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

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

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

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

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

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

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

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

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

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

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

$$\frac{1}{y}\cdot\frac{dy}{dx} = 1 + \frac{2\cos 2x}{\sin 2x} - \frac{5}{2}x^{-1}$$

$$\frac{1}{y}\cdot\frac{dy}{dx} = 1 + 2\cot 2x - \frac{5}{2x}$$

$$\frac{dy}{dx} = y\left[1 + 2\cot 2x - \frac{5}{2x}\right]$$

$$\frac{dy}{dx} = \frac{3e^x \sin 2x}{x^{5/2}}\left[1 + 2\cot 2x - \frac{5}{2x}\right]$$

* INTEGRATION

① $\int 4\sec^2(3m+1)$ * With respect to m

$\therefore \int 4\sec^2(3m+1)\, dm$

let $u = 3m+1$ $\therefore \frac{du}{dm} = 3$

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

$$\int y = \int 4\sec^2 u\, dm$$

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

$$4/3 \int \sec^2 u\, du$$

integral of $\sec^2 u = \tan u + C$

$$\therefore \int y = \frac{4}{3}\tan u + C$$

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

(2) $2t(3t^2-1)^{1/2}$ * with respect to t

$\therefore \int 2t(3t^2-1)^{1/2}\,dt$

let $u = 3t^2 - 1$

$du/dt = 6t$

but $dt = du/6t$

$\int 2t(u)^{1/2}\,dt$

$\int 2t(u)^{1/2}\,\frac{du}{6t}$

$\frac{2t}{6t}\int u^{1/2}\,du$

$y = \frac{1}{3}\left[\frac{u^{3/2}}{3/2} + c\right]$

$y = \frac{1}{3}\left[\frac{2u^{3/2}}{3} + c\right]$

$y = \frac{2}{9}\left[(3t^2-1)^{3/2} + c\right]$

(3) $2x/(4x^2-1)^{1/2}$ with respect to x

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

$du/dx = 8x$

$dx = du/8x$

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

$y = \frac{2x}{8x}\int \frac{1}{u^{1/2}}\,du$

$$y = \frac{1}{4}\left[\frac{u^{-1/2+1}}{(-1/2+2/2)}\right]$$

$$y = \frac{1}{4}\left[\frac{u^{1/2}}{1/2}\right]$$

$$y = \frac{1}{4}\left[2u^{1/2}\right]$$

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

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

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