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PAPER

Calculus

# QUESTION - 1

PART 'A'

Differentiate  $\frac{3x^3 - 5x^2 + 5}{x^2 + 1}$  with

respect to 'x'.

SOLUTION:-  $\frac{dy}{dx} \frac{3x^3 - 5x^2 + 5}{x^2 + 1}$

by using Quotient Rule we have

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

$$(x^2 + 1)^2$$

$$\Rightarrow \frac{x^2 + 1 (9x^2 - 10x) - (3x^3 - 5x^2 + 5) (2x)}{(x^2 + 1)^2}$$

$$\Rightarrow \frac{(9x^4 - 10x^3 + 9x^2 - 10x) - (6x^4 - 10x^2 + 10x)}{(x^2 + 1)^2}$$

$$\Rightarrow \frac{9x^4 - 10x^3 + 9x^2 - 10x - 6x^4 + 10x^2 - 10x}{x^4 + x^2 + x^2 + 1}$$

$$\Rightarrow \frac{3x^4 - 10x^3 + 19x^2 - 20x}{x^4 + 2x^2 + 1}$$

Ans

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PART 'B':-

Differentiate  $\frac{(x^2+1)^2}{x^2-1}$  with respect to 'x'.

SOLUTION:-  $\frac{dy}{dx} \frac{(x^2+1)^2}{x^2-1}$

By using Quotient Rule

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

$$\Rightarrow \frac{(x^2-1) 2(x^2+1) \frac{d}{dx} (x^2+1) - (x^2+1) \frac{d}{dx} (x^2-1)}{(x^2-1)^2}$$

$$\Rightarrow \frac{(x^2-1) 2(x^2+1) 2x - (x^2+1) \cdot 2x}{(x^2-1)^2}$$

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

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

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$$\Rightarrow \frac{(4x^5 - 4x) - (2x^3 + 2x)}{(x^2 - 1)(x^2 - 1)}$$

$$\Rightarrow \frac{4x^5 - 4x - 2x^3 - 2x}{x^4 - x^2 - x^2 + 1}$$

$$\Rightarrow \frac{4x^5 - 2x^3 - 2x}{x^4 + 4x^2 + 1} \quad \text{Ans.}$$

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## QUESTION - 2

### PART 'B'

Find  $\frac{dy}{dx}$  if  $y = \sqrt{\frac{1-x}{1+x}}$  Chain Rule

Solution:-  $\frac{dy}{dx} = \sqrt{\frac{1-x}{1+x}}$

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

$$\Rightarrow \frac{1}{2} \left(\frac{1-x}{1+x}\right)^{-1/2} \left(\frac{-1-x-1+x}{(1+x)^2}\right)$$

$$\Rightarrow \frac{1}{2} \frac{\sqrt{1+x}}{\sqrt{1-x}} \frac{(-2)}{(1+x)^2}$$

$$\Rightarrow \frac{-1}{(1+x)^{3/2}} \sqrt{1-x} \times \frac{\sqrt{1-x}}{\sqrt{1-x}}$$

$$\Rightarrow \frac{-1 \times \sqrt{1-x}}{(1+x) \sqrt{1+x} (1-x)}$$

$$\frac{dy}{dx} = \frac{-1}{(1+x)(1-x)} \times \sqrt{\frac{1-x}{1+x}}$$

Apply Identity

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

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

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QUESTION - 3  
PART 'A'

Find the Integration of  $\frac{1}{\sqrt{x^3}}$

Solution:-

$$\int \frac{1}{\sqrt{x^3}} dx$$

$$\Rightarrow \int \frac{1}{(x^3)^{1/2}} dx$$

$$\Rightarrow \int x^{-3/2} dx$$

$$\Rightarrow \frac{x^{-\frac{3}{2}+1}}{-\frac{3}{2}+1} + C$$

$$\Rightarrow \frac{x^{-\frac{1}{2}}}{-\frac{1}{2}}$$

$$\Rightarrow \frac{-1}{2\sqrt{x}} + C \quad \text{Ans}$$

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## PART 'B'

Find the integration  $\int \frac{1}{(6x+7)^6}$

SOLUTION:-  $\int \frac{1}{(6x+7)^6} dx$

$$\Rightarrow \int [f(x)]^n f'(x) dx = \frac{f(x)^{n+1}}{n+1}$$

$$\int \frac{1}{2} (6x+7)^{-6} \cdot (6) dx$$

$$\Rightarrow \frac{(6x+7)^{-6+1}}{2 \cdot (-6+1)}$$

$$\Rightarrow \frac{(6x+7)^{-5}}{2(-5)} + C$$

$$\Rightarrow \frac{1}{-10(6x+7)^5} + C \quad \text{Ans}$$

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