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MATH

a) $\frac{dy}{dx} + y \tanh x = 2 \sinh x$

$P = \tanh x$

$Q = 2 \sinh x$

$y.IF = \int Q.IF$

$IF = e^{\int P dx}$

$e \int \frac{\sinh x}{\cosh x} dx$

$u = \cosh x$

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

$IF\ e \int \frac{f'x}{F(x)} dx$

$IF = e^{\ln \cosh x} = \cosh x$

$y \cosh x = \int 2 \sinh x \cosh x$

$y \cosh x = 2 \int (\sinh x \cosh x)$

$fx = \sinh x \quad f'x = \cosh x$

$y \cosh x = 2 [f(x).f'(x)]$

$y \cosh x = 2 \left( \frac{fx^2}{2} + c \right)$

$y \cosh x = \frac{2 \sinh^2 x}{2} + 2c$

$y \cosh x = \sinh^2 x + 2c$

$y = \frac{(\sinh x)^2}{\cosh x} + \frac{2c(\cosh x)}{\cosh x}$

$y = \sinh x \tan x + \frac{2c}{\cosh x}$

b) $\frac{dy}{dx} + 2y = e^{3x}$

let $Q = e^{3x}$ & $P = 2$

$y.IF = \int Q.IF$

$IF = e^{\int P dx} = e^{\int 2 dx} = e^{2x}$

$y e^{2x} = \int e^{3x} . e^{2x}$

$y e^{2x} = e^{5x} + c$

$y = e^{5x-2x} + c e^{-2x}$

$y = e^{3x} + c e^{-2x}$

c) $x \frac{dy}{dx} = x^2 + 2x - 3$

$\frac{dy}{dx} = x + 2 - 3/x$

$y = \int (x + 2 - 3/x) dx$

$y = x^2/2 + 2x - 3 \ln x + c$

d) $\frac{dy}{dx} + y/x = y^3$

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

$z = y^{1-n}$

$z = y^{1-3} = y^{-2}$

$dz/dx = -2y^{-3} dy/dx$

multiply * by $-2$

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

$\frac{dz}{dx} - (2/x) z = -2$

$P_1 = -2/x, \quad Q = -2$

$e^{\int P_1 dx}$ hence

$e \int -2/x \, dx = e^{-2 \int 1/x}$

$= e^{-2 \ln x} = e^{\ln x^{-2}} = x^{-2}$

2 $IF = \int Q \cdot IF$

$x \cdot x^{-2} = \int -2x^{-2}$

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

$2x^{-2} = x^{-1}$

$2 = x^{-1} \cdot x^{2}$

$2 = x$

$\frac{1}{y^2} = x$

$y^2 = \frac{1}{x}$

$y = \sqrt{\frac{1}{x}}$

8) $x^2 \frac{dy}{dx} = x^3 \sin 3x + 4$

$\frac{dy}{dx} = x \sin 3x + 4x^{-2}$

$y = \int (x \sin 3x + 4x^{-2})$

$y = \int x \sin 3x + \frac{4x^{-2+1}}{-2+1}$

$\int x \sin 3x = -\frac{x}{3} \cos 3x + \int \sin 3x \cdot 1$

$\int x \sin 3x = -\frac{x}{3} \cos 3x - \frac{1}{3} \cos 3x + C$

$y = -x \cos 3x - 1 \cos 3x - 2 + C_1$