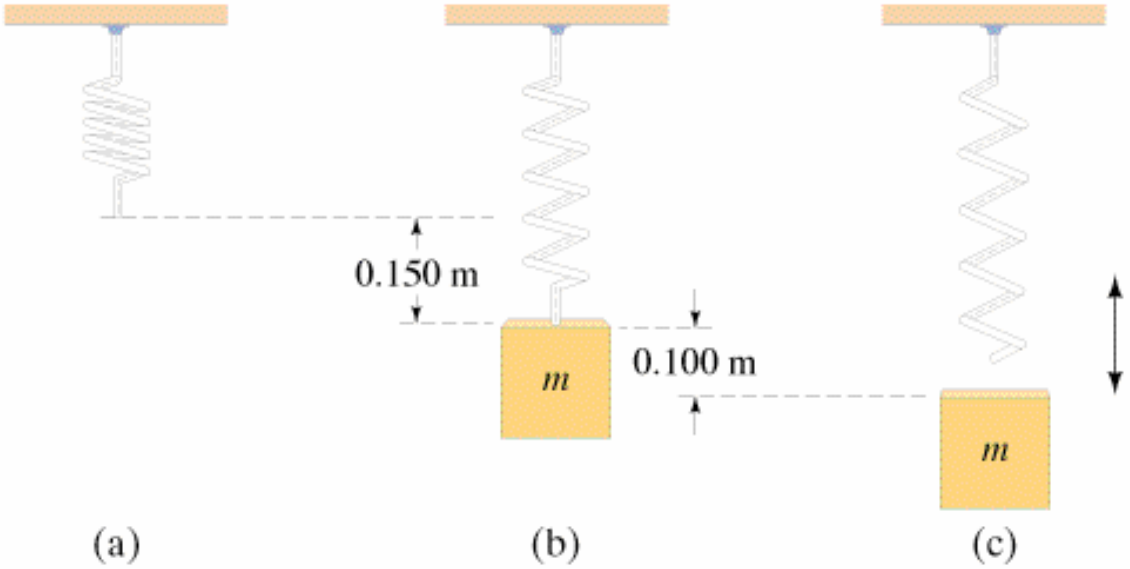
Doubling Amplitude

E?	$\sim A^2$,	x 4
v_0?	$\sim A$,	x 2
F_{max}?	$\sim A$,	x 2

Problem:



k?

A?

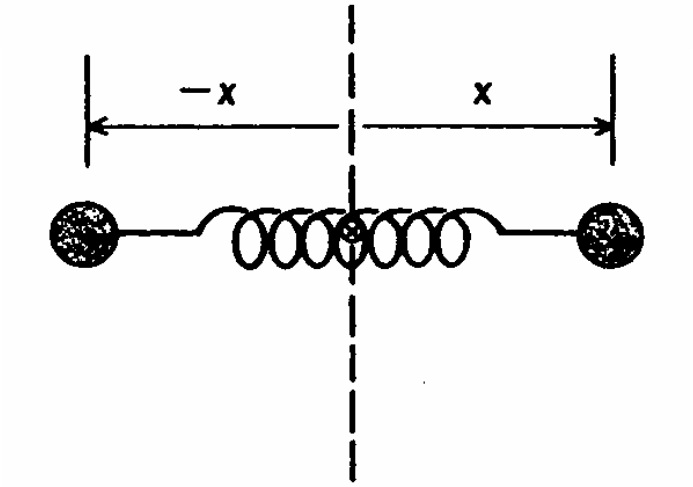
v_0?

v at 0.05m
from Eql. Posi.?

a_{max}?

H_2 Molecule

EXAMPLE 3. The hydrogen molecule (H_2) may be regarded as two masses joined by a spring (Figure 15.12). The center of the spring (center of mass) can be regarded as fixed, so the molecule consists of two identical simple harmonic oscillators vibrating in opposite directions. The spring constant of each oscillator is 1.1×10^3 N/m and the mass of each oscillator is 1.67×10^{-27} kg. Suppose that the vibrational energy of the molecule is 1.3×10^{-19} J. Find the corresponding amplitude of oscillation and the maximum velocity.



11-3. SHM Period

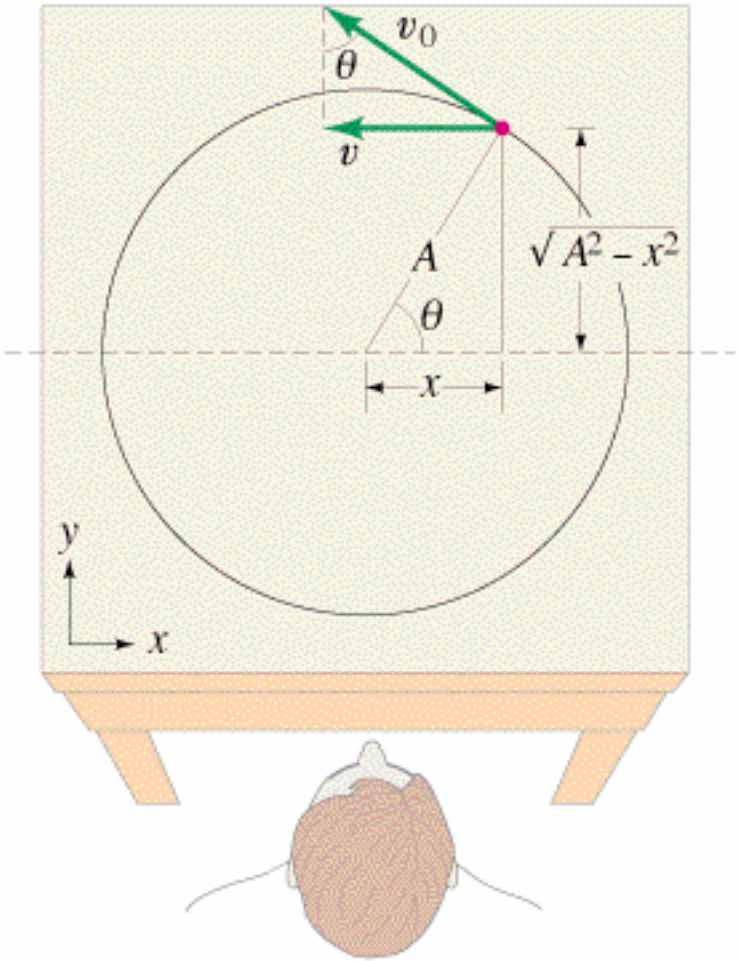
Does it depends on

Amplitude? NO!

Mass? YES!
Bigger ***m***, longer ***T***

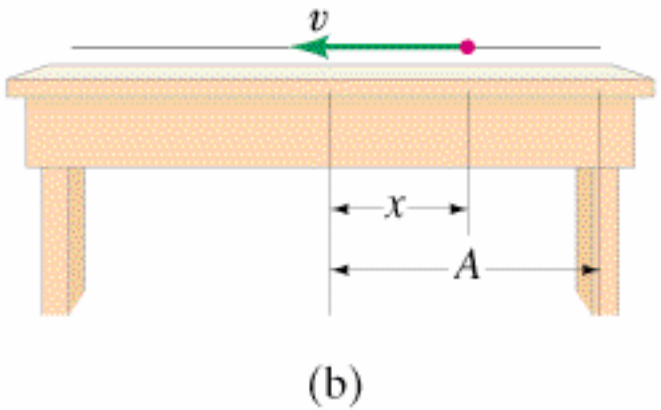
Spring Constant? YES!
Bigger ***k***, shorter ***T***

Analogy to constant-speed circular motion



Radius of reference circle: A

v is projection of v_0 onto x-axis



Period

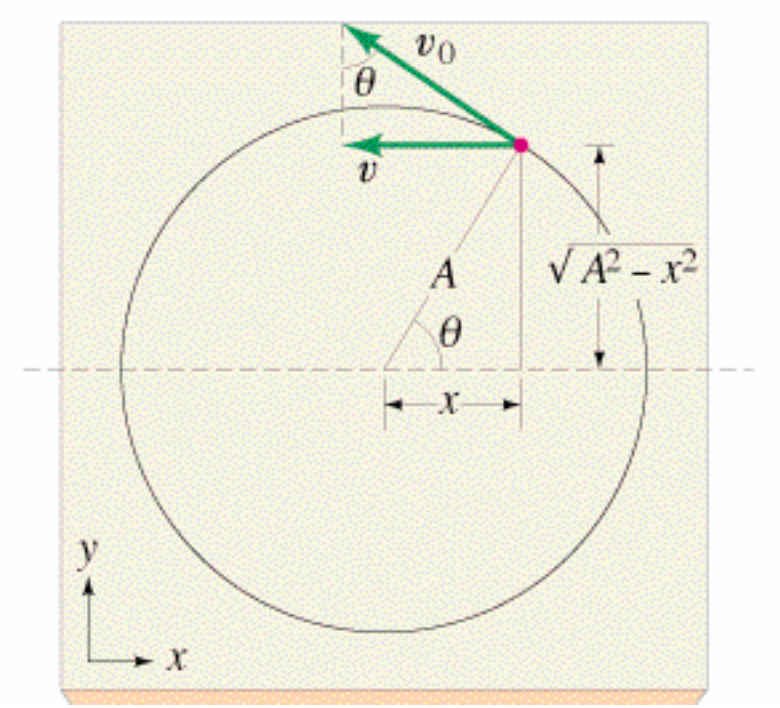
$$T = \frac{2\pi A}{v_0}$$

Since $v_0 = \sqrt{\frac{k}{m}} A$

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

Position of Oscillator

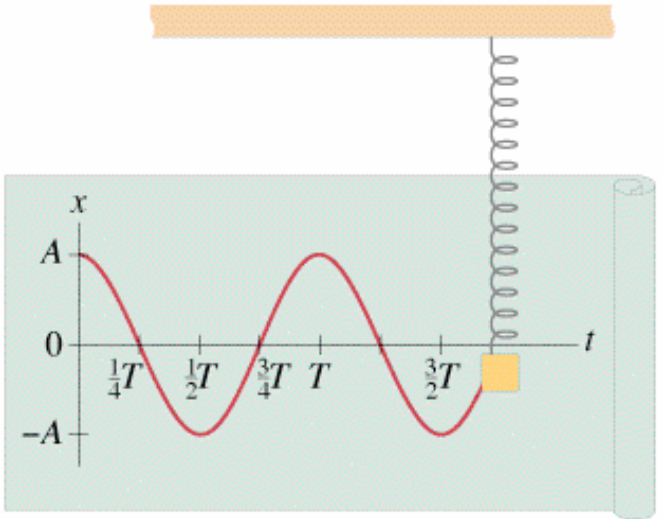


$\cos\theta = x/A$ $\qquad$ $\theta = \omega t$

ω - angular velocity (radians / s)

$= 2\pi f$

$= 2\pi / T$

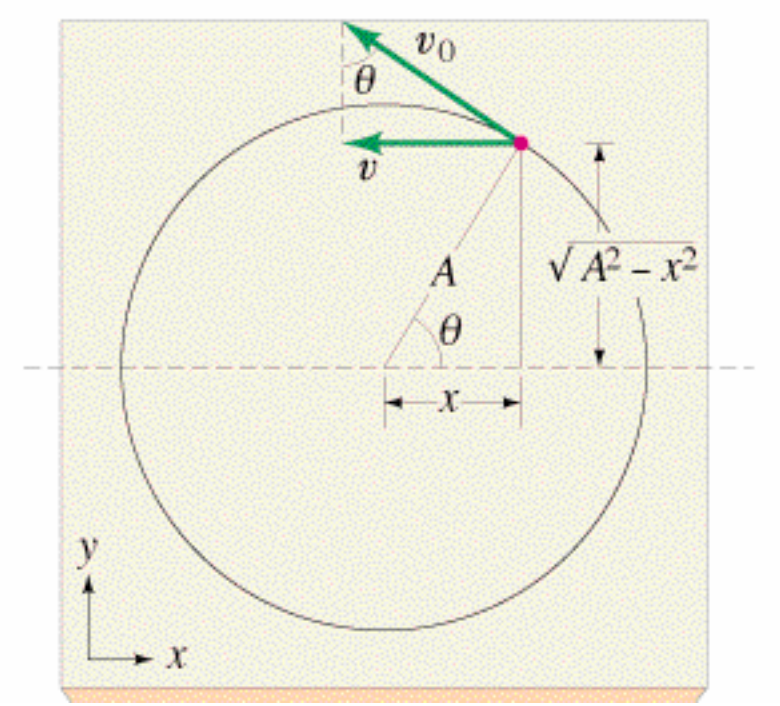


$x = A\cos\theta$

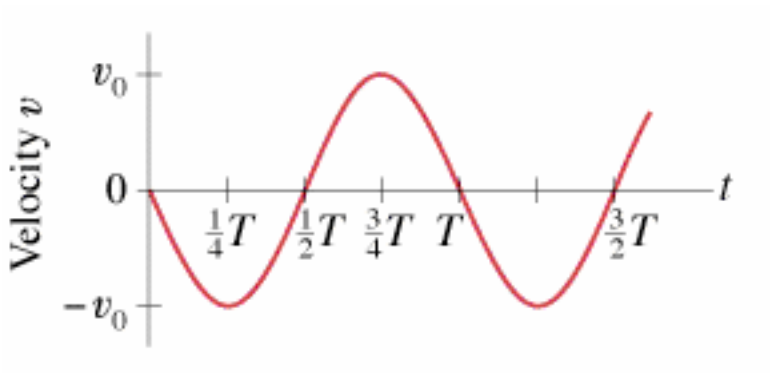
$= A\cos\ \omega t$

$= A\cos(2\pi t / T)$

Velocity of Oscillator

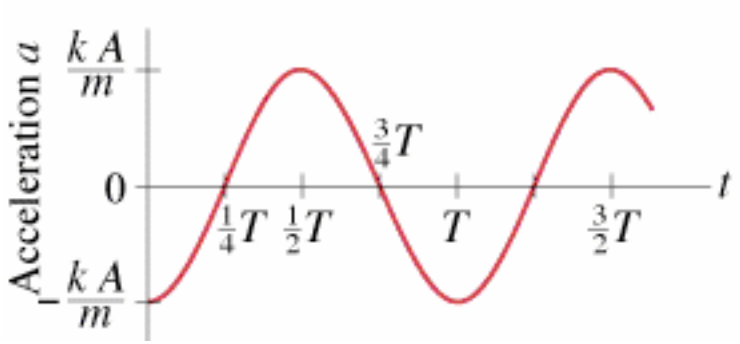


$$v = -v_0 \sin\theta$$
$$= -v_0 \sin\omega t$$
$$= -v_0 \sin(2\pi t/T)$$

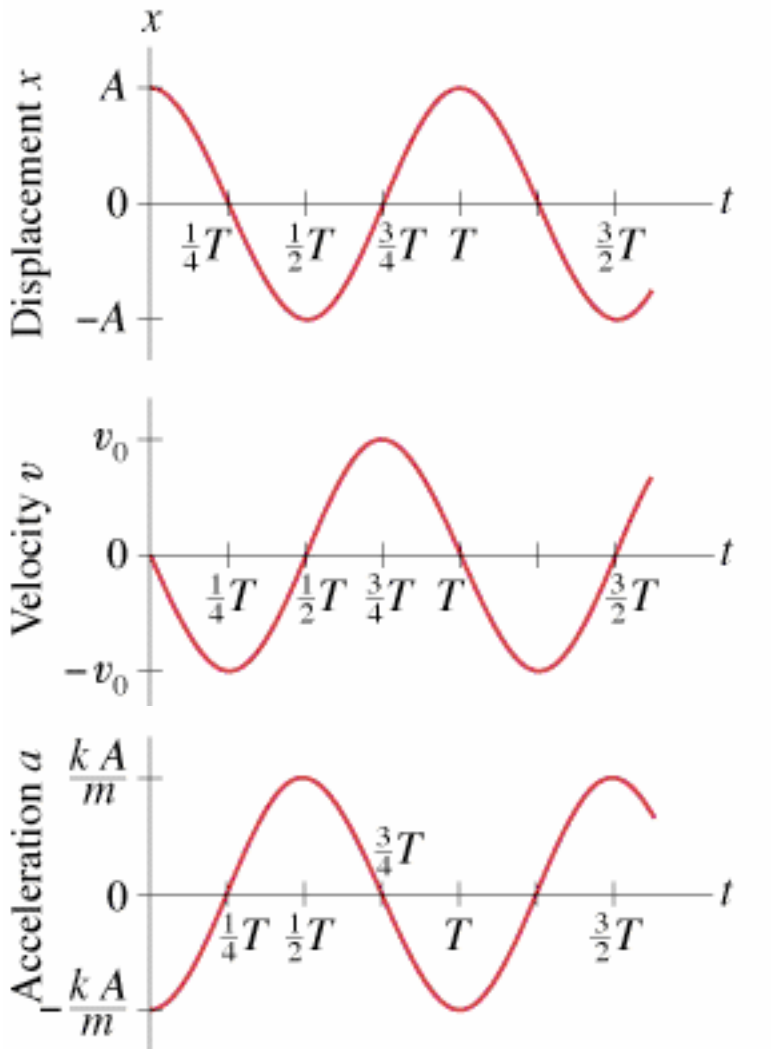


Acceleration of Oscillator

$$a = \mathrm{F/m}$$
$$= -kx/m$$
$$= -(k\mathrm{A/m})\cos(2\pi \mathrm{t}/T)$$
$$= -a_0 \cos(2\pi \mathrm{t}/T)$$



Simple Harmonic Motion

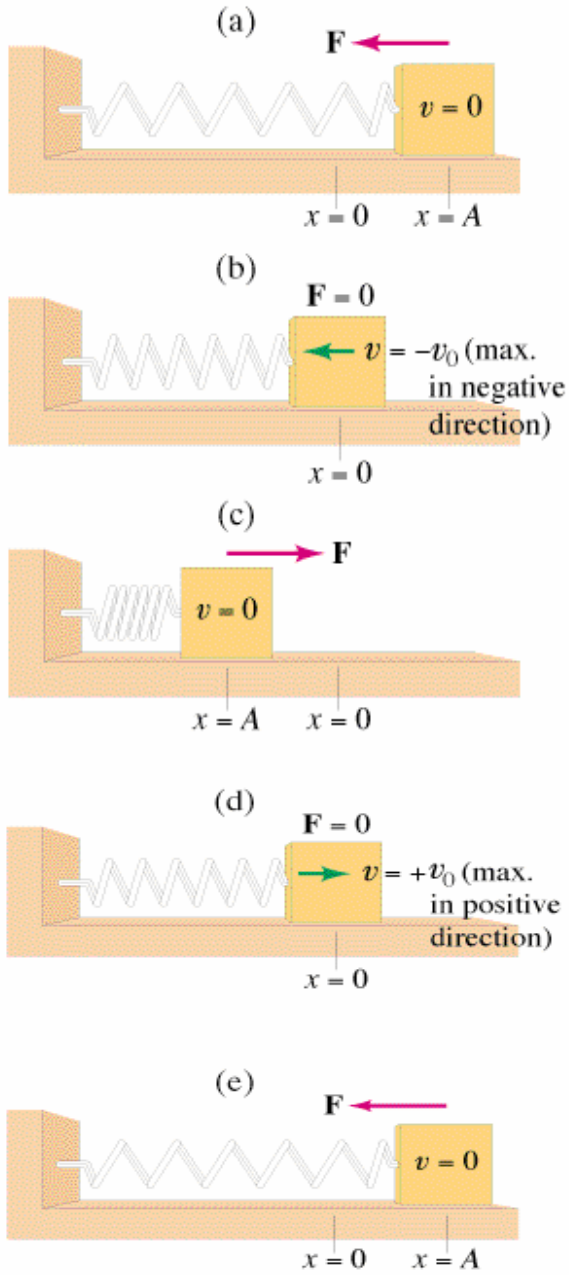


$x = A\cos(2\pi t/T)$

SHMs are sinusoidal

$v = -v_0 \sin(2\pi t/T)$

$a = -a_0 \cos(2\pi t/T)$



	x	***v***	***F***	***E***
t= 0	A,	0,	-kA,	$kA^2/2$
t= T/4	0,	$-v_0$,	0,	$mv_0^2/2$
t= T/2	-A,	0,	kA,	$kA^2/2$
t= 3T/4	0,	v_0,	0,	$mv_0^2/2$
t= T	A,	0,	-kA,	$kA^2/2$