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MAT 104

$$1. y = (x+1)^2 (x-2)^{1/2} \\ (2x-1)(x-3)^{4/3}$$

$$\ln y = \ln[(x+1)^2] + \ln[(x-2)^{1/2}] - \ln[(x-2)] - \ln[(x-3)^{4/3}]$$

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{1}{(x+1)^2} \cdot (2x+2) + \frac{1}{(x-2)^{1/2}} \cdot \frac{1}{2} (x-2)^{-1/2} - \frac{1}{2x-1} - \frac{1}{(x-3)^{4/3}} \cdot \frac{4}{3} (x-3)^{1/3}$$

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{2x+2}{(x+1)^2} + \frac{1}{2} \frac{(x-2)^{-1/2}}{(x-2)^{1/2}} - \frac{1}{2x-1} - \frac{4}{3} \frac{(x-3)^{1/3}}{(x-3)^{4/3}}$$

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{2}{x+1} + \frac{1}{2} \frac{1}{x-2} - \frac{1}{2x-1} - \frac{4}{3} \frac{(x-3)^{1/3}}{(x-3)^{4/3}}$$

$$\frac{dy}{dx} = y \left[\frac{2}{x+1} + \frac{1}{2} \frac{1}{x-2} - \frac{1}{2x-1} - \frac{4}{3} \frac{(x-3)^{1/3}}{(x-3)^{4/3}} \right]$$

$$\therefore \frac{dy}{dx} = \frac{(x+1)^2 (x-2)^{1/2}}{(2x-1)(x-3)^{4/3}} \left[\frac{2}{x+1} + \frac{1}{2} \frac{1}{x-2} - \frac{1}{2x-1} - \frac{4}{3} \frac{(x-3)^{1/3}}{(x-3)^{4/3}} \right]$$

$$2. y = 3e^k \sin 2k$$

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

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

$$\frac{1}{y} \cdot \frac{dy}{dk} = 1 + 2 \frac{\cos 2k}{\sin 2k} - 5 \frac{k^{3/2}}{2k^{5/2}}$$

$$\frac{1}{y} \cdot \frac{dy}{dk} = 1 + 2 \tan 2k - \frac{5k^{3/2}}{2k^{5/2}}$$

$$\frac{dy}{dk} = 9 \left[1 + 2 \tan 2k - \frac{5k^{5/2}}{2k^{5/2}} \right]$$

$$\therefore \frac{dy}{dk} = \frac{9e^x \sin 2k}{k^{5/2}} \left[1 + 2 \tan 2k - \frac{5k^{5/2}}{2k^{5/2}} \right]$$

Integration.

$$1. \int 4 \sec^2(3mt+1) = y$$

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

$$\text{let } u = 3mt+1$$

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

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

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

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

$$\textcircled{2} \quad 2 + (8t^2 - 1)^{1/2}$$

$$\int 2t(8t^2 - 1)^{1/2} dt$$

$$\text{let } u = 8t^2 - 1$$

$$\frac{du}{dt} = 16t \therefore dt = \frac{du}{16}$$

$$\Rightarrow \int 2t u^{1/2} \cdot \frac{du}{16} = \int u^{1/2} \cdot \frac{du}{8}$$

$$\frac{1}{8} \int u^{1/2} du \Rightarrow \frac{1}{8} \left[\frac{u^{3/2}}{3/2} + c \right] = \frac{1}{12} u^{3/2} + c$$

$$\textcircled{3} \quad \frac{2x}{(4x^2-1)^{1/2}}$$

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

$$\text{let } u = 4x^2 - 1$$

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

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

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

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

$$\text{or } \frac{\sqrt{4x^2-1}}{2} + c$$