2.2

21L5251 CLO-02

Q8 $e^x y\, y'(x) = e^{-y} + e^{-2x-y}$

$$\int\left(\frac{1}{e^x} + \frac{1}{e^{3x}}\right)dx = \int \frac{y}{e^{-y}}\,dy$$

$$c - e^{-x} - \frac{e^{-3x}}{3} = e^y(y-1)$$

$$c - \frac{1}{e^x} - \frac{1}{3e^{3x}} = e^y y - e^y$$

$$c - \frac{3e^{2x}+1}{3e^{3x}} = e^y y - e^y$$

OR $\ln\left(c - \frac{3e^{2x}+1}{3e^{3x}}\right) = y^2 - y$

Q12 $\sin 3x\, dx + 2y\cos^3 3x\, dy = 0$

$$\frac{\sin 3x}{\cos^3 3x}\,dx = -2y\,dy$$

$$\int \tan 3x \sec^2 3x\, dx = \int -2y\, dy$$

$$\frac{(\tan^2 3x)}{6} + c = -y^2$$

$$c - \frac{\tan^2 3x}{6} = y^2$$

$$y = \pm\sqrt{c - \frac{\tan^2 3x}{6}}$$

Q 13 $\quad (e^y+1)^2 e^{-y}\,dx + (e^x+1)^3 e^{-x}\,dy = 0$

$$(e^y+1)^2 e^{-y}\,dx = -(e^x+1)^3 e^{-x}\,dy$$

$$-\int \frac{1}{(e^x+1)^3 e^{-x}}\,dx = \int \frac{1}{(e^y+1)^2 e^{-y}}\,dy$$

$$\int \frac{-e^x}{(e^x+1)^3}\,dx = \int \frac{e^y}{(e^y+1)^2}\,dy$$

$$-(e^x+1)^{-2} + c = (e^y+1)^{-1}$$

$$\cancel{-(e^x+1)^2 + c - 1 = e^y}$$

$$\cancel{\ln\left(-(e^x+1)^2 + c - 1\right) = y}$$

Q22 $\quad (e^x+e^{-x})\,\frac{dy}{dx} = y^2$

$$\int \frac{1}{e^x+e^{-x}}\,dx = \int \frac{1}{y^2}\,dy$$

$$\cancel{\int \frac{e^x + e^{-x}}{(e^{2x}+e^{-2x})^2}\,dx = y^{-1}}$$

$$\int \frac{e^x}{e^{2x}+1}\,dx = \int \frac{1}{y^2}\,dy$$

$$c + \tan^{-1}(e^x) = \frac{1}{y}$$

$$c + \frac{1}{\tan^{-1}(e^x)} = y$$

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Q28 $(1+x^4)dy + x(1+4y^2)dx = 0 \qquad y(1)=0$

$(1+x^4)dy = -x(1+4y^2)dx$

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

$\int \frac{1}{1+4y^2}dy = \int \frac{x}{1+x^4}dx$

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

let $u = 2y$ then $2dy = du$

and $\frac{1}{2}\int \frac{1}{1+u^2}du = \frac{1}{2}\tan^{-1}(u) = \frac{1}{2}\tan^{-1}(2y)$

let $v = x^2$ then $2x\,dx = dv$

and $\frac{1}{2}\int \frac{1}{1+v^2}dv = \frac{1}{2}\tan^{-1}(v) = \frac{1}{2}\tan^{-1}(x^2)$

$\frac{1}{2}\tan^{-1}(2y) = \frac{1}{2}\tan^{-1}(x^2) + c$

Taking off arctan from both sides

$2y = x^2 + \cancel{2}\tan(c)$

$y = \frac{x^2}{2} + \cancel{2}\frac{2\tan c}{2}$

$0 = \frac{1}{2} + \cancel{2}\frac{2\tan c}{2} \to c = +\frac{\pi}{4}$

$y = \frac{x^2}{2} - \frac{\pi}{4}$

Q29 $\cancel{\frac{dy}{dx} = ye^{-x^2}}$ $\cancel{(y)(4)=1}$

$$\cancel{\frac{1}{y}\, dy = e^{-x^2}\, dx}$$

$$\cancel{\int_4^x \frac{1}{y}\, dy = \int e^{-x^2}\, dx}$$

$$\cancel{\ln(y) = \int}$$

Q29 $\frac{dy}{dx} = ye^{-x^2}$ $y(4)=1$

$$\int_4^x \frac{1}{y}\frac{dy}{dt}\, dt = \int_4^x e^{-t^2}\, dt$$

$$\ln y(x) - \ln y(4) = \int_4^x e^{-t^2}\, dt$$

$$\ln y(x) = \ln y(4) + \int_4^x e^{-t^2}\, dt \qquad (\ln y(4) = \ln 1 = 0)$$

$$\ln y(x) = \int_4^x e^{-t^2}\, dt$$

$$y(x) = e^{\int_4^x e^{-t^2}\, dt}$$

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Q37

1) $\frac{dy}{dx} = x\sqrt{1-y^2}$

BS are 0 for $y = \pm 1$

Solving DE,

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

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

No value of c gives neither $y = 1$ nor $y = -1$

so, both $y = 1$, $y = -1$ are singular solutions.

2) $(e^x + e^{-x}) \frac{dy}{dx} = y^2$

BS of DE are zero for $y = 0$

After solving,

$c + \frac{1}{\tan^{-1}(e^x)} = y$

No value of c gives $y = 0$, so it is a singular solution.

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Q46

$$\frac{dy}{dx} = \frac{\sin\sqrt{x}}{\sqrt{y}}$$

$$\int \sqrt{y}\, dy = \int \sin\sqrt{x}\, dx$$

$$\frac{2y^{3/2}}{3} = 2\sin(\sqrt{x}) - 2\sqrt{x}\cos\sqrt{x} + c$$

$$y = \left(3\left(\sin\sqrt{x} - \sqrt{x}\cos\sqrt{x} + c\right)\right)^{2/3}$$

$\int \sin\sqrt{x}\, dx$

let $\sqrt{x} = u$

$\frac{1}{2\sqrt{x}} dx = du$

$dx = 2 \cdot u\, du$

$2\int u \sin u\, du$

$= 2\sin(\sqrt{x}) - 2\cos(\sqrt{x})\sqrt{x} + c$

Q49

$$\frac{dy}{dx} = \frac{e^{\sqrt{x}}}{y} \qquad y(1) = 4$$

$$\int y\, dy = \int e^{\sqrt{x}} dx$$

$$\frac{y^2}{2} = 2\left(\sqrt{x}e^{\sqrt{x}} - e^{\sqrt{x}} + c\right)$$

Put $y = 4$ and $x = 1$

$4 = c$

$$\frac{y^2}{2} = 2\left(\sqrt{x}e^{\sqrt{x}} - e^{\sqrt{x}} + 4\right)$$

$$y = \sqrt{4\sqrt{x}e^{\sqrt{x}} - 4e^{\sqrt{x}} + 16}$$

$$y = 2\sqrt{\sqrt{x}e^{\sqrt{x}} - e^{\sqrt{x}} + 4}$$

let $\sqrt{x} = u$

$\frac{1}{2\sqrt{x}} = du \Rightarrow dx = 2u\,du$

$2\int ue^{u}\, du$

$= 2(ue^{u} - e^{u} + c)$

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2 - 3

21L5251 CLO - 3

Q3 $\frac{dy}{dx} + y = e^{3x}$

$I = e^{\int 1 dx}$ $P(x) = 1$

$= e^{x}$ $(-\infty, +\infty)$

$e^{x}\frac{dy}{dx} + e^{x}y = e^{4x}$

$\frac{d}{dx}(e^{x}y) = e^{4x}$

$e^{x}y = \int e^{4x}$

$e^{x}y = \frac{e^{4x}}{4} + c$

$y = \frac{e^{4x} + c}{4e^{x}}$

$y = \frac{1}{4}e^{3x} + e^{-x}c$ | ce^{-x} is transient

Q12

$(1+x)\frac{dy}{dx} - xy = x + x^{2}$

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

$\int \frac{x}{1+x} dx = x - \ln(|x+1|) + c$

$e^{-(x-\ln(x+1))} = \frac{e^{-x}}{(x+1)^{-1}} = \frac{x+1}{e^{x}}$

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$$dx$$

$$\int \frac{d}{dx}\left(\frac{-xe^{x}}{(x+1)^{2}}\,y\right) = \int \frac{xe^{x}}{x+1}\,dx$$

$$\frac{-xe^{x}}{(x+1)^{2}}\,y =$$

$$\int \frac{d}{dx}\,\frac{-x}{e^{x}}\,y\,dx = \int \frac{(x+1)\,x}{e^{x}}\,dx$$

$$\frac{fx}{e^{x}}\,y = f(x^{2}+3x+3)\,e^{-3x} + c$$

$$y = e^{-2x}(x^{3}+3x^{2}+3x) + xc$$

$$\int \frac{d}{dx}\,\frac{x+1}{e^{x}}\,y\,dx = -(x^{2}+3x+3)\,e^{-3x} + c$$

$$\frac{x+1}{e^{x}}\,y = -(x^{2}+3x+3)\,e^{-3x} + c$$

$$y = \left(-x^{2}e^{-2x} + 3xe^{-2x} + 3e^{-2x} + c\right)(x+1)$$

No transient term

$$-1 < x < \infty$$

Q14 $xy' + (1+x)y = e^{-x}\sin 2x$

$$y' + \frac{1+x}{x}y = \frac{e^{-x}\sin 2x}{x}$$

$$\int \frac{1+x}{x} = \ln x + x$$

$$e^{\ln x + x} = xe^{x}$$

$$\int \frac{d}{dx}(xe^{x}y)\,dx = \int \sin 2x\,dx$$

$$xe^{x}y = \frac{-\cos 2x}{2} + c$$

$$y = \frac{-\cos 2x}{2xe^{x}} + \frac{ce^{-x}}{x}$$

$0 < x < \infty$

Q27 $xy' + y = e^{x}$ $\quad y(1) = 2$

$$y' + \frac{1}{x}y = \frac{e^{x}}{x}$$

$$\int \frac{1}{x}\,dx = \ln x$$

$$e^{\ln x} = x \qquad (-\infty, \infty)$$

$$\int \frac{d}{dx}(xy)\,dx = \int e^{x}\,dx$$

$$xy = e^{x} + c$$

$$y = \frac{e^x}{x} + \frac{c}{x} \quad \leftarrow y(1) = 2 \qquad \Big| \quad \frac{2}{e} = c$$

$$y = \frac{e^x}{x} + \frac{2}{ex}$$

$$0 < x < \infty$$

Q34 $$x(x+1)\frac{dy}{dx} + xy = 1$$

$$\frac{dy}{dx} + \frac{1}{x+1}y = \frac{1}{x(x+1)}$$

$$e^{\int \frac{1}{x+1}dx} = x+1 \qquad (-\infty, +\infty)$$

$$\int \frac{d}{dx}\left((x+1)y\right)dx = \int \frac{1}{x}\,dx$$

$$(x+1)y = \ln x + c$$

$$y = \frac{\ln x}{x+1} + \frac{c}{x+1}$$

$$-1 < x < \infty$$

$$y(e) = 1$$

$$1 = \frac{1}{e+1} + \frac{c}{e+1}$$

$$e+1 = c+1$$

$$e = c$$

$$y = \frac{\ln x}{x+1} \quad \frac{e}{x+1}$$

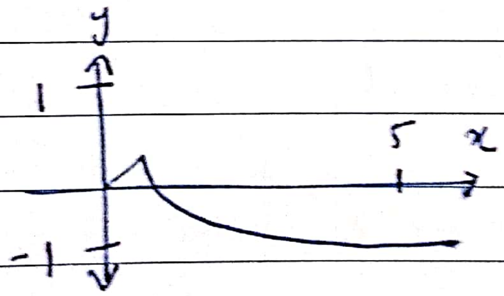
Q40 $(1+x^2)\frac{dy}{dx} + 2xy = f(x) \qquad y(0) = 2$

$$f(x) = \begin{cases} x, & 0 \le x < 1 \\ -x, & x \ge 1 \end{cases}$$

$$y' + \frac{2x}{1+x^2}\, y = \begin{cases} \frac{x}{1+x^2}, & 0 \le x < 1 \\ \frac{-x}{1+x^2}, & x \ge 1 \end{cases}$$

$I = 1 + x^2$

$$y = \begin{cases} \frac{1}{2} - \frac{1}{2(1+x^2)}, & 0 \le x < 1 \\ \frac{3}{2(1+x^2)} - \frac{1}{2}, & x \ge 1 \end{cases}$$



2.4

Q6 $\left(2y - \frac{1}{x} + \cos 3x \frac{dy}{dx} + \frac{y}{x^2} - 4x^3 + 3y \sin 3x\right) = 0$

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

$\cos 3x \, dy = \left(\frac{1}{x} - 2y + \frac{y}{x^2} - 4x^3 + 3y \sin 3x\right) dx$

$N(y)\, dy = M(x)\, dx$

$M(x)\, dx + (-N(y))\, dy = 0$

$\frac{d N(y)}{dx} = -3\sin 3x$

$\frac{d M(x)}{dy} = -2 + \frac{1}{x^2} + 3\sin 3x$

Equation not exact

Q18 $(2y \sin x \cos x - y + 2y^2 e^{xy^2})dx = (x - \sin^2 x - 4xye^{xy^2})dy$

$(2y \sin x \cos x - y + 2y^2 e^{xy^2})\, dx + (-x + \sin^2 x + 4xy\, e^{xy^2})\, dy = 0$

$\frac{dM}{dy} = 2\sin x \cos x - 1 + 4y e^{xy^2} + 4y^3 e^{xy^2} . x$

$\frac{dN}{dx} = -1 + 2\sin x \cos x + 4y e^{xy^2} + 4xy^3 e^{xy^2}$

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Equation is exact

Integrating $M(x,y)\,dx$

$$\int (2y\sin x\cos x - y + 2y^2 e^{xy^2})\,dx$$

$$= 2y\int \sin x\cos x\,dx - \int y\,dx + 2y^2\int e^{xy^2}\,dx$$

$$= y\sin^2 x - yx + 2e^{xy^2} + g(y)$$

Derivating wrt y

$$= \sin^2 x - x + 4e^{xy^2}\cdot xy + g'(y)$$

$$\cancel{\sin^2 x} - \cancel{x} + \cancel{4e^{xy^2}\cdot xy} + g'(y) = -\cancel{x} + \cancel{\sin^2 x} + \cancel{4xye^{xy^2}}$$

$$g'(y) = 0$$

$$g(y) = 0$$

$$C = y\sin^2 x - yx + 2e^{xy^2}$$

$\int \sin x\cos x\,dx$

~~$\cos x \int \cos x \sin x\,dx$~~

$\frac{\sin^2 x}{2}$

e^{xy^2}

$\frac{e^{xy^2}}{y^2}$

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Q 25 $(y^2\cos x - 3x^2y - 2x)\,dx + (2y\sin x - x^3 + \ln y)\,dy = 0$

$y(0) = e$

$\frac{dM}{dy} = 2y\cos x - 3x^2$

$\frac{dN}{dx} = 2y\cos x - 3x^2$

Exact

$\int (y^2\cos x - 3x^2y - 2x)\,dx$

$= \int y^2\cos x\,dx - 3y\int x^2\,dx - 2\int x\,dx$

$= y^2\sin x - yx^3 - x^2 + g(y)$

$\boxed{\begin{array}{l} \int \ln y \\ y\ln y - \int \frac{y}{y} \\ y\ln y - y \end{array}}$

Differentiating wrt y

$= 2y\sin x - x^3 + g'(y)$

$2y\sin x \cancel{- x^3} + g'(y) = 2y\sin x \cancel{- x^3} + \ln y$

$g'(y) = \ln y$

$g(y) = y\ln y - y$

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

$c = e\ln e - e$

$c = 0$

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$y^2 \sin x - x^3 y - x^2 + y \ln y - y = 0$

Q32

$y(x+y+1)\,dx + (x+2y)\,dy = 0$

$\frac{dM}{dy} = x + 2y + 1$

$\frac{dN}{dx} = 1$

Finding integrating factor

$= \frac{x + 2y + \cancel{x} - \cancel{1}}{x + 2y}$

$= 1$

$e^{\int 1 dx}$

$= e^{x}$

$ye^{x}(x+y+1)\,dx + e^{x}(x+2y)\,dy = 0$

$\frac{dM}{dy} = xe^{x} + 2e^{x}y + e^{x}$

$\frac{dN}{dx} = xe^{x} + 2e^{x}y + e^{x}$

Exact

$$\int e^{x}(x+2y)\,dy$$

$$= e^{x}\int (x+2y)\,dy$$

$$= xe^{x}y + y^{2}e^{x} + f(x)$$

Differentiating wrt x

$$xy\cancel{e^{x}} + \cancel{ye^{x}} + \cancel{y^{2}e^{x}} + f'(x) = \cancel{xye^{x}} + \cancel{y^{2}e^{x}} + \cancel{ye^{x}}$$

$$f'(x) = 0$$

$$f(x) = 0$$

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

Q33 $\quad 6xy\,dx + (4y + 9x^{2})\,dy = 0$

$$\frac{dM}{dy} = 6x$$

$$\frac{dN}{dx} = 18x$$

$$= \frac{+18x - 6x}{6xy}$$

$$= \frac{+2}{y}$$

$$= e^{\int \frac{2}{y}\,dy} = y^{+2}$$

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$$6xy^3\,dx + (4y^3 + 9x^2y^2)\,dy = 0$$

$$\frac{dM}{dy} = 18xy^2$$

$$\frac{dN}{dx} = 18xy^2$$

Exact

$$\int 6xy^3\,dx$$

$$= 3x^2y^3 + g(y)$$

$$\cancel{3x^2y^3 + g(y) = 4y^3}$$

$$= 9x^2y^2 + g'(y)$$

$$9x^2y^2 + g'(y) = 4y^3 + 9x^2y^2$$

$$g'(y) = 4y^3$$

$$g(y) = y^4$$

$$c = 3x^2y^3 + y^4$$

Q37 $x\,dx + (x^2y + 4y)\,dy = 0$ $y(4) = 0$

$$\frac{dM}{dy} = 0$$

$$\frac{dN}{dx} = 2xy$$

$$= \frac{2xy - 0}{x}$$

$$= 2y$$

$$e^{\int 2y\,dy}$$

$$= e^{y^2}$$

$$xe^{y^2}dx + e^{y^2}(x^2y + 4y)\,dy = 0$$

$$\frac{dM}{dy} = xe^{y^2} \cdot 2y$$

$$\frac{dN}{dx} = 2xye^{y^2}$$

$$\int xe^{y^2}dx$$

$$= \frac{x^2}{2}e^{y^2} + g(y)$$

Differentiating wrt y

$$= \frac{x^2}{\cancel{2}} \cdot e^{y^2} \cdot \cancel{2}y + g'(y) = x^2 e^{y^2} y + e^{y^2} 4y$$

$$\int e^{y^2} 4y = 2e^{y^2}$$

$$e^{y^2} 4y = g'(y)$$

$$g(y) = 2e^{y^2}$$

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

$$c = 10$$

$$10 = \frac{x^2 e^{y^2}}{2} + 2e^{y^2}$$

$$20 = (x^2+4)e^{y^2}$$

2.5

Q9

$$-y\,dx + (x + \sqrt{xy})\,dy = 0$$

Dividing by x

$$-\left(\frac{y}{x}\right)dx + \left(1 + \sqrt{\frac{y}{x}}\right)dy = 0 \qquad \left(v = \frac{y}{x}\right)$$

$$-v\,dx + (1+\sqrt{v})(v\,dx + x\,dv)$$

$$-\cancel{v\,dx} + \cancel{v\,dx} + v\sqrt{v}\,dx + x\,dv + x\sqrt{v}\,dv = 0$$

$$v\sqrt{v}\,dx = -dv\,(x(1+\sqrt{v}))$$

$$\frac{v\sqrt{v}}{1+\sqrt{v}}\,\frac{1}{dv} = \frac{1}{dx}(-x)$$

$$\int \frac{1+\sqrt{v}}{v\sqrt{v}}\,dv = -\int \frac{1}{x}\,dx$$

$$-2v^{-1/2} + \ln v = -\ln x + c$$

$$\ln y = 2\sqrt{x/y} + c$$

$$y(\ln|y| - c)^2 = 4x$$

Q13 $(x + ye^{y/x})dx - xe^{y/x}dy = 0$

Dividing by x

$(1 + ve^{v})dx - e^{v}(x\,dv + v\,dx) = 0 \qquad (y = vx)$

$dx + \cancel{ve^{v}dx} - e^{v}x\,dv - \cancel{e^{v}v\,dx} = 0$

$dx = e^{v}x\,dv$

$\int \frac{1}{x}\,dx = \int e^{v}dv$

$\ln x + c = e^{v}$

$\ln x + c = e^{y/x}$

$y(1) = 0$

$c = e^{0}$

$= 1$

$\ln x - e^{y/x} = -1$

17 $\frac{dy}{dx} = y(xy^{3} - 1)$

$\frac{dy}{dx} = xy^{4} + y$

$\frac{dy}{dx} + y = xy^{4}$

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

$$v = y^{-3}$$

$$v' = \cancel{6}\ -3y^{-4}y'$$

$$\frac{v'}{-3} = y^{-4}y'$$

$$\frac{v'}{-3} + v = x$$

$$v' - 3v = -3x$$

$$e^{\int 3dx}$$

$$= e^{-3x}$$

$$\int \frac{d}{dx}\left(e^{-3x}v\right)^{dx} = \int -3x e^{-3x}\,dx$$

$$\cancel{e^{-3x}}\,v = \frac{+(3x+1)\cancel{e^{-3x}}}{3} + c$$

$$v = \frac{+3x+1}{3} + \frac{c}{e^{-3x}}$$

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

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Q21 $x^2 y' - 2xy = 3y^4 \qquad y(1) = 1/2$

$$y' - \frac{2}{x} y = \frac{3y^4}{x^2}$$

$$y^{-4} y' - \frac{2}{x} y^{-3} = \frac{3}{x^2}$$

$$v = y^{-3}$$

$$\frac{v'}{-3} = y^{-4} y'$$

$$\frac{v'}{-3} - \frac{2}{x} v = \frac{3}{x^2}$$

$$v' + \frac{6}{x} v = \frac{-9}{x^2}$$

$$e^{\int \frac{6}{x} dx} = x^6$$

$$\int \frac{d}{dx}(x^6 v)\, dx = \int \frac{-9}{x^2} \cdot x^6\, dx$$

$$x^6 v = \frac{-9}{5} x^5 + c$$

$$v = \frac{-9}{5} x^{-1} + \frac{c}{x^6}$$

$$y^{-3} = -\frac{9}{5x} + \frac{c}{x^6}$$

$$c = \frac{49}{5}$$

$$y^{-3} = \frac{-9}{5} x^{-1} + \frac{49}{5} x^{-6}$$

24 $\frac{dy}{dx} = \frac{1-x-y}{x+y}$

$\frac{dy}{dx} = \frac{1}{x+y}$

$\frac{dy}{dx} = \frac{\frac{1}{x} - 1 - v}{1+v}$ $(y = vx)$

$(x\,dv + v\,dx)(1+v) = \frac{1}{x} - 1 - v$

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

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

$+ v + x\,dv(v+1) = -dx(v^2+v)$

Q 24 $\frac{dy}{dx} = \frac{1-x-y}{x+y}$ let $v = x+y$

$\frac{dv}{dx} = 1 + \frac{dy}{dx}$

$\frac{dv}{dx} - 1 = \frac{1-v}{v}$

$\int v\,dv = \int dx$

$\frac{v^2}{2} = x + c$

$(x+y)^2 = 2x + c_1$

$$\frac{dy}{dx} = \frac{3x+2y}{3x+2y+2} \qquad \text{let } v = 3x+2y$$

$$\frac{dv}{dx} = 3 + 2\frac{dy}{dx}$$

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

$$\frac{1}{2}\left(\frac{dv}{dx} - 3\right) = \frac{v}{v+2}$$

$$\frac{dv}{dx} - 3 = \frac{2v}{v+2}$$

$$\frac{dv}{dx} = \frac{5v+6}{v+2}$$

$$\int \frac{v+2}{5v+6}\,dv = \int dx$$

$$\cancel{\frac{1}{5}\ln|5v+6| = x+c}$$

$$\frac{1}{5}(3x+2y) + \frac{4}{25}\ln|75x+50y+30| = x + c$$

$$c = \frac{4}{25}\ln 95$$

$$\frac{1}{5}(3x+2y) + \frac{4}{25}\ln|75x+50y+30| = x + \frac{4}{25}\ln 95$$

$$5y - 5x + 2\ln|75x+50y+30| = 2\ln 95$$

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