$$y = \frac{3e^x \sin^2 2x}{x^{5/2}}$$

Find the log ap both sides

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

Differentiate with respect to $x$

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

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

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

multiply both side by $y$

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

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

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

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

$u = 3m+1$

$du = 3dm$

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

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

$= \tan u + C$

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

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

$\int 2t \times (3t^2-1)^{\frac{1}{2}}$

$u = 3t^2 - 1$

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

$dt = \frac{du}{6t}$ $\int 2t \times [u]^{\frac{1}{2}} \frac{du}{3}$

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

$\frac{1}{3}\int u^{\frac{1}{2}}\, du$ $= \frac{1}{3} \times \frac{u^{\frac{1}{2}+1}}{\frac{1}{2}+1} + C$

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

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

$\frac{4}{3}\tan u + C$ Integration of $\sec^2 u$

$= \tan u + C$

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

2 $\int 2t \times (3t^2 - 1)^{\frac{1}{2}}$

$u = 3t^2 - 1$

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

$dt = \frac{du}{6t}$ $\int 2t \times (u)^{\frac{1}{2}}$

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

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

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

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

$u = 4x^2 - 1$

$du = 8x\,dx$

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

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

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

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

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

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

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

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

$u = 3m+1$

$du = 3dm$

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

$\frac{4}{3}\int \sec^2 u\, du$ Integration of $\sec^2 u = \tan u + C$

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

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

2 $\int 2t \times (3t^2-1)^{\frac{1}{2}}$

$u = 3t^2 - 1$

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

$dt = \frac{du}{6t}$ $\int 2t \times [u]^{\frac{1}{2}} \frac{du}{3}$

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

$\frac{1}{3}\int u^{\frac{1}{2}}\, du = \frac{1}{3} \times \frac{u^{\frac{1}{2}+1}}{\frac{1}{2}+1} + C$

A)

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

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

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

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

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

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

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