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S/N: 36

Mechanical Engr

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

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

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

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

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

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

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

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

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

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

Integrate the following with respect to the variable.

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

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

$$\text{Let } u = 3m+1$$

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

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

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

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

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

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

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

$$\text{Let } u = \sqrt{3t^2-1}$$

$$u^2 = 3t^2 - 1$$

$$3t^2 = u^2 + 1$$

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

$$t = \sqrt{\frac{u^2 + 1}{3}}$$

$$t = \sqrt{\frac{u^2 + 1}{3}}$$

$$\frac{dt}{du} = \frac{1}{2} \left( \frac{u^2 + 1}{3} \right)^{-1/2} \cdot \frac{2u}{3}$$

$$\frac{dt}{du} = \frac{u}{3} \left( \frac{u^2 + 1}{3} \right)^{-1/2}$$

$$dt = \frac{u du}{3} \left( \frac{u^2 + 1}{3} \right)^{-1/2}$$

$$\int 2 \left( \frac{u^2+1}{3} \right)^{1/2} \cdot u \cdot \frac{u du}{3} \left( \frac{u^2+1}{3} \right)^{-1/2}$$

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

$$= \frac{2}{3} \left[ \frac{u^3}{3} \right] + C$$

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

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

$$3. \int \frac{2x}{\sqrt{4x^2-1}} dx$$

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

$$u^2 = 4x^2-1$$

$$4x^2 = u^2+1$$

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

$$x = \frac{\sqrt{u^2+1}}{2}$$

$$\frac{dx}{du} = \frac{1}{2} \left( \frac{u^2+1}{4} \right)^{-1/2} \cdot \frac{u}{2}$$

$$\frac{dx}{du} = \frac{u}{4} \left( \frac{u^2+1}{4} \right)^{-1/2}$$

$$dx = \frac{u du}{4} \left( \frac{u^2+1}{4} \right)^{-1/2}$$

$$\int x \left( \frac{u^2+1}{4} \right)^{1/2} \cdot \frac{u du}{4} \left( \frac{u^2+1}{4} \right)^{-1/2}$$

$$\frac{1}{2} \int \left( \frac{u^2+1}{4} \right)^{1/2-1/2} du$$

$$= \frac{1}{2} \int du = \frac{u}{2} + C = \frac{\sqrt{4x^2-1}}{2} + C$$