Find x in Degrees, not Radians

Date: 01/14/98 at 11:26:59
From: Ronny
Subject: Trigonometry/Derivatives

Hi Dr. Math,

I Just have one quick question. We have learned in Math class that the derivative of sin(x) is cos(x). My teacher said this implies that the x is in radians, not degrees. My teacher gave us a homework assignment and one of the problems is to find the derivative of sin(x) when x is in degrees, not radians. I have no idea how to prove this. Could you please help?

Thank you very very much in advance.

Mathematically Yours,
Ronny

Date: 02/10/98 at 15:45:01
From: Doctor Sonya
Subject: Re: Trigonometry/Derivatives

The key to this problem is the lim (sin x)/x
x->0

When you work in radians the answer is 1. Look back in your book to where they do the proof of that result. The important point is that if x is in radians, then for values of x close to 0, sin x and x are approximately the same.

You also need to verify what happens to (1 - cos x)/x as x-> 0 when x is in degrees. This one will still be 0, just as in radians.

Let's suppose, instead, that x is in degrees. Then sin x is approximately the same as x * Pi/180. This is because sin x is approximately equal to x. If we want to convert x from radians to degrees, we have to multiply x by Pi/180, so sin(x) = x(Pi/180). Therefore we see that for x in degrees,

$$\lim_{x\to 0} \frac{\sin x}{x} = \frac{Pi}{180}$$

Now, let's go to derivatives.

$$\frac{d(\sin x)}{dx} = \lim_{h\to 0}\frac{\sin(x+h) - \sin x}{h} = \lim_{h\to 0}\frac{\sin x\cos h + \sin h\cos x - \sin x}{h}$$

$$= \lim_{h\to 0}\cos x\,\frac{\sin h}{h} - \lim_{h\to 0}\sin x\,\frac{1-\cos h}{h} = \frac{\pi}{180}\cos x - \sin x\ (0)$$

$$= \frac{\pi}{180}\cos x$$

I hope this helps.

-Doctors Sonya and Fred, The Math Forum
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