VERSION 52 #1

Given $r = ?$ $d = 80\text{cm} \rightarrow r = 40\text{cm}$

$\frac{dV}{dt} = -52\frac{cm^3}{min}$ $\frac{dh}{dt} = ?$

$\frac{dr}{dt} = 0$ (radius constant)

$V = \pi r^2 h$

$$\boxed{\frac{dV}{dt} = 2\pi r h \frac{dr}{dt} + \pi r \frac{dh}{dt}}$$

$$-52 = 2\pi(40)(0) + \pi(40)^2 \frac{dh}{dt}$$

$$-52 = 0 + 1600\pi \frac{dh}{dt}$$

$$-52 = 1600\pi \frac{dh}{dt}$$

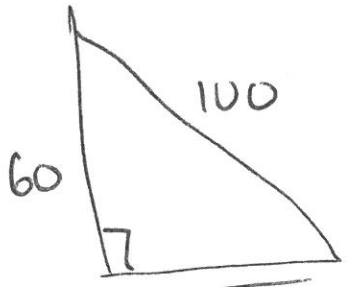
$$\frac{dh}{dt} = \frac{-52}{1600\pi}\frac{cm}{min}$$

$$= \frac{-13}{400\pi}\frac{cm}{min}$$

$$\approx -0.0103\frac{cm}{min}$$

VERSION S2 Problem #2

Given



$\leftarrow -2\frac{ft}{sec}$

$\frac{dz}{dt} = 0 \frac{ft}{sec}$

$\frac{dy}{dt} = ?$

$\frac{dx}{dt} = -2\frac{ft}{sec}$

$$x\frac{dx}{dt} + y\frac{dy}{dt} = z\frac{dz}{dt}$$

$$x(-2) + y\frac{dy}{dt} = 100(0)$$

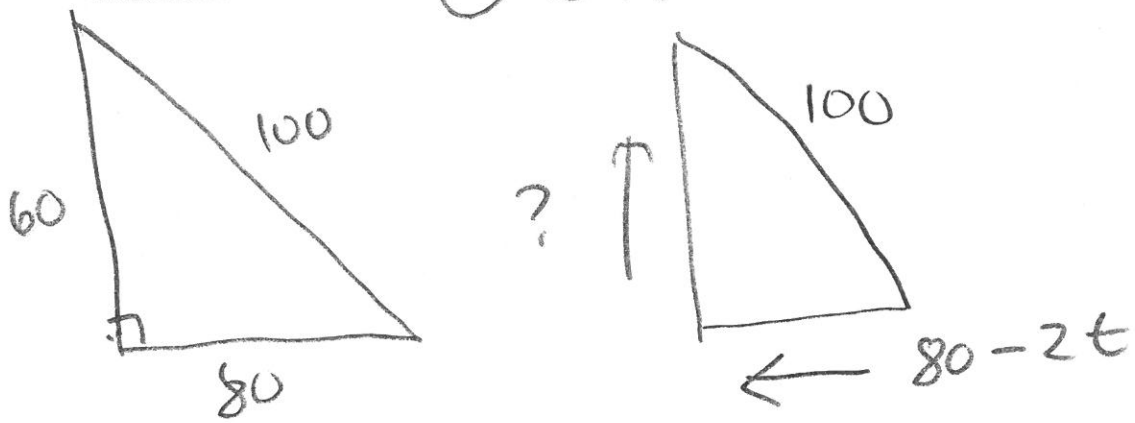
$$-2x + y\frac{dy}{dt} = 0$$

$$y\frac{dy}{dt} = 2x$$

$$\frac{dy}{dt} = \frac{2x}{y}$$

$$\boxed{\frac{dy}{dt} = \frac{2(x(t))}{y(t)}}$$

Version S2 ② cont



$t=0$ $t>0$

$$y(t) = \sqrt{100^2 - (80-2t)^2}$$

$$x(t) = 80 - 2t$$

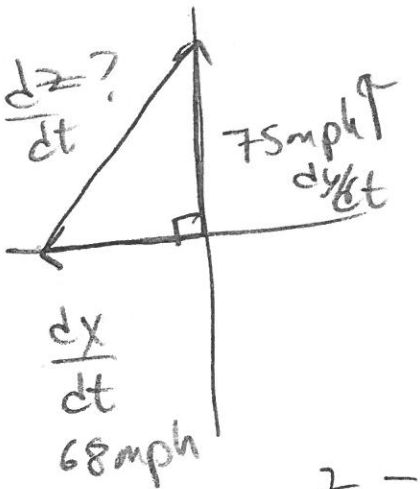
$$\text{So } \frac{dy}{dt} = \frac{2(x(t))}{y(t)} = \frac{2(80-2t)}{\sqrt{100^2-(80-2t)^2}}$$

$$\left.\frac{dy}{dt}\right|_{t=5} = \frac{2(80-2(5))}{\sqrt{100^2-(80-2(5))^2}}$$

$$= \frac{2(70)}{\sqrt{100^2-(70)^2}}$$

$$= \frac{140}{\sqrt{5100}} = 1.960 \frac{ft}{sec}$$

VERSION S2 #3



$$x^2+y^2=z^2$$

$$\downarrow$$

$$x\frac{dx}{dt}+y\frac{dy}{dt}=z\frac{dz}{dt}$$

$$z=\sqrt{(75t)^2+(68t)^2}$$

$$z(t)=\sqrt{75^2t^2+68^2t^2}$$

$$x(t)\frac{dx}{dt}+y(t)\frac{dy}{dt}=z(t)\frac{dz}{dt}$$

$$(68t)(68)+(75t)(75)=\sqrt{75^2t^2+68^2t^2}\,\frac{dz}{dt}$$

$$\frac{dz}{dt}=\frac{68^2t+75^2t}{\sqrt{75^2t^2+68^2t^2}}$$

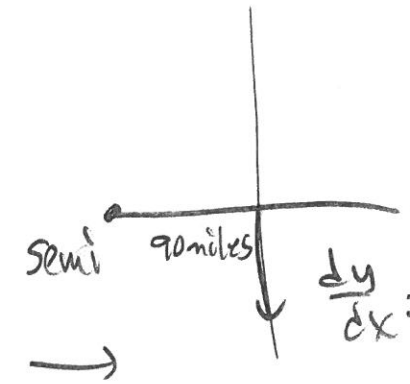
$$\left.\frac{dz}{dt}\right|_{t=1.5}=\frac{68^2(1.5)+75^2(1.5)}{\sqrt{75^2(1.5)^2+68^2(1.5)^2}}$$

$$=\frac{15373.5}{\sqrt{23060.25}}\approx 101.237 \text{ mph}$$

VERSION S2 #14

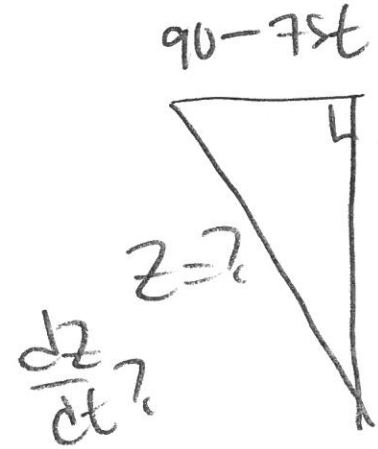
① car leaves $\frac{1}{2}$ hour early $(t+\frac{1}{2})$

② semi 90 miles to west when car leaves



$\frac{dx}{dt} = 75$ mph

$dx/dt = 75$ mph



$x^2 + y^2 = z^2 \, dz$

$x\frac{dx}{dt} + y\frac{dy}{dt} = z\frac{dz}{d}$

$z\frac{dz}{dt}$ $(90-75t)(75) + 55(t+\frac{1}{2})55$

$z = \sqrt{(90-75t)^2 + (55(t+2))^2}$

$\frac{dz}{dt} = \frac{(\frac{90}{75} - t)75^2 + 55^2(t+\frac{1}{2})}{\sqrt{(90-75t)^2 + (55(t+\frac{1}{2})^2}}$

$\frac{dz}{dt} = \frac{(\frac{6}{5} - t)75^2 + (t+\frac{1}{2})\cdot 55^2}{\sqrt{(\frac{6}{5} - t)75^2 + (t+\frac{1}{2})55^2}}$

Version 52 (#4)

$$\left.\frac{dz}{dt}\right|_{t=\frac{6}{5}} = \frac{\left(\frac{6}{5}-\frac{6}{5}\right)(75)^2 + \left(\frac{6}{5}+\frac{1}{2}\right)55^2}{\sqrt{\left(\frac{6}{5}-\frac{6}{5}\right)^2 75^2 + \left(\frac{6}{5}+\frac{1}{2}\right)^2 55^2}}$$

Note $\frac{6}{5} = t$ to get semi truck to restaurant

$$= \frac{0 \cdot 75^2 + \frac{17}{10}(55^2)}{\sqrt{0 \cdot 75^2 + \left(\frac{17}{10}\right)^2 \cdot 55^2}}$$

$$= \frac{\frac{17}{10}(55)^2}{\sqrt{\left(\frac{17}{10}\right)^2 55^2}}$$

$$= \frac{\frac{17}{10}}{\frac{17}{10}} \cdot \frac{55^2}{55^1} = 55 \text{ mph}$$