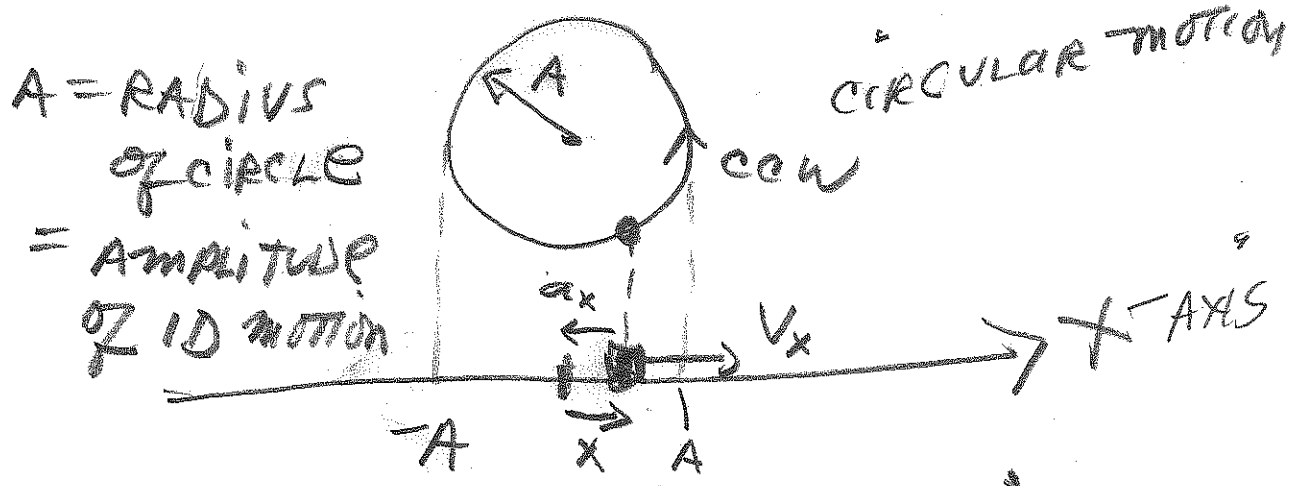
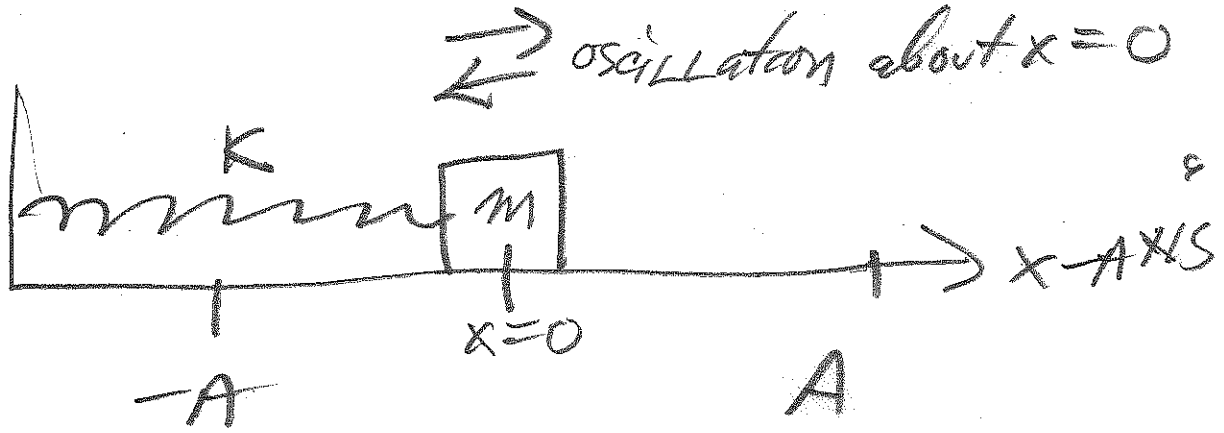
Yin yang sign (my website)

unity of "opposites"



1D SHM = projection of a circular 2D path on "ground"



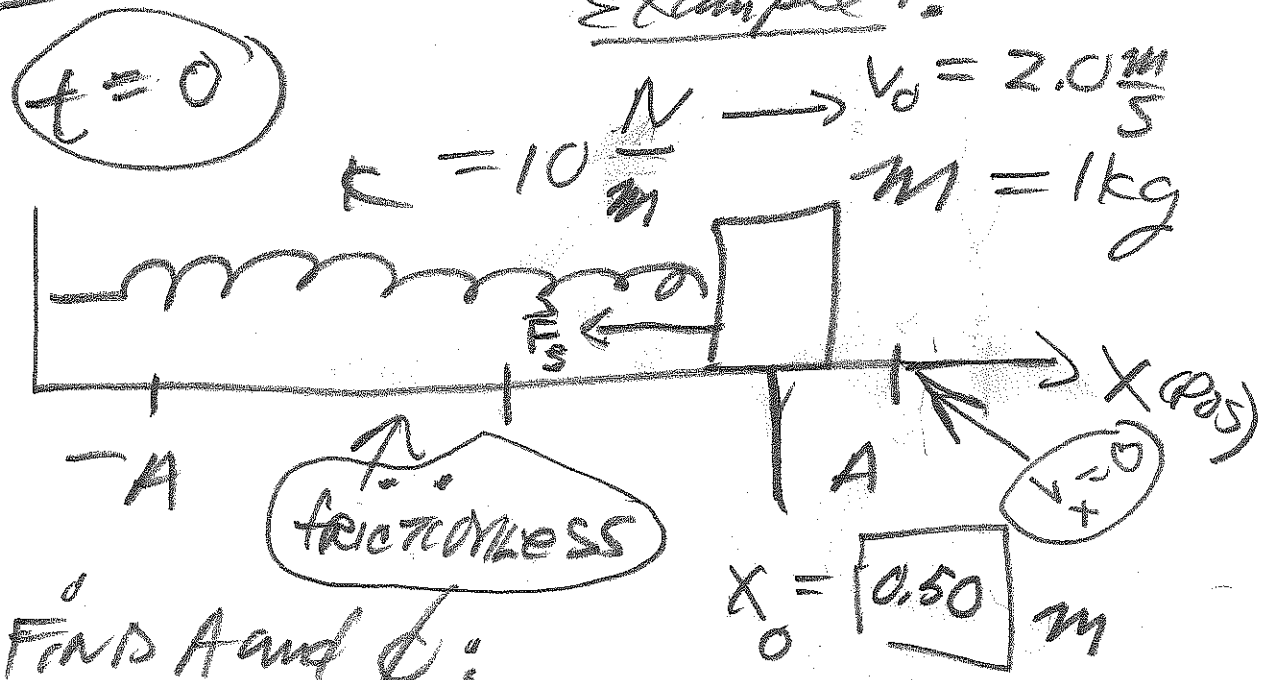
$x = A\cos(\omega t + \phi)$; 2 UNKNOWNS: A, ϕ.

$\frac{d^2x}{dt^2} = -\frac{k}{m}x$: 2ND ORDER DIFFERENTIAL EQN.

Summary Ch 14 ; masteringphysics.com

Q11 (short)

Example 1:



Find A and f:

conservation of Energy for A.

Ch 7 $\frac{1}{2}mv_x^2 + \frac{1}{2}kx^2 = \text{constant}$

$$\frac{1}{2}mv_{ix}^2 + \frac{1}{2}kx_i^2 = \frac{1}{2}mv_{fx}^2 + \frac{1}{2}kx_f^2$$

Pick: $x_f = \pm A \Rightarrow v_{fx} = 0$

$$i: t=0;\ \frac{1}{2}mv_0^2 + \frac{1}{2}kx_0^2 = \frac{1}{2}kA^2$$

$$\rightarrow \frac{1}{2}(1)(2.0)^2 + \frac{1}{2}(10)(0.50)^2 = \frac{1}{2}(10)A^2$$

$$2 + 1.25 = 5A^2$$

$$3.25 = 5 \cdot A^2$$

$$A = \pm\sqrt{\frac{3.25}{5}}$$

$$= 0.80\,G$$

$$\approx 0.81\,(m)$$

FIND ϕ:

$$X_0 = X(0) = A\cos(\omega t + \phi) \qquad t = 0$$

$$X_0 = A\cos(0 + \phi)$$

$$\boxed{X_0 = A\cos\phi}$$

$$\left.\frac{dx}{dt}\right|_{t=0} = V_0 = -\omega A\sin(\omega t + \phi)$$

$$\boxed{V_0 = -\omega A\sin\phi}$$

$0.50\,m = A\cos\phi$

$2.0\,\frac{m}{s} = -\omega A\sin\phi$

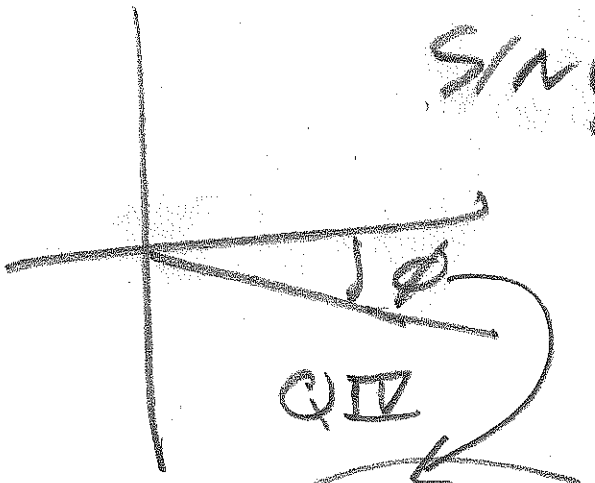
FIND ϕ

$$\cos\phi = \frac{0.50\,m}{A}$$

$$\sin\phi = -\frac{2.0\,m/s}{\omega A}$$

$\cos\phi > 0$

$\sin\phi < 0$



$\phi = -52°$

FIND ϕ_R = related angle

$0.50 = A\cdot\cos\phi_R$

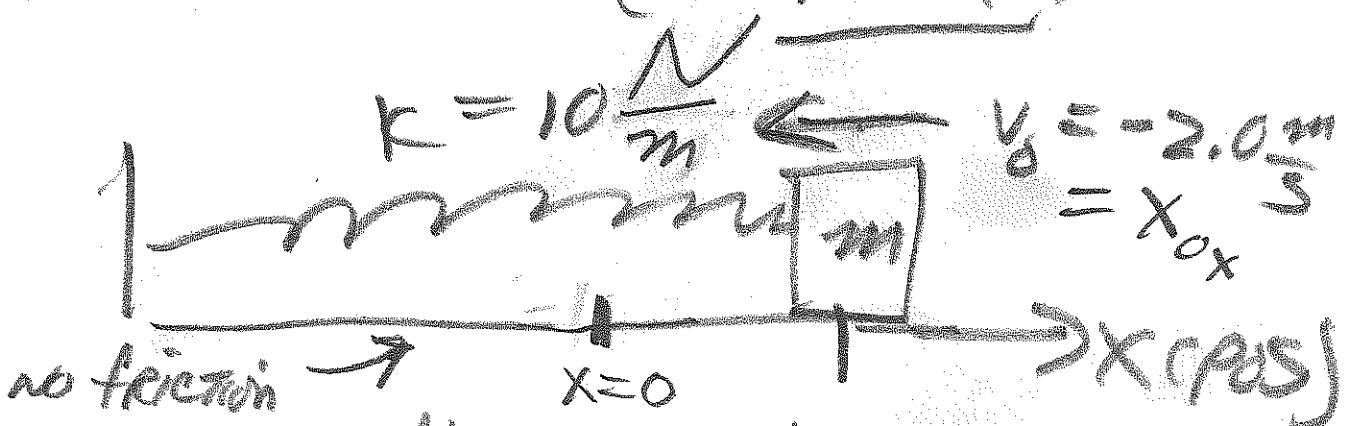
$\phi_R = \cos^{-1}\left(\frac{0.50}{A}\right)$

$\phi_R = \cos^{-1}\left(\frac{0.50}{0.81}\right) =$ **52°**

TIP:

Example 2:

TRY THIS @ HOME:



$m = 1\,kg$ $\quad x_0 = 0.50\,m$

Move: same A as previous example 1 (test 3?)

SAME A, BUT opposite ϕ.

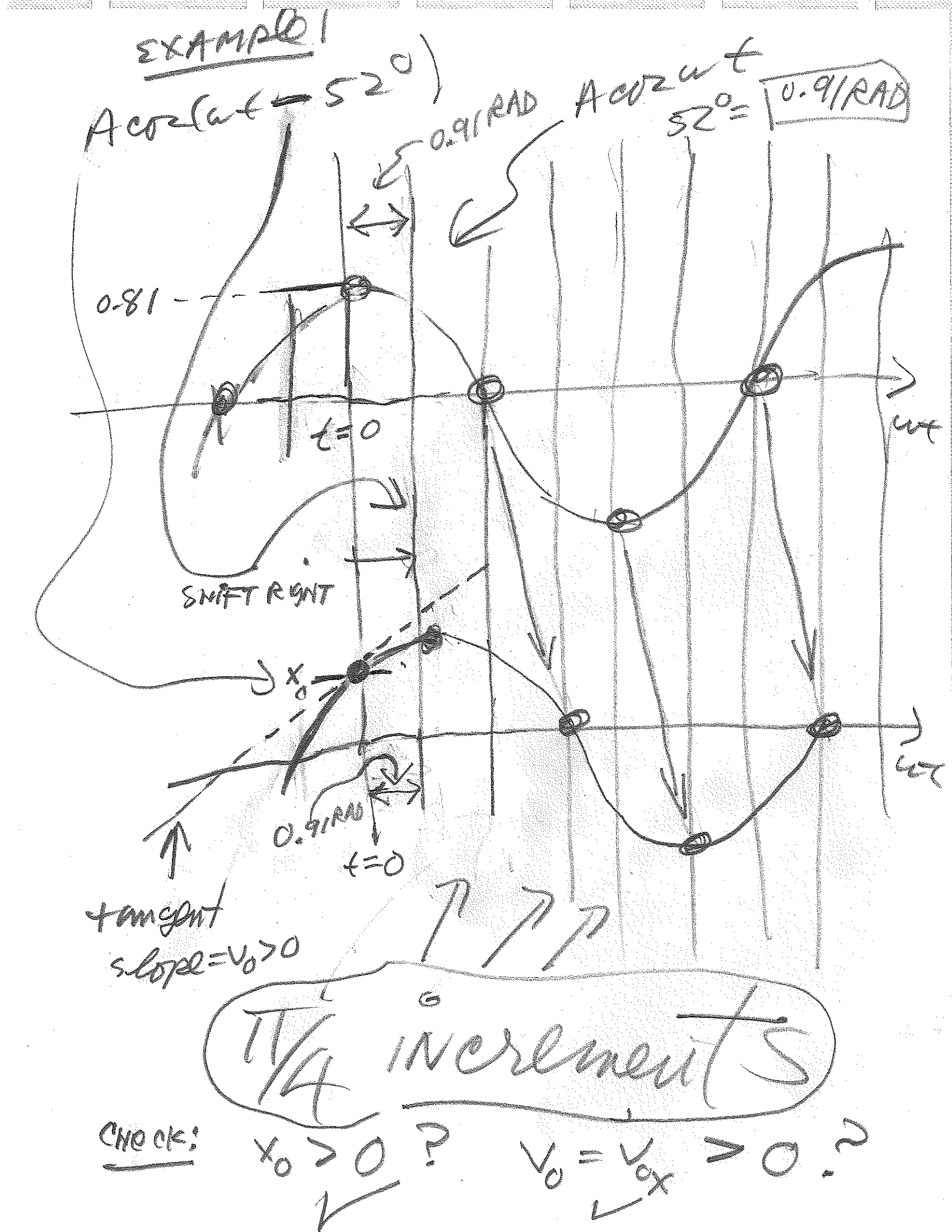
Example 1

$$x = 0.81 \cdot \cos(\omega t - 52^\circ)$$

(52° CONVERT TO RAD.)

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{10\,N/m}{1\,kg}} = 3.13 \frac{RAD}{s}$$

USE RAD


EXAMPLE 1
$A\cos(\omega t - 52^\circ)$
$A\cos\omega t$
$52^\circ = 0.91$ RAD
0.91 RAD
0.81
$t=0$
ωt
SHIFT RIGHT
x_0
0.91 RAD
$t=0$
ωt
tangent
slope $= v_0 > 0$
$\pi/4$ increments
CHECK: $x_0 > 0$? ✓
$v_0 = v_{0x} > 0$? ✓

$52^\circ \approx \pi/4$ rad

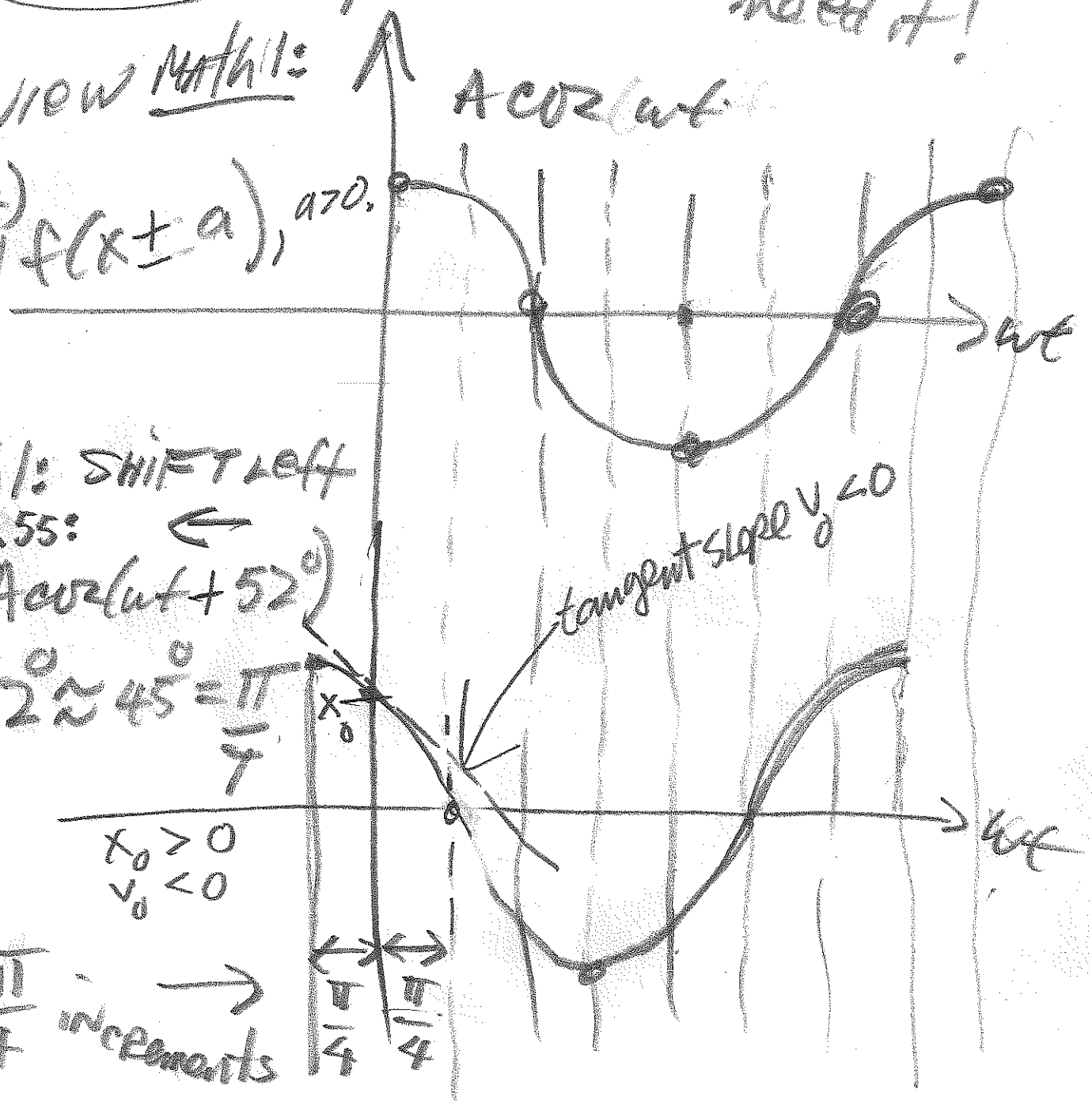
APPROXIMATION

BUT we need it!

Example

Review Math II:

$f(x)$ and $f(x \pm a)$, $a > 0$.



test 3 – 3 weeks

from Monday (April 24th)

Quiz 10, Quiz 11, Quiz 12, Quiz 13

CH8, CH9, CH10