)^2}$$

$$\frac{dy}{dx} = \frac{(3x-2) \left(2(x^2+1) \frac{d}{dx}(x^2+1) \right) - (x^2+1)^2(3)}{(3x-2)^2}$$

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

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

$$= (x^2+1) \left[\frac{12x^2 - 8x - 3x^2 - 3}{(3x-2)^2} \right]$$

$$\frac{dy}{dx} = \frac{(x^2+1)(9x^2-8x-3)}{(3x-2)^2} \quad \text{Ans}$$

$$(13) y = \frac{(x+1)^2}{(x-1)^2}$$

$$\text{Sol. } \frac{dy}{dx} = \frac{(x-1)^2 \frac{d}{dx} (x+1)^2 - (x+1)^2 \frac{d}{dx} (x-1)^2}{[(x-1)^2]^2}$$

$$\frac{dy}{dx} = \frac{(x-1)^2 \left[2(x+1) \frac{d}{dx} (x+1) \right] - (x+1)^2 \left[2(x-1) \frac{d}{dx} (x-1) \right]}{(x-1)^4}$$

$$\frac{dy}{dx} = \frac{2(x-1)^2 (x+1)(1) - (x+1)^2 2(x-1)(1)}{(x-1)^4}$$

$$\frac{dy}{dx} = \frac{2(x-1)(x+1) \left[\frac{(x-1) - (x+1)}{(x-1)^4} \right]}{(x-1)^4}$$

$$= \frac{2(x^2-1)(x-1-x-1)}{(x-1)^4}$$

$$= \frac{2(x^2-1)(-2)}{(x-1)^4} \Rightarrow \frac{dy}{dx} = \frac{-4(x^2-1)}{(x-1)^4} \Rightarrow \frac{dy}{dx} = \boxed{\frac{-4(x+1)}{(x-1)^3}}$$

$$(14) y = \frac{4x-1}{x}, x = -1$$

$$\text{for } \frac{dy}{dx} = \frac{x \frac{d}{dx} (4x-1) - (4x-1) \frac{d}{dx} (x)}{x^2}$$

$$\frac{dy}{dx} = \frac{x(4) - (4x-1)(1)}{x^2} = \frac{4x - 4x + 1}{x^2} = \boxed{\frac{1}{x^2}}$$

$$\left. \frac{dy}{dx} \right|_{x=-1} = \frac{1}{(-1)^2} = 1 \Rightarrow \boxed{\left. \frac{dy}{dx} \right|_{x=-1} = 1}$$

$$(15) y = \frac{54}{x^2+1}, x = 2$$

$$\frac{dy}{dx} = \frac{(x^2+1) \frac{d}{dx} (54) - 54 \left(\frac{d}{dx} (x^2+1) \right)}{(x^2+1)^2}$$

$$\frac{dy}{dx} = \frac{(x^2+1)(0) - 54(2x)}{(x^2+1)^2}$$

$$\frac{dy}{dx} = \frac{-108x}{(x^2+1)^2}$$

$$\left. \frac{dy}{dx} \right|_{x=2} = \frac{-108(2)}{(4+1)^2}$$

$$\left. \frac{dy}{dx} \right|_{x=2} = \frac{-216}{25} \text{ Ans}$$

Q16) $y = \frac{2x+5}{x+2}, x=1$

$$\text{for } \frac{dy}{dx} = \frac{(x+2) \frac{d}{dx}(2x+5) - (2x+5) \frac{d}{dx}(x+2)}{(x+2)^2}$$

$$\frac{dy}{dx} = \frac{(x+2)(2) - (2x+5)(1)}{(x+2)^2}$$

$$\frac{dy}{dx} = \frac{2x+4-2x-5}{(x+2)^2} \Rightarrow \frac{dy}{dx} = \frac{-1}{(x+2)^2}$$

$$\left. \frac{dy}{dx} \right|_{x=1} = \frac{-1}{(3)^2} \Rightarrow \left. \frac{dy}{dx} \right|_{x=1} = \boxed{\frac{-1}{9}}$$

Q17) $y = (2\sqrt{x}+1)(x^3-6), x=0$

$$\text{for } \frac{dy}{dx} = (2\sqrt{x}+1) \frac{d}{dx}(x^3-6) + (x^3-6) \frac{d}{dx}(2\sqrt{x}+1)$$

$$\frac{dy}{dx} = (2\sqrt{x}+1)(3x^2) + (x^3-6)\left(2 \cdot \frac{1}{2} x^{\frac{1}{2}-1} + 0\right)$$

$$\begin{aligned} \frac{dy}{dx} &= (2\sqrt{x}+1)(3x^2) + (x^3-6)x^{-1/2} \\ &= 6x^{1/2+2} + 3x^2 + x^{3-1/2} - 6x^{-1/2} \end{aligned}$$

$$\frac{dy}{dx} = 6x^{5/2} + 3x^2 + x^{5/2} - 6x^{-1/2}$$

$$\frac{dy}{dx} = 7x^{5/2} + 3x^2 - \frac{6}{x^{1/2}}$$

$$\left. \frac{dy}{dx} \right|_{x=0} = \frac{-6}{0} = \text{undefined}$$