§2.5 Questions: #s 19 – 21

19. 0/2 points SCalc8 2.5.076. [33

If the equation of motion of a particle is given by $s = A\cos(\omega t + \delta)$, the particle is said to undergo *simple harmonic motion*.

(a) Find the velocity of the particle at time t.

$s'(t) =$ ✗ $-A\omega\sin(\delta + \omega t)$

$$\frac{ds}{dt} = \frac{d}{dt}\left[A\cos(\omega t + \delta)\right]$$

(b) When is the velocity 0? (Use n as the arbitrary integer.)

$h(t) = f(g(t)) \Rightarrow$

$$\frac{dh}{dt} = \frac{df}{dg}\cdot\frac{dg}{dt}$$

$f(g) = A\cos(g) \Rightarrow \frac{df}{dg} = -A\sin(g)$

$g(t) = \omega t + \delta \Rightarrow \frac{dg}{dt} = \omega$

$h'(t) = -A\sin(\omega t + \delta)\cdot\omega$
$= -A\omega\sin(\omega t + \delta)$

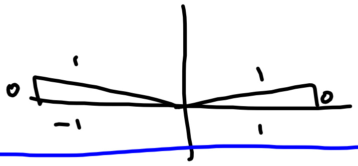
$$\underbrace{-A\sin(\omega t + \delta)}_{\text{derivative of cosine, outside wrt inside}}\cdot\underbrace{\omega}_{\text{derivative of inside wrt independent variable } t.}$$

(b) $\frac{ds}{dt} \overset{\text{SET}}{=} 0 \Rightarrow$

$-A\sin(\omega t + \delta) = 0 \Rightarrow$

$\sin(\omega t + \delta) = 0$

$\sim\sim + n\pi$



$$\boxed{\omega t + \delta = 0, \pi \in [0, 2\pi)}$$

$\Rightarrow \omega t = -\delta, \pi - \delta$

$t = \frac{-\delta}{\omega}, \frac{\pi - \delta}{\omega}$

Generally:

$\omega t + \delta = n\pi, n \in \mathbb{Z}$

$\omega t = n\pi - \delta, n \in \mathbb{Z}$

$t = \boxed{\frac{n\pi - \delta}{\omega}}, n \in \mathbb{Z}$

WebAssign.

Mills would want to see

$$t \in \left\{\frac{n\pi - \delta}{\omega} \,\middle|\, n \in \mathbb{Z}\right\}$$

$H(t) = 12 + 2.8 \sin\left(\frac{2\pi}{365}(t-80)\right)$

Period = 365

want $bt = 2\pi$ when $t = 365$:

Yeah, that makes sense.

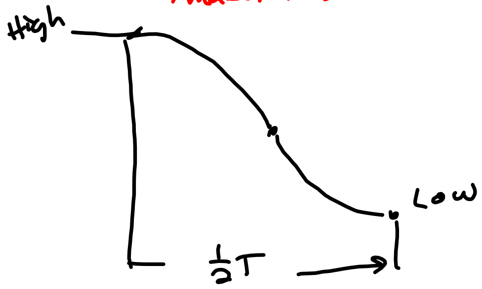
$365b = 2\pi$

$b = \frac{2\pi}{365}$

May 21 & June 15th

Find the rate of increase in Hours of Sun per day

$H'(t) = 2.8\cos\left(\frac{2\pi}{365}(t-80)\right) \cdot \frac{2\pi}{365}$



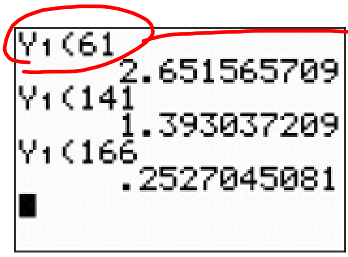
J F M A M
31 28 31 30 21

$t = 141$

J F M A M J
31 28 31 30 31 15

$t = 166$

$H'(141) = 2.8\cos\left(\frac{2\pi}{365}(141-80)\right) = 2.8\cos\left(\frac{2\pi}{365}(61)\right)$



No. $t = 141$.

18. 0/2 points

A table of values for f, g, f', and g' is given.

x	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
1	3	2	4	6
2	1	8	5	7
3	7	2	7	9

(a) If $h(x) = f(g(x))$, find $h'(3)$.

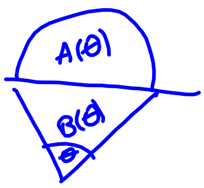
$h'(3) =$ ✖ 45

$h'(x) = f'(g(x))g'(x)$

$\left(\frac{df}{dg} \cdot \frac{dg}{dx}\right)\Big|_x$

$\Longrightarrow h'(3) = f'(g(3)) \cdot g'(3)$

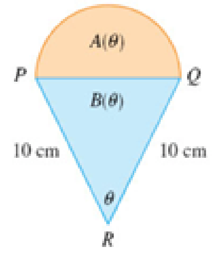
$= f'(2) \cdot 9 = 5 \cdot 9 = 45$

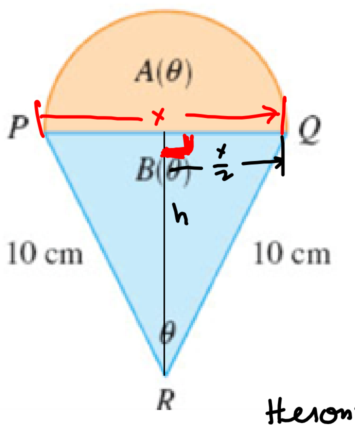


23. –/1 points SCalc8 2.4.056. My Notes Ask Your Teacher

A semicircle with diameter PQ sits on an isosceles triangle PQR to form a region shaped like a two-dimensional ice-cream cone, as shown in the figure. If $A(\theta)$ is the area of the semicircle and $B(\theta)$ is the area of the triangle, find

$$\lim_{\theta \to 0^+} \frac{A(\theta)}{B(\theta)}.$$





Need $x(\theta)$

$A(\theta) = \frac{1}{2}\left(\pi\left(\frac{x}{2}\right)^2\right) = \frac{\pi}{8}x^2$

$x = x(\theta) = ?$

$\frac{h}{10} = \cos\left(\frac{\theta}{2}\right)$ we don't have chain rule, yet. $\Rightarrow h = 10\cos\left(\frac{\theta}{2}\right)$ **A**

$h^2 + \left(\frac{x}{2}\right)^2 = 10^2$

$B(\theta) = \frac{1}{2}bh = \frac{1}{2}\left(\frac{x}{2}\right)h$ **B**

Heron's formula for Area of triangle

$\sqrt{s(s-a)(s-b)(s-c)}$

where $s = \frac{a+b+c}{2}$

A & **B** $\Rightarrow B(\theta) = \frac{1}{2}\left(\frac{x}{2}\right)\left(10\cos\left(\frac{\theta}{2}\right)\right)$

& $\frac{\frac{x}{2}}{10} = \sin\left(\frac{\theta}{2}\right) = \frac{x}{20} \Rightarrow$

$x = 20\sin\left(\frac{\theta}{2}\right)$

$\Rightarrow B(\theta) = \frac{1}{2}\left(\frac{20\sin\left(\frac{\theta}{2}\right)}{2}\right)\left(10\cos\left(\frac{\theta}{2}\right)\right)$

$= 50\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\theta}{2}\right)$

$A(\theta) = \frac{\pi}{8}x^2 = \frac{\pi}{8}\left(20\sin^2\left(\frac{\theta}{2}\right)\right) = \frac{5\pi\sin^2\left(\frac{\theta}{2}\right)}{2}$

$\Rightarrow \frac{A(\theta)}{B(\theta)} = \frac{\frac{\cancel{5}}{2}\pi\sin^2\left(\frac{\theta}{2}\right)}{\underset{10}{\cancel{50}}\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\theta}{2}\right)} = \frac{\pi}{20}\frac{\sin\left(\frac{\theta}{2}\right)}{\cos\left(\frac{\theta}{2}\right)}$ $\xrightarrow{\theta \to 0} 0$

Assuming I did this right!

$\frac{\pi}{2}\tan\left(\frac{\theta}{2}\right)$?

Not real sure.

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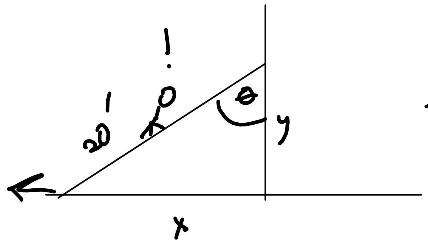

How fast is the end of the 20-ft ladder falling $\underbrace{\text{when } \theta = \frac{\pi}{4}}$?

with respect to θ

20-foot ladder.

want $\frac{dy}{d\theta}$

WebAssign wanted $\left.\frac{dx}{dt}\right|_{\theta=\frac{\pi}{3}}$

$$\frac{y}{20} = \cos\theta$$

$$y = 20\cos\theta$$

$$\left.\frac{dy}{d\theta}\right|_{\theta=\frac{\pi}{4}} = \left.-20\sin\theta\right|_{\theta=\frac{\pi}{4}} = -20\cdot\frac{\sqrt{2}}{2} = \boxed{-10\sqrt{2}}$$

$10\sqrt{2}$ is in what units? $\frac{ft}{radian}$!

$g(x) = (2x^2-5x)^5(\sin(x)+x^3)^{17}$

$\rightarrow g'(x) = 5(2x^2-5x)^4(4x-5)(\sin(x)+x^3)^{17} + (2x^2-5x)^5\left(17(\sin(x)+x^3)^{16}(\cos(x)+3x^2)\right)$

= Final Answer on hand-written test.