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

$u = 3m+1$

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

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

$= \frac{1}{3} \cdot \int 4\sec^2 u\, du$

$= \frac{1}{3} \cdot [4\tan u + c]$

$= \frac{4\tan u}{3} + c$

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

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

$u = 3t^2 - 1$

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

$\Rightarrow \int 2t \cdot u^{1/2} \cdot \frac{du}{dt} = \int u^{1/2}\,\frac{du}{3}$

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

$\Rightarrow \frac{2u^{3/2}}{9} + c \;//\; = \frac{2(3t^2-1)^{3/2}}{9} + c$

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

$u = 4x^2 - 1$

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

$\Rightarrow \int \frac{2x}{u^{1/2}} \cdot dx = \int \frac{2x}{u^{1/2}} \cdot \frac{du}{8x}$

$= \frac{1}{4}\int u^{-1/2} \cdot du = \frac{1}{4}\left[\frac{u^{1/2}}{1/2}\right] + c$

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

//

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

$\frac{d}{dx}(\ln y) = \frac{d}{dx}$

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

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

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

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

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

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

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

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

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

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

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

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

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

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