$\frac{dz}{dy} - \frac{dz}{dx} = -2$

$\therefore P = -2/x, \quad Q = -2$

$z \cdot If = \int Q \cdot If \, dx$

$z \cdot x^{-2} = \int -2x \cdot 2 \, dx$

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

$zx^{-2} = 2x^{-1} + c$

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

$z = 2x + cx^2$

$z = x(2 + cx)$

$z = y^{-2}$

$y^{-2} = x(2 + cx)$

$1/y^2 = x(2 + cx)$

$y^2 = 1/x(2+c)2$

$\therefore y = \sqrt{\frac{1}{x(2+cx)}}$

$y = \frac{1}{\sqrt{x}\,(2+cx)}$

e) $x^2 \, dy/dx = x^2 \sin 3x + 4$

$dy/dx = x \sin 3x + 4$

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

$= 1/3 \cos 3x + \int 1/3 \cos 3x + \frac{4x^{-1}}{-1}$

$= \frac{-x\cos 3x}{3} + \frac{\sin 3x}{9} - \frac{4x-1}{-1}$

$= -\frac{x\cos 3x}{3} + \frac{\sin 3x}{a} - 4x^{-1}$

$y = \frac{\sin 3x}{a} - \frac{x\cos 3x}{3} - \frac{4}{x}$ //

3) $(x^3 + xy^2)\, dy/dx = 2y^3$

$y = vx$

$dy/dx = v + x\, dv/dx$

$v + x\, dv/dx = 2(vx)^3$

$v + x\, dv/dx = \frac{x^3(2v^3)}{x^3(1+v^2)}$

$= \frac{2v^3 - v(1-v^2)}{1+v^2}$

$= \frac{2v^3 - v - v^3}{1+v^2}$

$\frac{x\,dv}{1+v^2} = v^3$

$\frac{1+v^2}{v^3 - v} = dv = 1/x \, dx$

$v(v-1)(v+1) = v^3 - v$

$\frac{1+v^2}{v^3-v} = \frac{A}{v} + \frac{B}{v-1} + \frac{C}{v+1}$

$1+v^2 = A(v-1)(v+1) + B(v)(v+1) + C(v)(v-1)$

$v = 1$

$1 + 1^2 = B(1)(2)$

$2 = B(2)$

$\therefore B = 1$

$v = -1$

$1 + (-1)^2 = C(-1)(-1-1)$

$2 = 2C$

$\therefore C = 1$

$v = 0$

If $(0)^2 = A(0-1)(0+1)$

$1 = A(-1)(1)$

$2 = A - 1$

$\therefore A = -1$

$\int [-1/v + 1/(v+1) + 1/(v+1)]\, dv = \int dx \, 1/x$

$\int -1/v \, dv + \int 1/(v-1)\, dv + \int 1/(v+1)\, dv = \int 1/x \, dv$

(8) $-\ln v + \ln(v-1) + \ln(v+1) = c$

$= \ln(v-1)(v+1) - \ln v = \ln x$

$= \dfrac{v^2 - 1}{v} = Ax$

$y = vx \therefore x = y/x$

$\left(y/x\right)^2 - 1 = Ax$

$y^2/x^2 - 1 = Ax - y/\cancel{x}$

$y^2/x^2 - 1 = Ay$

$\dfrac{y^2 - x^2}{x^2} = Ay$

$\dfrac{y^2 - x^2}{x^2} \cdot y^2 - x^2 = Ayx^2$

$y^2 = Ax^2y + x^2$

$y^2 = x^2(Ay + 1)_{//}$

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Elect/Elect
Eng 282

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

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

$P = \tanh x$

$Q = 2\sinh x$

$\int P dx = \int \tanh x = \int \frac{\sinh x}{\cosh} dx$

$\cosh x = u$

$\int \frac{\sinh x}{4} dx$

$u = \cosh x \quad dx = \frac{du}{\sinh x}$

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

$\int \frac{\sinh x}{u} \cdot \frac{du}{\sinh x}$

$\int 1/u \, du = \ln u = \ln\cosh x$

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

$IF = \int Q \cdot IF dx$

$IF = \int Q \cdot IF dx$

then $y IF = \int Q \cdot IF dx$

$y \cdot \cosh x = \int 2\sinh x \cdot \cos x\, dx$

$2\sin x \cos x = \sin(2x)$

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

$y \cdot \cosh x = 1/x \cdot \cosh$

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

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

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

let $2c = A$

$y = \frac{\cosh 2x + A}{\cosh x}$ //

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

$P = 2 \quad \int P dx = 2x$

$Q = e^{3x}$

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

$\therefore y \cdot IF = \int Q \cdot IF dx$

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

$y \cdot e^{2x} = \int e^{5x} dx$

$y \cdot e^{2x} = 1/5 e^{5x} dx$

$y = \frac{1/5 e^{5x} + c}{e^{3x}}$ //

c) $2dy/dx = x^2 + 2x - 3$

$dy/dx = x + 2 - 3/x$

$\therefore \int dy/dx = \int x + 2 - 3/x \, dx$

$y = \frac{x^2}{2} + 2x - 3\ln x + c$

d) $dy/dx + y/x = y^3$

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

$z = y^{1-n} \quad n = 3$

$z = y^{1-3}, \; z = y^{-2} \cdots (2)$

$\therefore \frac{dz}{dy} = -2y^{-3}\, dy/dx \cdots (3)$

then multiply equ(1) by $1-n$

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

~~Sub~~ and $\frac{dz}{dy} = \frac{-2y^{-3} dy}{dx}$

Sub eq 2 & 3 into 4