कक्षा-12

सांतत्य तथा अवकलनीयता

(Continuity and Differentiability)

अध्याय - 5

भाग - 7

प्रश्नावली 5.2

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उदाहरण–21 : $f(x) = \sin(x^2)$ का अवकलज ज्ञात कीजिए।

$$y = f(x) = \sin(x^2)$$

$$\frac{dy}{dx} = \frac{d}{dx}(\sin(x^2))$$

$$= \cos(x^2)\frac{d}{dx}x^2$$

$$= \cos(x^2)(2x)$$

$$\frac{dy}{dx} = 2x \cdot \cos(x^2)$$

$$\left[\frac{d}{dx}(\sin x) = \cos x \qquad \frac{d}{dx}x^n = nx^{n-1}\right]$$

उदाहरण–22 : tan (2x + 3) का अवकलज ज्ञात कीजिए।

$$y = \tan(2x+3)$$

$$\frac{dy}{dx} = \frac{d}{dx}(\tan(2x+3))$$

$$= \sec^2(2x+3)\frac{d}{dx}(2x+3)$$

$$= \sec^2(2x+3)[2+0]$$

$$\frac{dy}{dx} = 2\sec^2(2x+3)$$

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उदाहरण–23 : x के सापेक्ष sin (cos (x^2)) का अवकलन कीजिए

$$y = \sin(\cos(x^2))$$

$$\frac{dy}{dx} = \frac{d}{dx}\left[\sin(\cos(x^2))\right]$$

$$= \cos(\cos(x^2))\frac{d}{dx}\cos(x^2)$$

$$= \cos(\cos(x^2))\left[-\sin(x^2)\frac{d}{dx}(x^2)\right]$$

$$= \cos(\cos(x^2))\left[-\sin(x^2)(2x)\right]$$

$$= -2x \sin(x^2) \cdot \cos(\cos(x^2)) \cdot$$

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प्रश्नावली 5.2

प्रश्न 1 से 8 में x के सापेक्ष निम्नलिखित फलनों का अवकलन कीजिए:

1. $\sin(x^2 + 5)$.

$y = \sin(x^2+5)$

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

$= \cos(x^2+5) \cdot \frac{d}{dx}(x^2+5)$

$= \cos(x^2+5)(2x+0)$

$\frac{dy}{dx} = 2x \cdot \cos(x^2+5)$

$\frac{d}{dx}\sin x = \cos x$

$\frac{d}{dx}\cos x = -\sin x$

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2. cos (sin x).

$y = \cos(\sin x)$

$\frac{dy}{dx} = \frac{d}{dx} \cdot \cos(\sin x)$

$= -\sin(\sin x) \frac{d}{dx} \sin x$

$= -\sin(\sin x) \cdot \cos x$

$= -\cos x \cdot \sin(\sin x)$

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$y = \sin(ax+b)$

3. $\sin(ax + b)$

$$\frac{dy}{dx} = \frac{d}{dx}\left(\sin(ax+b)\right)$$

$$= \cos(ax+b)\,\frac{d}{dx}(ax+b)$$

$$= \cos(ax+b)\,(a)$$

$$\frac{dy}{dx} = a\cos(ax+b)$$

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$y = \sec(\tan(\sqrt{x}))$

4. $\sec(\tan(\sqrt{x}))$

$$\frac{dy}{dx} = \frac{d}{dx}\sec(\tan(\sqrt{x}))$$

$$= \sec(\tan(\sqrt{x})) \cdot \tan(\tan(\sqrt{x})) \cdot \frac{d}{dx}\tan(\sqrt{x})$$

$\frac{d}{dx}\cdot\sec x = \sec x \cdot \tan x$

$\frac{d}{dx}\cdot\tan x = \sec^2 x$

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$$= \sec(\tan\sqrt{x}) \cdot \tan(\tan\sqrt{x}) \cdot \sec^2\sqrt{x} \cdot \frac{d}{dx}\sqrt{x}$$

$$= \sec(\tan\sqrt{x}) \cdot \tan(\tan\sqrt{x}) \cdot \sec^2\sqrt{x} \cdot \left(\frac{1}{2\sqrt{x}}\right)$$

$$= \frac{1}{2\sqrt{x}} \cdot \sec^2\sqrt{x} \cdot \sec(\tan\sqrt{x}) \cdot \tan(\tan\sqrt{x}).$$

$$\frac{d}{dx}\sqrt{x}$$

$$= \frac{d}{dx} x^{1/2}$$

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

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

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$$y = \frac{\sin(ax+b)}{\cos(cx+d)}$$

5. $\dfrac{\sin(ax+b)}{\cos(cx+d)}$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{d}{dx}(u) - u\frac{d}{dx}(v)}{v^2}$$

$$\frac{dy}{dx} = \frac{\cos(cx+d)\frac{d}{dx}\sin(ax+b) - \sin(ax+b)\frac{d}{dx}\cos(cx+d)}{\cos^2(cx+d)}$$

$$\frac{dy}{dx} = \frac{\cos(cx+d)\left[\cos(ax+b)\cdot a\right] - \sin(ax+b)\left[-\sin(cx+d)\cdot c\right]}{\cos^2(cx+d)}$$

$$\frac{dy}{dx} = \frac{a \cdot \cos(ax+b) \cdot \cos(cx+d) + c \cdot \sin(ax+b) \cdot \sin(cx+d)}{\cos^2(cx+d)}$$



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$y = \cos x^3 \cdot \sin^2(x^5)$

6. $\cos x^3 \cdot \sin^2 (x^5)$.

$$\frac{dy}{dx} = \frac{d}{dx}\left[\cos x^3 \cdot \sin^2 x^5\right]$$

$$= \cos x^3 \frac{d}{dx} \sin^2(x^5) + \sin^2 x^5 \frac{d}{dx} \cos(x^3)$$

$$\frac{d}{dx}(u \cdot v) = u\frac{dv}{dx} + v\frac{du}{dx}$$

$$= \cos x^3 \cdot 2\sin(x^5) \frac{d}{dx} \sin(x^5) + \sin^2 x^5 \cdot \left[-\sin x^3 \cdot \frac{d}{dx} x^3\right]$$

$$= \cos x^3 \cdot 2\sin x^5 \left[\cos x^5 \frac{d}{dx} x^5\right] + \sin^2 x^5 \left[-\sin x^3 \cdot 3x^2\right]$$

$$= 2\sin x^5 \cdot \cos x^3 \cdot \cos x^5 (5x^4) + \sin^2 x^5 (-3x^2 \sin x^3)$$

$$= 10x^4 \cdot \sin x^5 \cdot \cos x^3 \cdot \cos x^5 - 3x^2 \cdot \sin x^3 \cdot \sin^2 x^5 .$$

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$y = 2\sqrt{\cot(x^2)}$

7. $2\sqrt{\cot\left(x^2\right)}$

$$\frac{dy}{dx} = \frac{2 \times 1}{2\sqrt{\cot x^2}} \times \frac{d}{dx}\cot(x^2)$$

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

$$\frac{dy}{dx} = \frac{-2x}{\sqrt{\cot x^2}} \cdot \operatorname{cosec}^2(x^2)$$

$$\frac{d}{dx}\sqrt{x} = \frac{1}{2\sqrt{x}}$$

$$\frac{d}{dx}\cot x = -\operatorname{cosec}^2 x$$