2) $If = \int Q \cdot If\, \partial x$.

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

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

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

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

$z = 2x + cx^2$

$z = x(2 + cx)$.

$z = y^{-2}$.

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

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

$y^2 = \frac{1}{x(2+cx)}$.

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

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

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

$\partial y/\partial x = x \sin 3x + 4$

$\int \partial y/\partial x = \int x^4 \sin 3x + \int 4x^{-2}$.

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

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

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

$= \frac{\sin 3x}{9} - \frac{x \cos 3x}{3} - \frac{4}{\cancel{8}}$ //

4) $(x^3 + xy^2)\, \partial y/\partial x = 2y^3$

$y = vx$

$\partial y/\partial x = v + x\, \partial u/\partial x$.

$v + x\, \partial u/\partial x = 2(v_2)^3$.

$v + x\, \partial u/\partial x = \frac{x^3(2x^3)}{x^3(1+v^2)}$.

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

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

$\frac{x\, \partial u}{} = v^3$.

$\frac{1+v^2}{u^3 - v} = \partial u = 1/x\, \partial x$.

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

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

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

$+ c(v)(v-1)$, $v = 1$

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

$2 = B(2)$

$\therefore B = 1$

$v = -1$

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

$2 = x$

$\therefore c = 1$

$v = 0$

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

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

$\int = A - 1$

$\therefore A = -1$.

$\int \left[-1/v + \frac{1}{v-1} + \frac{1}{v+1}\right] \partial u = \int \partial x\, 1/x$

$\int -1/v\, \partial u + \int 1/v - 1 + \partial u + \int \frac{1}{v+1}\, \partial u$

$= \int 1/x\, \partial u$.

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

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

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

$y = vx$: $x = y/x$.

$(y/x)^2 - 1 = Ax$.

$y^2/x^2 - 1 = Ax \cdot y/x$.

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

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

$\frac{y^2 - x^2}{x^2}$, $y^2 - x^2 = Ayx^2$

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

$y^2 = x^2(Ay + 1)$.

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18/ENG06/063
MECHANICAL ENG.

(a) $\frac{\partial y}{\partial x} = 2\sinh x - y\tanh x.$

$\frac{\partial y}{\partial x} + y\tanh x = \sinh x$

$P = \tanh x.$

$Q = 2\sinh x.$

$\int P\,\partial x = \int \tanh x = \int \frac{\sinh x}{\cosh}\,\partial x.$

$\cosh x = u$

$\int \frac{\sinh x}{u}\,\partial x.$

$u = \cosh x \quad \partial x = \frac{\partial u}{\sinh x}.$

$\frac{\partial u}{\partial x} = \sinh x.$

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

$\int \frac{1}{u}\,\partial u = \ln u = \ln\cosh x.$

$If = e^{\int P\partial x} = e^{\ln\cosh x}.$

$If = \int Q \cdot If\,\partial x.$

$If = \int Q \cdot If\,\partial x.$

Then $y\,If = \int Q \cdot If\,\partial x.$

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

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

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

$y \cdot \cosh x = \frac{1}{2} \cdot 2\cosh 2x + c.$

$\cosh x\,y = \cosh 2x + c.$

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

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

Let $x = A$

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

b) $\partial y/\partial x + 2y = e^{3x}.$

$\int P\,\partial x \quad P = 2 = 2x.$

$Q = e^{3x}$

$If = e^{\int P\partial x} = e^{2x}.$

$\therefore y \cdot If = \int Q \cdot If\,\partial x.$

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

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

$y \cdot e^{2x} = \frac{1}{5}e^{5x} + c.$

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

(c) $\int \frac{\partial y}{\partial x} = x^2 + 2x - 3.$

$\frac{\partial y}{\partial x} = x + 2 - 3/x.$

$\therefore \int \frac{\partial y}{\partial x} = \int x + 2 - 3/3\,\partial x.$

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

d) $\partial y/\partial x + y/x = y^{-3}$

$\partial y/\partial x\,y^{-3} + y^{-2}/x = 1$ — eq (1)

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

$t = y^{1-3},\ t = y^{-2}$ — (2)

$\therefore \frac{\partial t}{\partial y} = -2y^{-3}\,\partial y/\partial x$ — (3)

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

$-2y^{-3}\,\partial y/\partial x \quad -\frac{2y^{-2}}{x} = -2.$

and $\frac{\partial t}{\partial y} = \frac{-2y^{-3}\,\partial y}{\partial x}.$

sub eqn 2 & 3 into 4

$\frac{\partial t}{\partial y} - \frac{\partial z}{\partial x} = -2.$

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

$\int P\,\partial x = -2\ln x$

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