92. Harmonic Motion The displacement for equilibrium of an object in harmonic motion on the end of a spring is

$$y = \frac{1}{3}\cos(12t) - \frac{1}{4}\sin(12t)$$

where y is measured in feet and t is the time in seconds. Determine the position and velocity of the object when $t = \frac{\pi}{8}$.

position $y = \frac{1}{3}\cos\left(\frac{12\pi}{8}\right) - \frac{1}{4}\sin\left(12\frac{\pi}{8}\right)$

Velocity $\frac{dy}{dx} = \frac{1}{3}(-\sin(12t))(12) - \frac{1}{4}\cos(12t)(12)$

$= -4\sin(12t) - 3\cos(12t)\Big|_{t=\frac{\pi}{8}}$

Nov 9-11:46 AM

93. Pendulum A 15-centimeter pendulum moves according to the equation

$$\theta = 0.2\cos 8t$$

where θ is the angular displacement from the vertical in radians and t is the time in seconds. Determine the maximum angular displacement and the rate of change of θ when $t = 3$ seconds.

Nov 9-11:53 AM

94. Wave Motion A buoy oscillates in simple harmonic motion

$$y = A\cos\omega t \qquad \omega = \frac{2\pi}{x} = 10$$

as waves move past it. The buoy moves a total of 3.5 feet (vertically) from its low point to its high point. It returns to its high point every 10 seconds.

amp=1.75

period=10sec

a) Write an equation describing the motion of the buoy if it is at its high point at $t=0$.

$$y = 1.75\cos\left(\frac{\pi}{5}t\right)$$

b) Determine the velocity of the buoy as a function of t.

$$\frac{dy}{dx} = -1.75\sin\left(\frac{\pi}{5}t\right)\cdot\frac{\pi}{5} = -\frac{7\pi}{20}\sin\left(\frac{\pi}{5}t\right)$$

Nov 9-12:39 PM

95. Circulatory System The speed S of blood that is r centimeters from the center of the artery is

$$S = C(R^2 - r^2) = CR^2 - Cr^2$$

where C is a constant, R is the radius of the artery, and S is measured in centimeters per second. Suppose a drug is administered and the artery begins to dilate at a rate of dR/dt. At a constant distance r, find the rate at which S changes with respect to t for

$C = 1.76\times10^5$, $R = 1.2\times10^{-2}$, and $\frac{dR}{dt} = 10^{-5}$.

$$\frac{dS}{dt} = 2CR\frac{dR}{dt} - 0$$

$$\frac{dS}{dt} = 2(1.76\times10^5)(1.2\times10^{-2})(10^{-5})$$

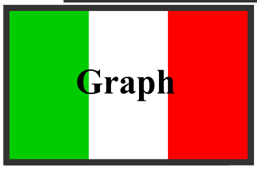
Nov 9-12:44 PM

96. Modeling Data The normal daily maximum temperature T (in degrees Fahrenheit) for Denver, CO is shown in the table.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	43.2	46.6	52.2	61.8	70.8	81.4	88.2	85.8	76.9	66.3	52.5	44.5

a) use a graphing utility to plot the data and find a model for the data of the form $a + b\sin\left(\frac{\pi}{6}t - c\right)$ where T is the temperature and t is the time in months, t=1→Jan.

b) Graph the model:



How well does it fit the data?

c) Find T' and graph the derivative:

d) During what times does the temperature change most rapidly? Most slowly?
Do your answers agree with personal observations of the temperature changes? Explain.

Nov 9-12:56 PM

97. Modeling Data The cost of producing x units of a product is
For one week management determined the number of units produced at the end of t hours during an 8-hour shift. The average values of x for the week are shown in the table.

t	0	1	2	3	4	5	6	7	8
x	0	16	60	130	205	271	336	384	392

(a) Fit a cubic model to the data.

(b) Use the Chain Rule to find dC/dt.

(c) Explain why the cost function is not increasing at a constant rate during the 8 hour shift.

Nov 12-8:54 AM

104) $|u| = \sqrt{u^2}$ $\qquad u = F(x)$

$$\frac{d|u|}{dx} = \frac{1}{2\sqrt{u^2}} \cdot 2u\frac{du}{dx} = \frac{\cancel{2}u}{\cancel{2}|u|}\frac{du}{dx}$$

105) $g(x) = |2x-3|$

$$g'(x) = \frac{2x-3}{|2x-3|}(2) \quad \text{or} \quad \begin{cases} 2 & x > \frac{3}{2} \\ -2 & x < \frac{3}{2} \end{cases}$$

Nov 10-11:27 AM