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Department: Computer Engineering
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1 $y = [(x+1)^2(x-2)^{1/2}] / [(2x-1)(x+3)^{3/2}]$

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

$$\ln y = [\ln(x+1)^2 + \ln(x-2)^{1/2}] - [\ln(2x-1) + \ln(x+3)^{3/2}]$$

$$\frac{1}{y}\cdot\frac{dy}{dx} = \left[\frac{1}{(x+1)^2}\cdot 2(x+1) + \frac{1}{(x-2)^{1/2}}\cdot\frac{(x-2)^{-1/2}}{2}\right] - \left[\frac{1}{2x-1}\cdot 2 + \frac{1}{(x+3)^{3/2}}\cdot\frac{3(x-3)^{1/2}}{2}\right]$$

$$\frac{1}{y}\cdot\frac{dy}{dx} = \left[\frac{2(x+1)}{(x+1)^2} + \frac{(x-2)^{-1/2}}{2(x-2)^{1/2}}\right] - \left[\frac{2}{2x-1} + \frac{3(x-3)^{1/2}}{2(x-3)^{3/2}}\right]$$

$$\frac{1}{y}\cdot\frac{dy}{dx} = \left[\frac{2}{(x+1)} + \frac{1}{2(x-2)}\right] - \left[\frac{2}{2x-1} + \frac{3}{2(x-3)}\right]$$

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

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

2. $y = [3e^x \sin 2x] / [x^{5/2}]$

Find the $\ln$ of both

$\ln y = \ln 3e^x + \ln \sin 2x - \ln x^{5/2}$

Differentiate $y$ with respect to $x$

$\frac{d}{dx}(\ln y) = \frac{d}{dx}(3e^x) + \frac{d}{dx}(\ln \sin^2 x) - \frac{d}{dx}(\ln x^{5/2})$

$\frac{1}{y}\frac{dy}{dx} = \frac{1}{3e^x}(3e^x) + \frac{1}{\sin 2x}(\cos 2x) - \frac{1}{x^{5/2}}(5/2\, x^{3/2})$

$\frac{1}{y}\frac{dy}{dx} = \frac{3e^x}{3e^x} + \frac{\cos 2x}{\sin 2x} - \frac{5/2\, x^{5/2}}{x^{5/2}}$

multiply both sides by $y$

$\frac{1}{y}\frac{dy}{dx} \times y = y\left(\frac{3e^x}{3e^x} + \frac{\cos 2x}{\sin 2x} - \frac{5/2\, x^{5/2}}{x^{5/2}}\right)$

$\frac{dy}{dx} = y\left(1 + \frac{\cos 2x}{\sin 2x} - \frac{5/2\, x^{3/2}}{x^{5/2}}\right)$

$\frac{dy}{dx} = \frac{3e^x \sin 2x}{x^{5/2}}\left(\frac{1 + \cos 2x}{\sin 2x} - \frac{5/2\, x^{5/2}}{x^{5/2}}\right)$

Integrate

1) $4\sec^2(3m+1)$

$u = 3m+1$

$du = 3\,dm$

$dm = \frac{du}{3}$

$\int 4\sec^2 u \frac{du}{3}$

$\frac{4}{3}\int \sec^2 u\, du$

Integration of $\sec^2 u$

$\int = \tan u + C$

$\frac{4}{3}\tan u + C$

$\frac{4}{3}\tan(3m+1) + C$

2) $2t(3t^2-1)^{1/2}$

$u = 3t^2 - 1$

$\frac{du}{dt} = \frac{6t}{6t}\,dt$

$dt = \frac{du}{6t}$

$\int 2t \times [u]^{1/2} \frac{du}{6t3}$

$\int \frac{1}{3} \times u^{1/2} du$

$\frac{1}{3}\int u^{1/2}\, du$

$= \frac{1}{3} \times \frac{u^{1/2+1}}{1/2+1} + C$

$= \frac{1}{3} \times \frac{2}{3} u^{3/2} + C$

$= \frac{2}{9} u^{3/2} + C$

$= \frac{2}{9}(3t^2-1)^{3/2} + C$

3) $\int \frac{2x}{(4x^2-1)^{1/2}} = \int 2x(4x^2-1)^{-1/2}\,dx$

$u = 4x^2 - 1$

$du = 8x\,dx$

$dx = \frac{du}{8x}$

$= \int 2x(u)^{-1/2} \frac{du}{8x}$

$\frac{1}{4}\int u^{-1/2}\,du$

$= \frac{1}{4} \cdot \frac{u^{-1/2+1}}{-1/2+1}$

$= \frac{1}{4} \cdot \frac{u^{1/2}}{1/2}$

$= \frac{1}{4} \times 2u^{1/2}$

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