$Q(x) = \cos(6w) - 6\cos(w)$

No x's $\Rightarrow$ is constant wrt x.

A clever student might assume $w = w(x)$

$\Rightarrow \dfrac{dQ}{dx} = (-\sin(6w))(6w') + (6\sin(w))w'$

by chain rule.

I was looking for $Q'(x) = 0$,

but this would've been bonus

TEST IS MONDAY

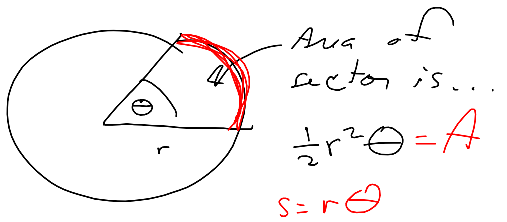
IN CLASS.

The radius of a disk is 5 cm $\pm .2$ cm.

Use a differential to approximate the error in the calculated area.

$A = \pi r^2 = \frac{1}{2}(2\pi) r^2 = \frac{1}{2}\theta r^2$

$\theta = 2\pi$



$C = 2\pi r$

$\theta = 2\pi$, so $C = \theta r$ = arc length.

$A = \pi r^2$

$\frac{dA}{dr} = 2\pi r$

Related Rates

Radius is expanding @ 5 cm/sec

How fast is area growing?

$A = \pi r^2$

$\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$

$= 2\pi(5)(5)$

$\Delta A = dA = 2\pi r\, dr = 2\pi(5)(\pm .2) = \pm 2\pi$

a

$\begin{array}{r} \overset{2}{.2} \\ \hline .4 \end{array}$ $(.4)(5) = 2.0$

Change in y is rate of change in y wrt a change in x times the change in x.

$y = m(x - x_1) + y_1$ $\quad dx = \Delta x$

$y - y_1 = m(x - x_1)$

$\Delta y = m\,\Delta x \approx f'(x_1)\Delta x = f'(x_1)\,dx$

b Relative error:

$\frac{\Delta A}{A} \approx \frac{dA}{A} = \frac{\pm 2\pi}{25\pi} = \pm\frac{2}{25} = \pm .8$

c % error: $\pm 80\%$

$f(x) = x^3 - 6x^2 + 15x - 7$

has no tangent line w/ a slope of $m = -2$

This is saying $f'(x) = -2$ is impossible.

Assume that there IS a place (x-val) where the slope of the tangent line is $m = -2$

$f'(x) = 3x^2 - 12x + 15 \overset{SET}{=} -2$

$$\begin{array}{r} 17 \\ \underline{12} \\ 34 \\ \underline{170} \\ 204 \end{array}$$

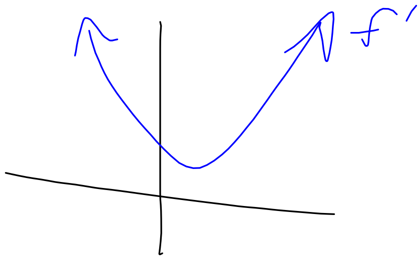
$\Rightarrow 3x^2 - 12x + 17 = 0$

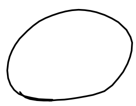
$\Rightarrow b^2 - 4ac = (-12)^2 - 4(3)(17)$

$= 144 - 204 < 0 \longrightarrow$

No real sol'ns.

$\Rightarrow \nexists\, x \ni f'(x) = m_{tan} = -2.$





2.7 #2

1–4 A particle moves according to a law of motion $s = f(t)$, $t \geqslant 0$, where t is measured in seconds and s in feet.

(a) Find the velocity at time t.
(b) What is the velocity after 1 second?
(c) When is the particle at rest?
(d) When is the particle moving in the positive direction?
(e) Find the total distance traveled during the first 6 seconds.
(f) Draw a diagram like Figure 2 to illustrate the motion of the particle.
(g) Find the acceleration at time t and after 1 second.
(h) Graph the position, velocity, and acceleration functions for $0 \leqslant t \leqslant 6$.
(i) When is the particle speeding up? When is it slowing down?

1. $f(t) = t^3 - 9t^2 + 24t$ **2.** $f(t) = 0.01t^4 - 0.04t^3$

t = time in seconds
f = position left/right, in feet.

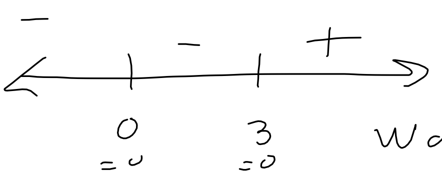
a) $f'(t) = .04t^3 - .12t^2$

b) $f'(1) = .04 - .12 = -.08$

c) $f'(t) \overset{\text{SET}}{=} 0 \Rightarrow t^2(.04t - .12) = 0$

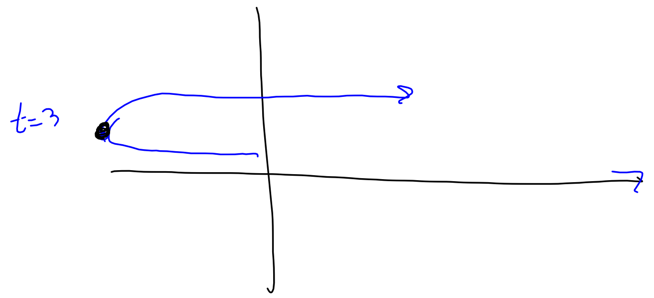
d) $t = 0, \quad .04t = .12$

$t = \frac{.12}{.04} = 3 = t$



$\underline{.04t^3 - .12t^2} = f'(t)$

Want $f'(t) > 0$
$\Rightarrow t > 3$



$f(t) = .01t^4 - .04t^3$
$= t^3(.01t - .04) \overset{\text{SET}}{=} 0 \Rightarrow t = 0, 4$

$f'(t) = .04t^3 - .12t^2$
$= t^2(.04t - .12) \overset{\text{SET}}{=} 0 \Rightarrow t = 0, t = 3$

$$f''(t) = .12t^2 - .24t$$
$$= t[.12t - .24] \overset{\text{set}}{=} 0$$

$$\Rightarrow t = 0, 2$$