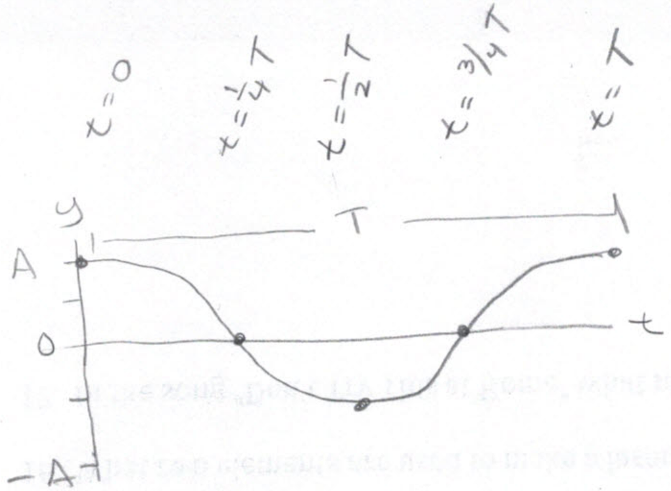
14.3

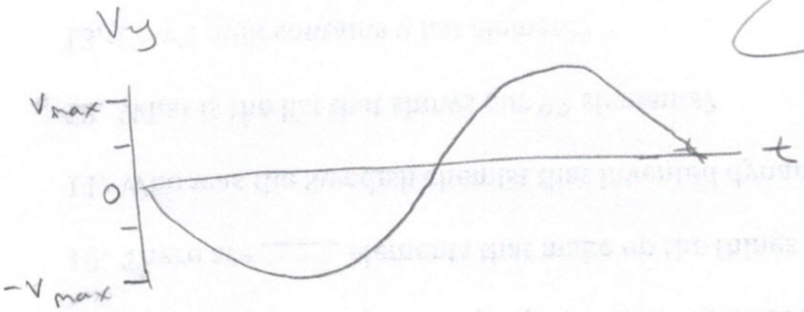
$x(t) = A\cos\left(\frac{2\pi t}{T}\right)$

$x(t) = A\cos(2\pi f t)$



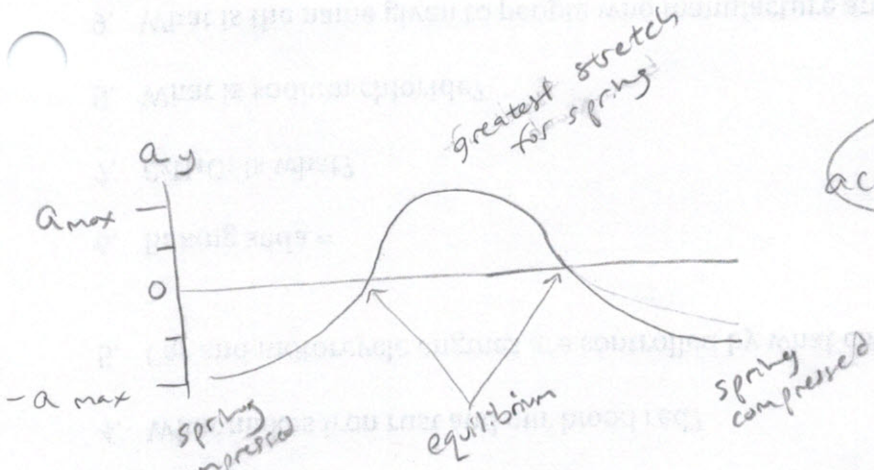
position graph

← 0 = equilibrium



velocity graph

☆ when velocity is a maximum, acceleration is zero. when acceleration is zero, velocity is a max.



acceleration graph

position-vs-time graph (cosine curve)

object's position $x(t) = A\cos\left(\frac{2\pi t}{T}\right)$ — $f = \frac{1}{T}$

or

$x(t) = A\cos(2\pi f t)$ ← in radians

velocity graph (upside down sine)

$v_x(t) = -v_{max}\sin\left(\frac{2\pi t}{T}\right)$

or

$= -v_{max}\sin(2\pi f t)$

↑ needed to turn the sine function upside down (p. 444, 14.12)

acceleration graph

$a_x = \frac{(F_{net})_x}{m}$

or

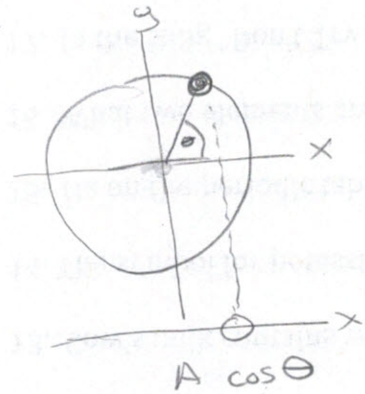
$a_x = -\frac{k}{m}x$

$a_x(t) = -a_{max}\cos\left(\frac{2\pi t}{T}\right) = -a_{max}\cos(2\pi f t)$

↑ needed to turn the cosine function upside-down (p. 444, 14.14)

Uniform circular motion projected onto one dimension is simple harmonic motion

14.2a



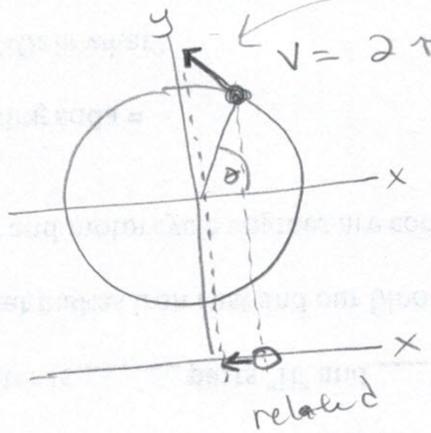
$x = A \cos\theta$

if ball starts from $\theta_0 = 0$ at $t = 0$
it's angle at a later time
is $\theta = \omega t$

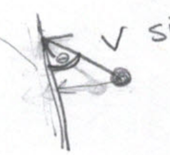
angular velocity

$\omega = 2\pi f$

so, $x(t) = A \cos(2\pi f t)$

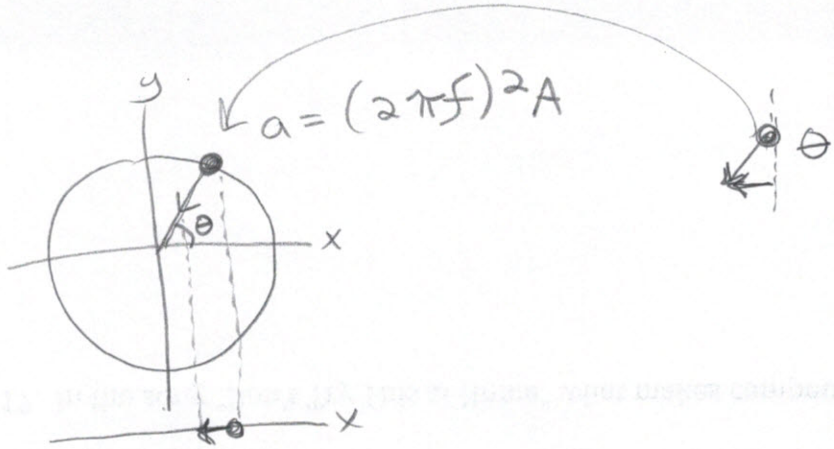


$v = 2\pi f A$



$$v_x = -v \sin\theta$$
$$= -(2\pi f) A \sin(2\pi f t)$$

$$v_{max} = 2\pi f A$$



$a\cos\theta$

$$a = \frac{v^2}{A}$$ centripetal acceleration

$$a = (2\pi f)^2 A$$

acceleration for SHM

$$a_x = -a\cos\theta = -(2\pi f)^2 A \cos(2\pi f t)$$

max. acceleration

$$a_{max} = (2\pi f)^2 A$$