1. Find dy/dx if $y\cos(x) = x^2 + y^2$

$$y'\cos(x) - y\sin(x) = 2x + 2yy'$$

$$y'[\cos(x) - 2y] = 2x + y\sin(x)$$

$$\boxed{y' = \frac{2x + y\sin(x)}{\cos(x) - 2y}}$$

2. Show that $\overset{(-1,27)}{\cancel{(-3\sqrt{3}, 1)}}$ lies on the asteroid $x^{2/3} + y^{2/3} = \overset{=10}{\cancel{4}}$. Then compute dy/dx at that point.

$$(-1)^{2/3} + (27)^{2/3} = 1 + 3^2 = 10$$

$$\frac{d}{dx}\left(x^{2/3} + y^{2/3}\right) = \frac{d}{dx} 10$$

$$\frac{2}{3}x^{-1/3} + \frac{2}{3}y^{-1/3}y' = 0$$

$$y' = -\frac{x^{-1/3}}{y^{-1/3}} = -\frac{y^{1/3}}{x^{1/3}}$$

at $(x,y) = (-1, 27)$

$$\boxed{y' = -\frac{(27)^{1/3}}{(-1)^{1/3}} = 3}$$

$$\frac{d}{dx}\arctan(x) = \frac{1}{1+x^2}$$

$$\frac{d}{dx}\arcsin(x) = \frac{1}{\sqrt{1-x^2}}$$

3. Find dy/dx if $y = \arcsin(3x)$.

$$\frac{d}{dx}\arcsin(3x) = \frac{1}{\sqrt{1-(3x)^2}} \cdot \frac{d}{dx}(3x)$$

$$= \frac{3}{\sqrt{1-(3x)^2}}$$

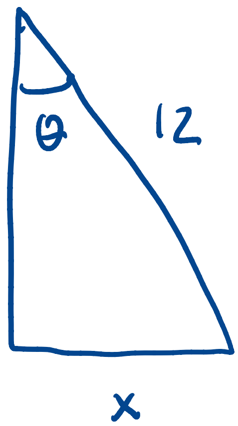
4. Find dy/dx if $y = \arctan\left(\sqrt{4-x^2}\right)$.

$$\frac{d}{dx}\arctan\left(\sqrt{4-x^2}\right) = \frac{1}{1+4-x^2} \cdot \frac{d}{dx}\sqrt{4-x^2}$$

$$= \frac{1}{5-x^2} \cdot \frac{1}{2\sqrt{4-x^2}} \cdot \underbrace{\frac{d}{dx}(4-x^2)}_{\to -2x}$$

$$= \frac{1}{5-x^2} \cdot \frac{-x}{\sqrt{4-x^2}}$$

5. A 12-foot ladder is leaning against a wall. Let x denote the distance of the base of the ladder from the wall, and let θ be the angle between the ladder and the wall. How fast does the angle θ change with respect to x?



$$x = 12 \sin\theta$$

$$\arcsin\left(\frac{x}{12}\right) = \theta$$

$$\frac{d\theta}{dx} = \frac{1}{12}\frac{1}{\sqrt{1-(x/12)^2}} = \frac{1}{\sqrt{12^2 - x^2}}$$

6. I compute that $d\theta/dx \approx 0.1$ when $x = 7$. What does this mean in language your parents can understand? Feel free to express your answer in terms of degrees instead of radians.

When the base of the ladder is 7 ft from the wall, the angle at the wall changes at a rate of $0.1 \frac{\text{rad}}{\text{foot}}$ as I change the distance of the base of the ladder from the wall. Note: $0.1 \frac{\text{rad}}{\text{foot}} = 0.1 \cdot \frac{360}{2\pi} \frac{\text{deg}}{\text{foot}}$

$\approx 5°/\text{foot}$