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 Matric no: 19/ENG06/038
 Department: Mech Engrs
 Course Code: MAE 104

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$u = 3m+1$$

$$du = 3$$

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

$$du = 3 dm$$

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

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

$$\frac{1}{3} \int \sec^2(u) du$$

$$\frac{1}{3} \tan u + c$$

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

$$4) \int 2t \sqrt{3t^2-1} dt$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\frac{1}{2} \int \frac{(u^2+1)}{4} \int \frac{1}{2} \cdot \frac{1}{2} du$$

$$\frac{1}{2} \int du$$

$$= \frac{u}{2} + c$$

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

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