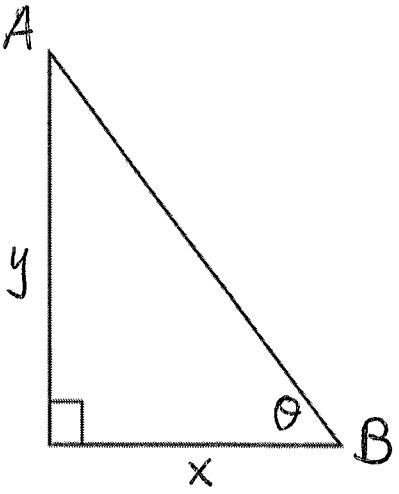
Related Rates Practice Trig Problem

a) Two cyclists are traveling on perpendicular roads. Cyclist A travels North at 15 mph. Cyclist B travels East at 25 mph. Find the rate at which the distance between the 2 cyclists are changing when x = 5 miles and y = 12 miles.

b) What is the rate of change of θ at that moment?



Key

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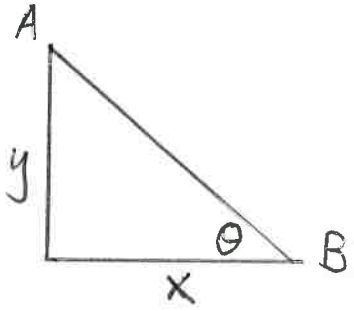


a) $x^2+y^2=z^2$

$2x\left(\frac{dx}{dt}\right)+2y\left(\frac{dy}{dt}\right)=2z\left(\frac{dz}{dt}\right)$

$x=5 \quad dx/dt=25$

$y=12 \quad dy/dt=15$

$z=13 \quad dz/dt=\_\_\_$

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

$z^2=5^2+12^2$

$z=\sqrt{169}=13$

$2(5)(25)+2(12)(15)=2(13)\left(\frac{dz}{dt}\right)$

$250+360=26\left(\frac{dz}{dt}\right)$

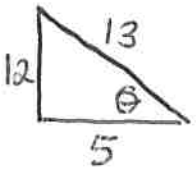
$610=26\left(\frac{dz}{dt}\right)$

$\frac{610}{26}=\frac{305}{13}=\frac{dz}{dt}$

$\frac{dz}{dt}=\frac{305}{13}$ mph or 23.462 mph

b) $\tan\theta=\frac{y}{x}$ (f / g)

$\sec^2\theta\left(\frac{d\theta}{dt}\right)=\frac{(dy/dt)(x)-(y)(dx/dt)}{x^2}$ (f′, g, −f, g′; x^2 = g^2)



$\sec\theta=\frac{13}{5}$

$\left(\frac{13}{5}\right)^2\left(\frac{d\theta}{dt}\right)=\frac{(15)(5)-12(25)}{5^2}$

$\frac{169}{25}\left(\frac{d\theta}{dt}\right)=\frac{75-300}{25}$

$\frac{d\theta}{dt}=\frac{25}{169}\cdot\frac{-225}{25}=\frac{-225}{169}$ or -1.331 rad/hr.