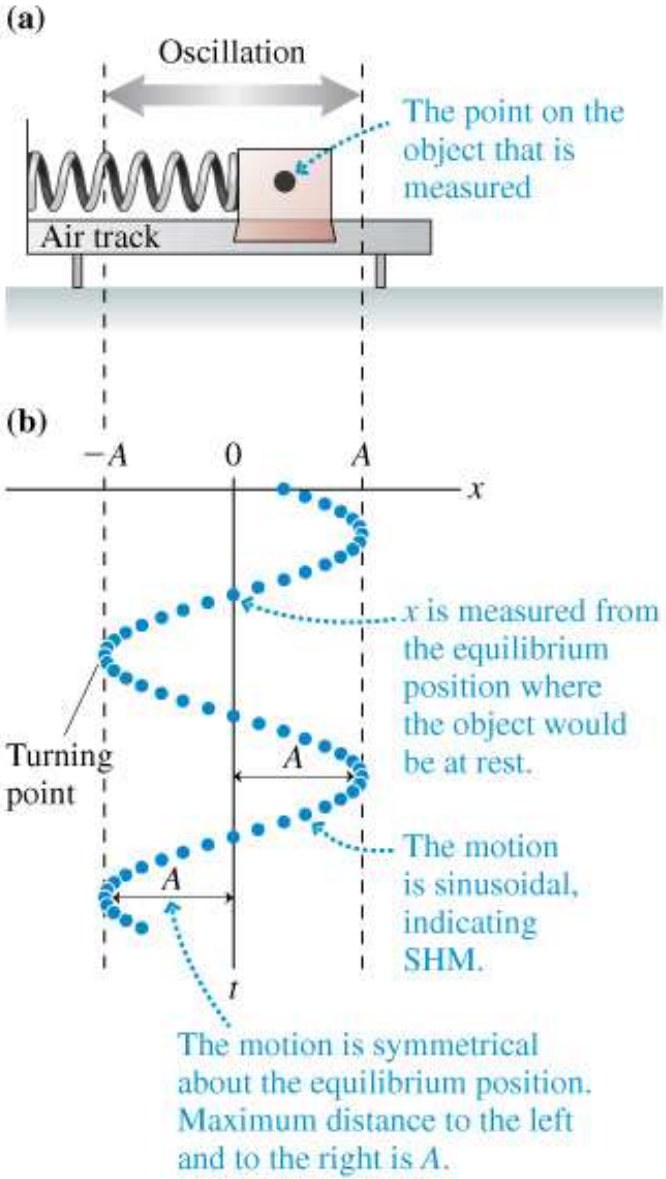
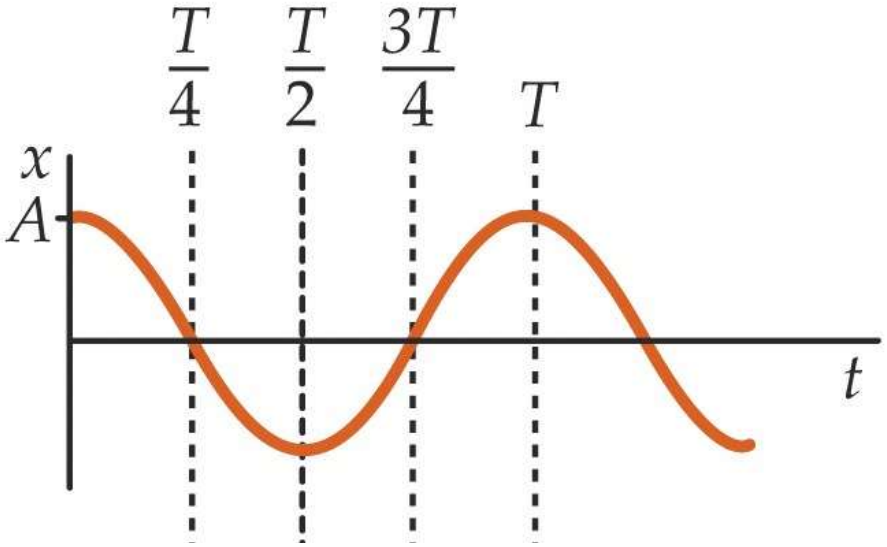




Questions

Equations of SHM

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

A – amplitude, ω – angular frequency,

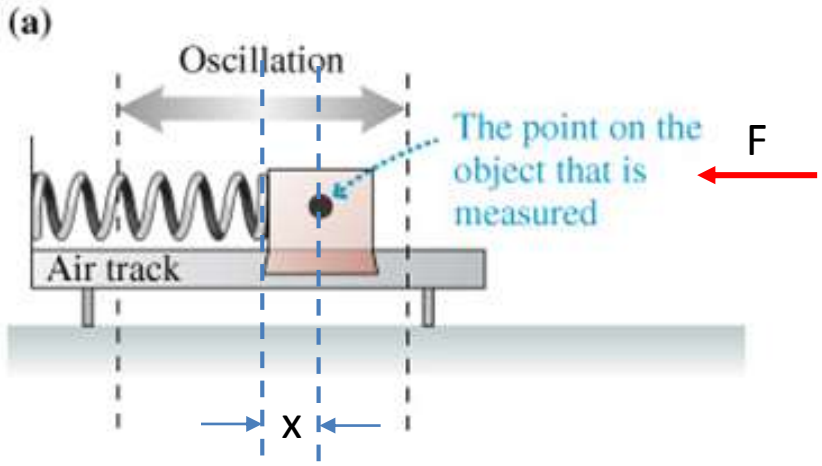
T – period, ϕ – phase constant

Equilibrium is x = 0

$v(t) = -\omega A\sin(\omega t + \phi)$ $v_{max} = \omega A$

$a(t) = -\omega^2 A\cos(\omega t + \phi)$ $a_{max} = \omega^2 A$

ω From Physical Principles

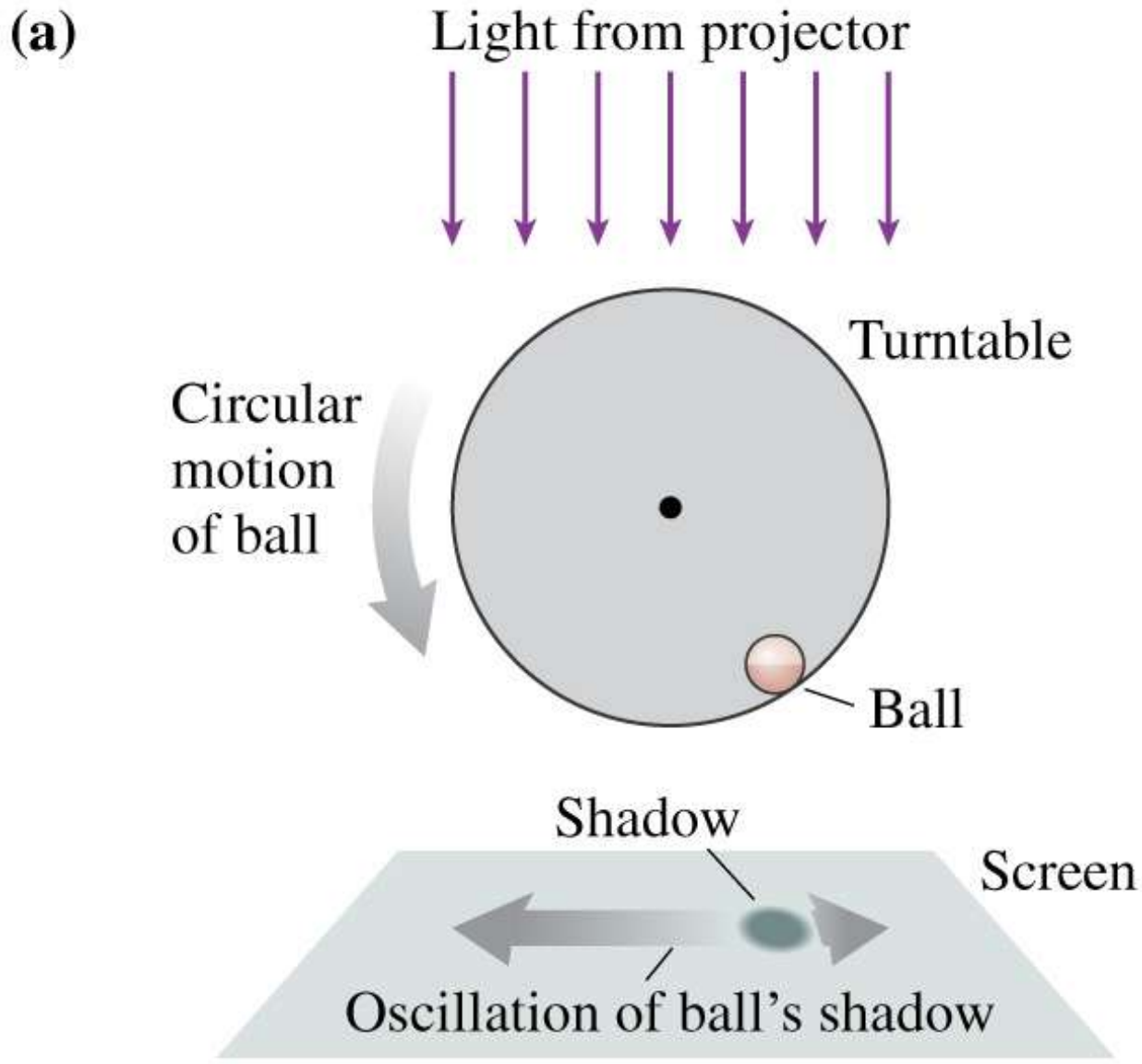


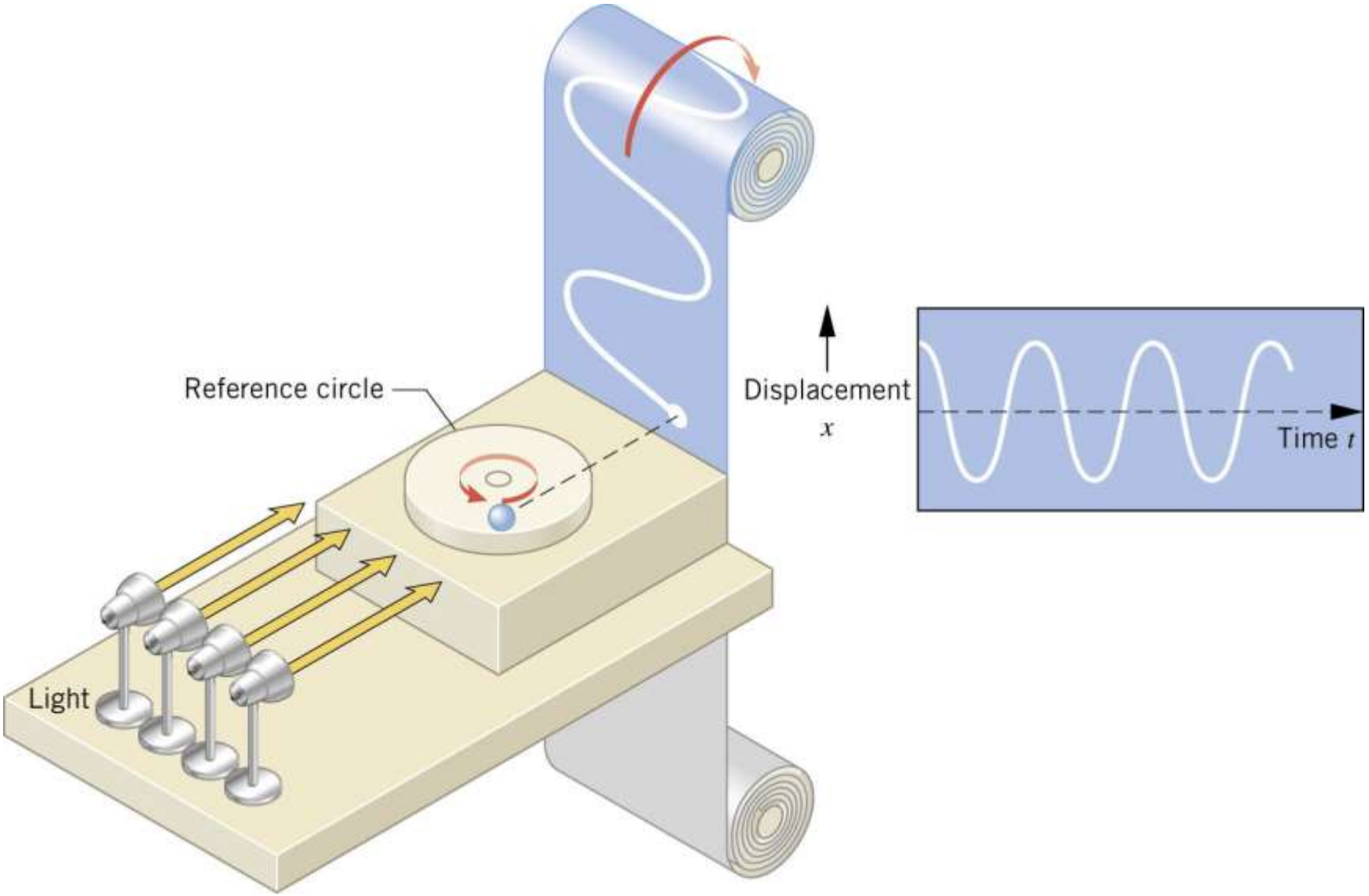
By NII, $-kx(t) = ma(t)$

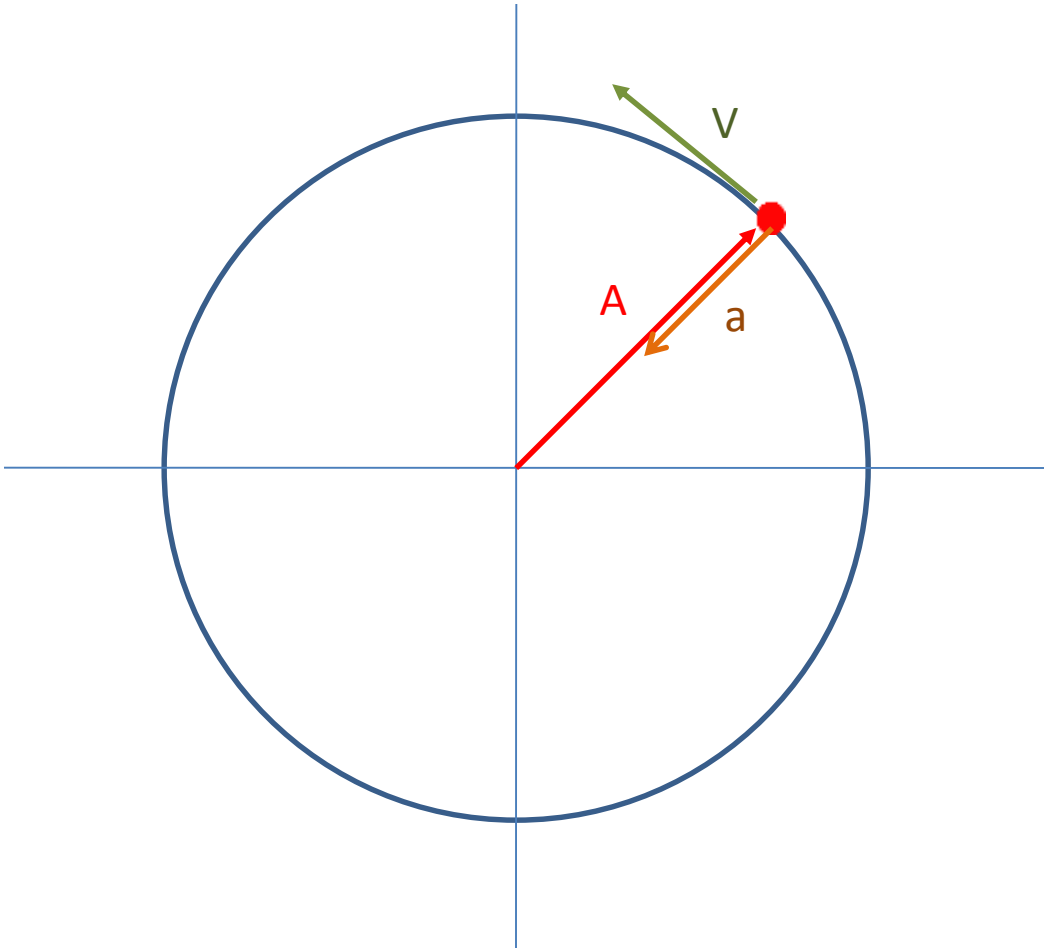
$-kA\cos(\omega t + \phi) = -m\,\omega^2 A\cos(\omega t + \phi)$

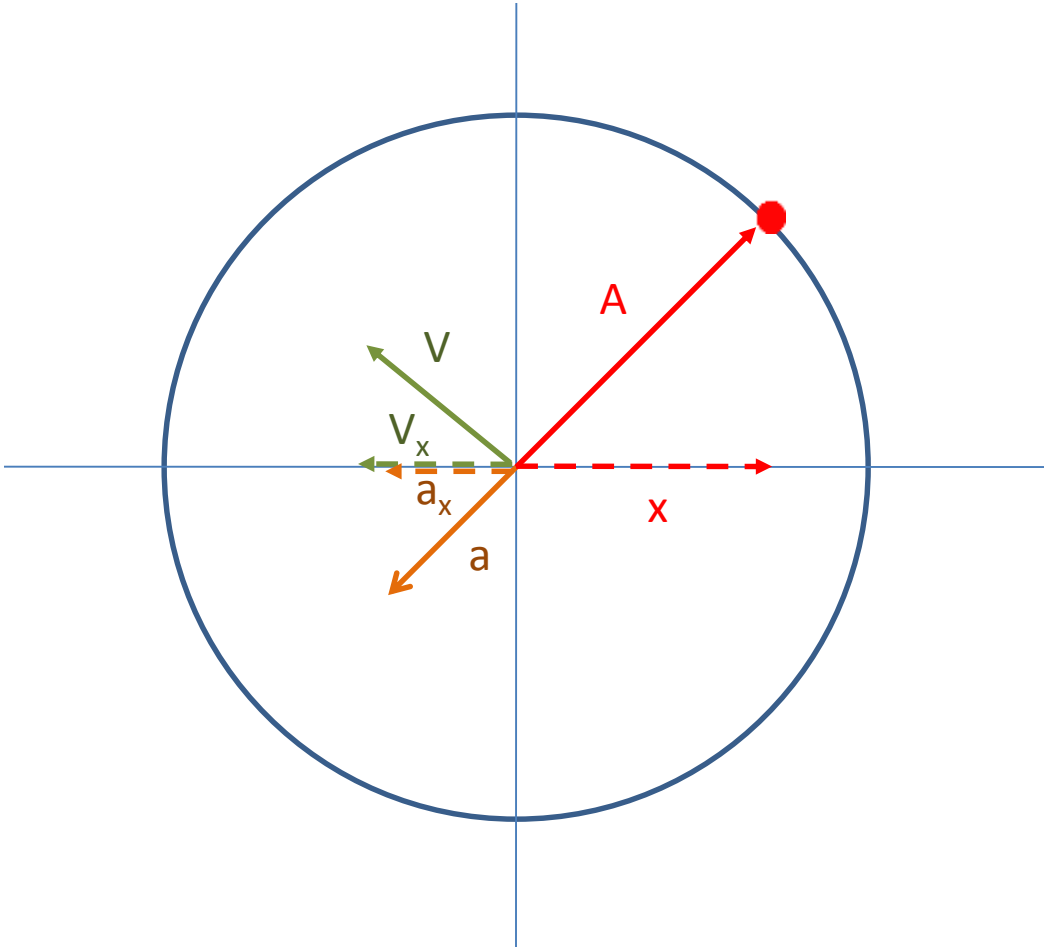
$k = m\omega^2$ or $\omega^2 = k/m$

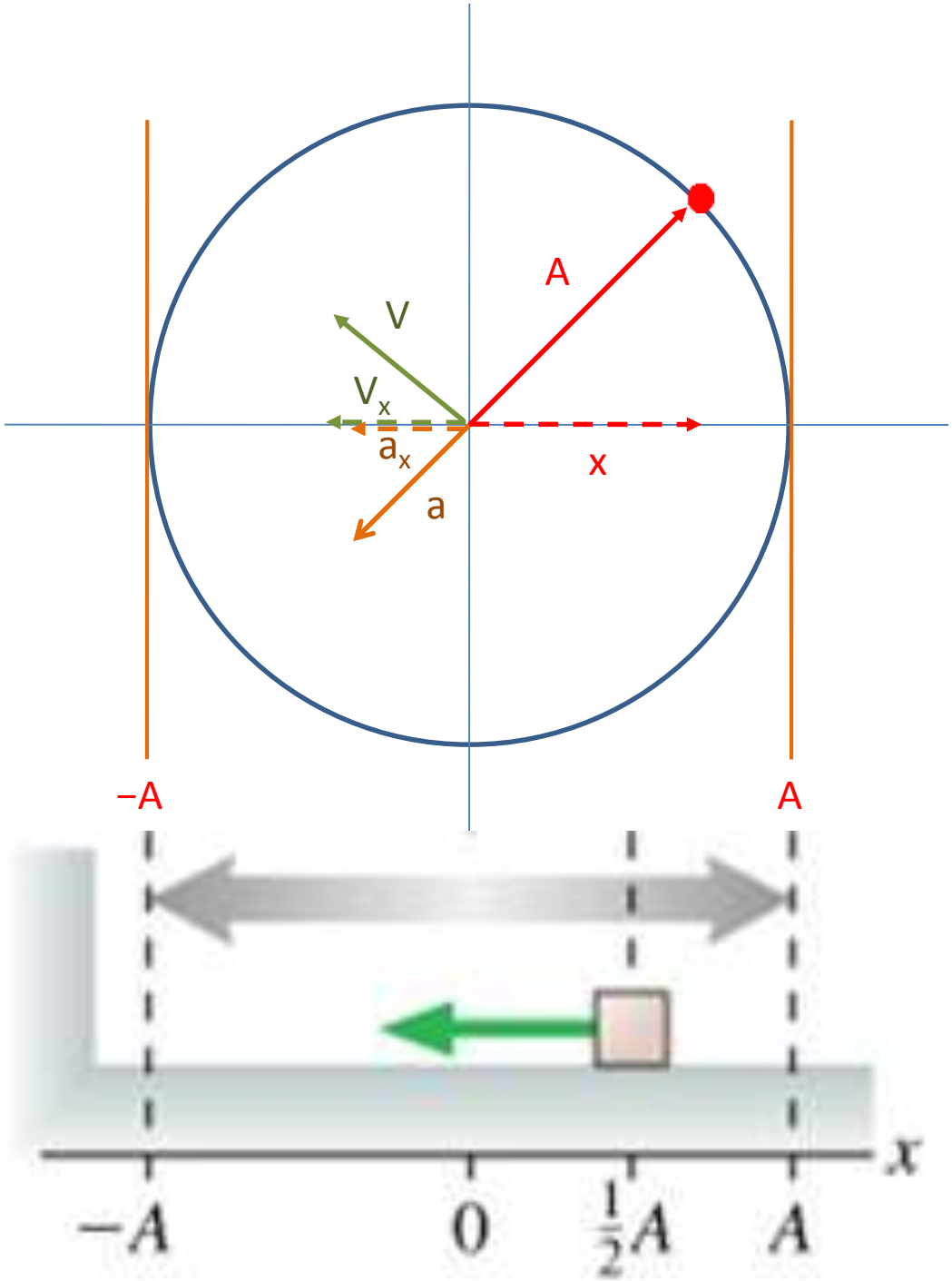
Note – No dependence on A

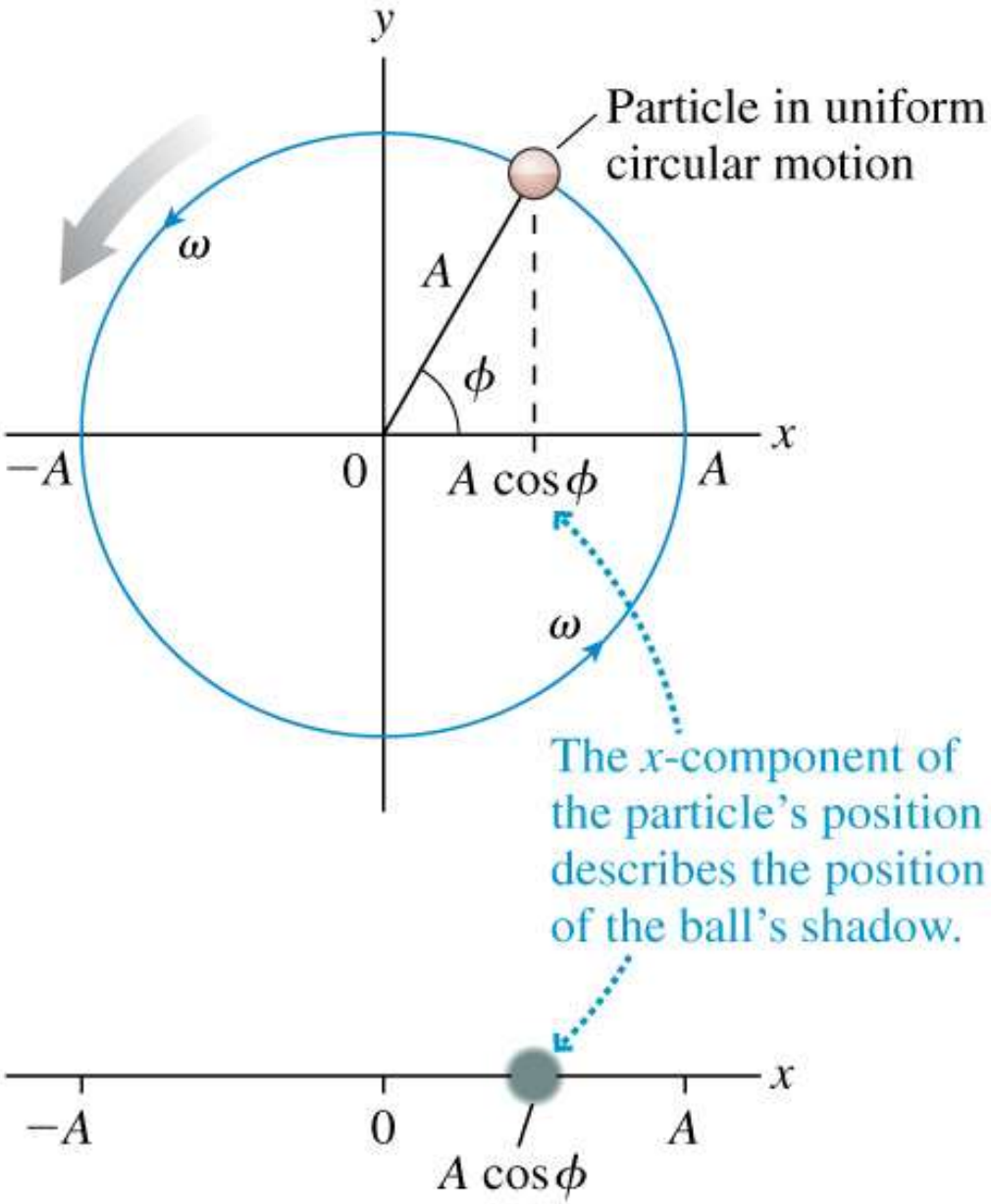


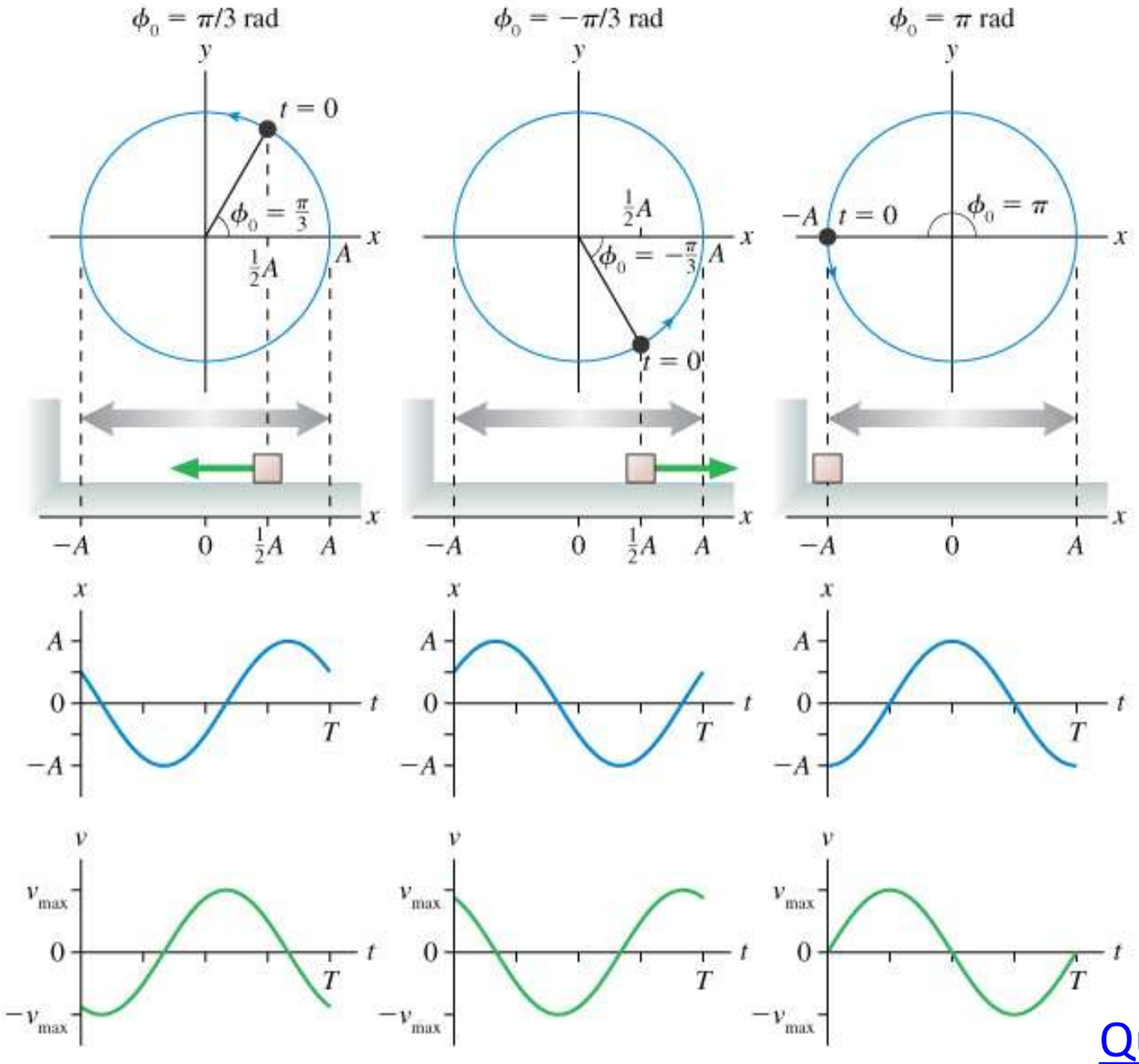

Reference circle
Light
Displacement
x
Time t


V
A
a


A
V
V_x
a_x
a
x

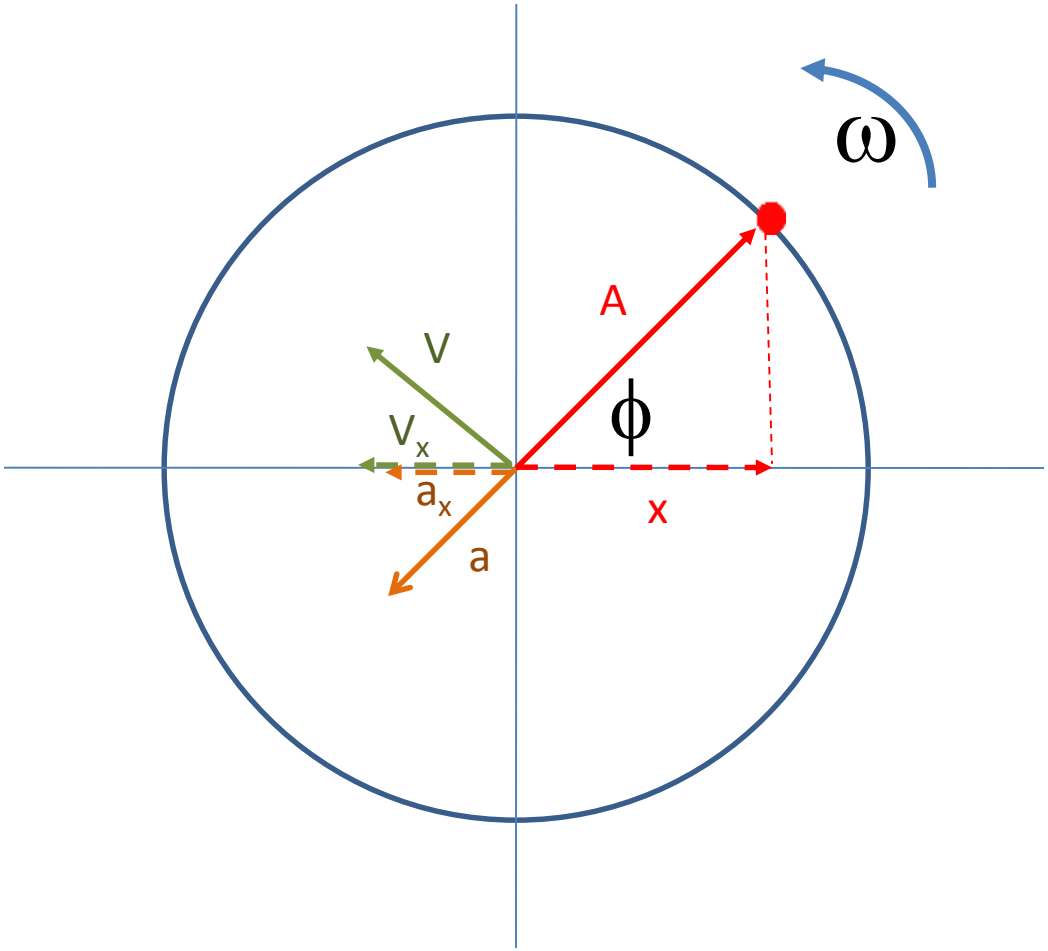

A
V
V_x
a_x
a
x
−A
A
x
−A
0
$\frac{1}{2}A$
A





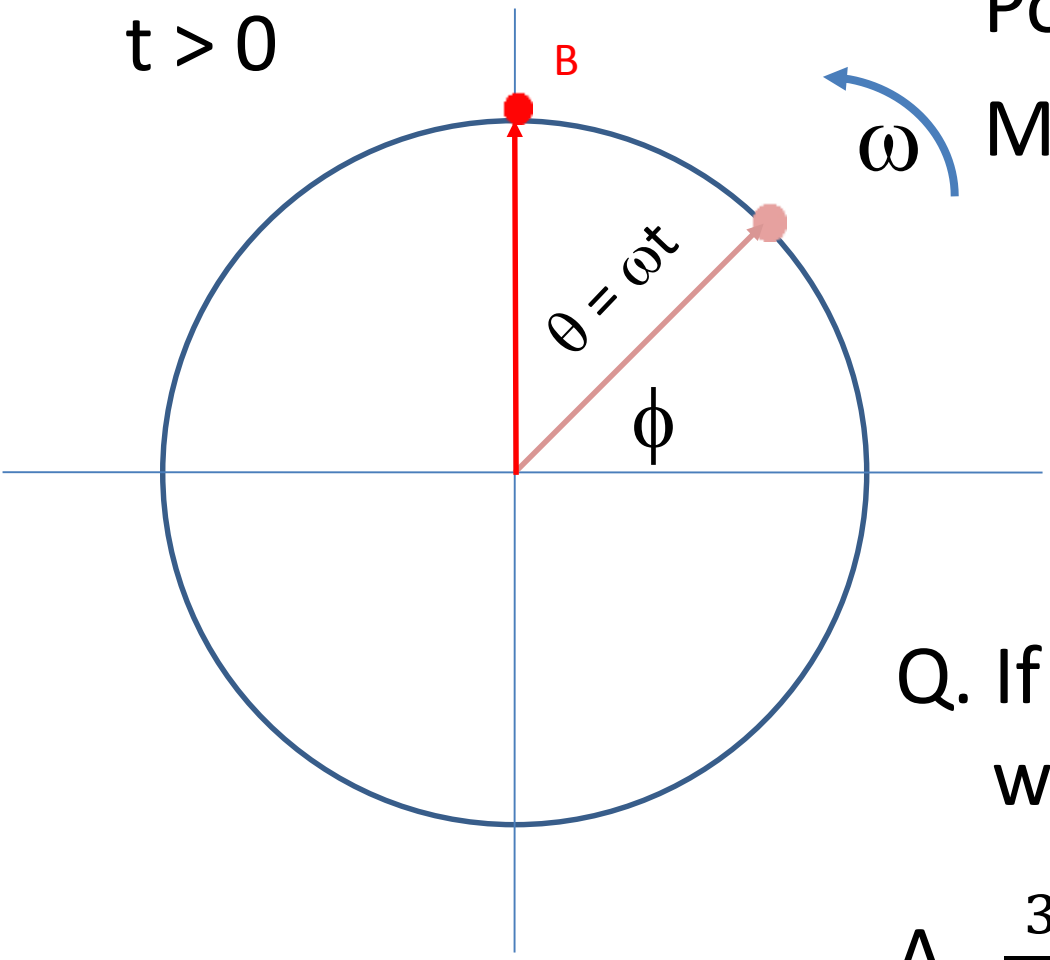
Questions

t = 0



If you know x and A, can find ϕ by simple trig.

Time and the Reference Circle



Position repeats every T.

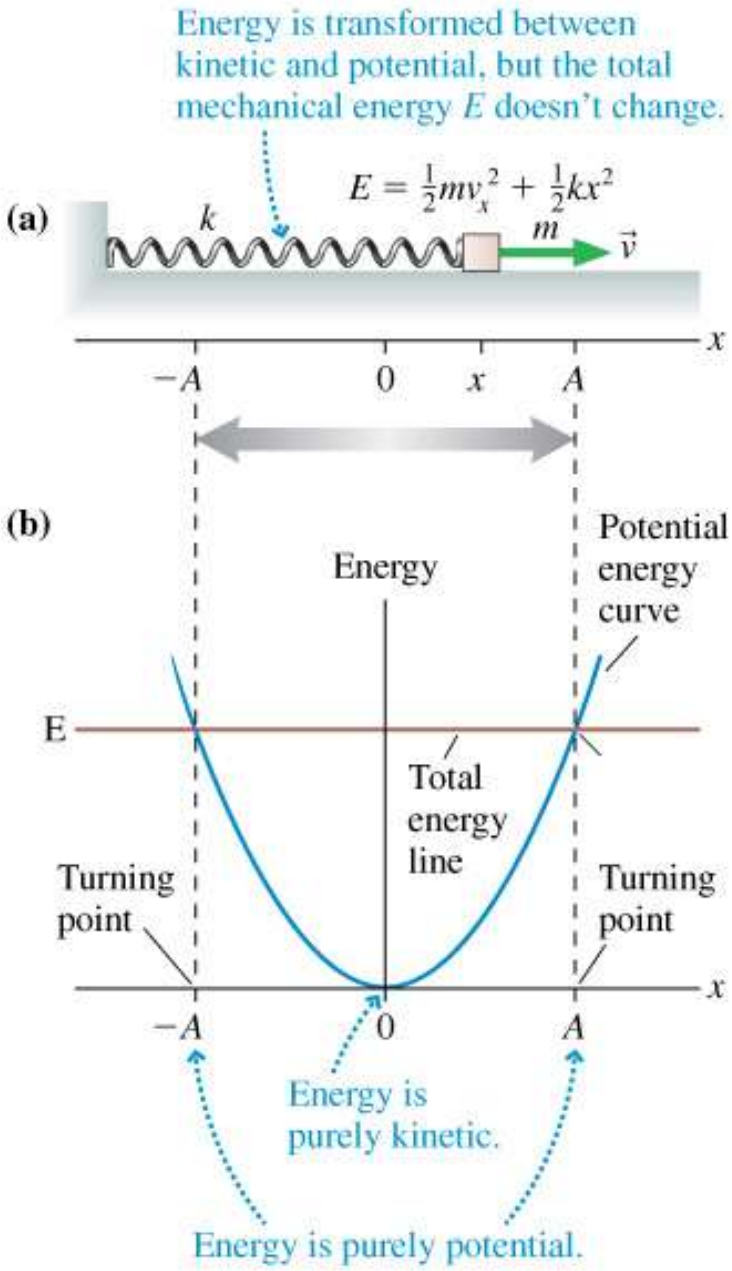
Move angle θ in time t.

$$\theta = \omega t = \frac{2\pi}{T} t$$

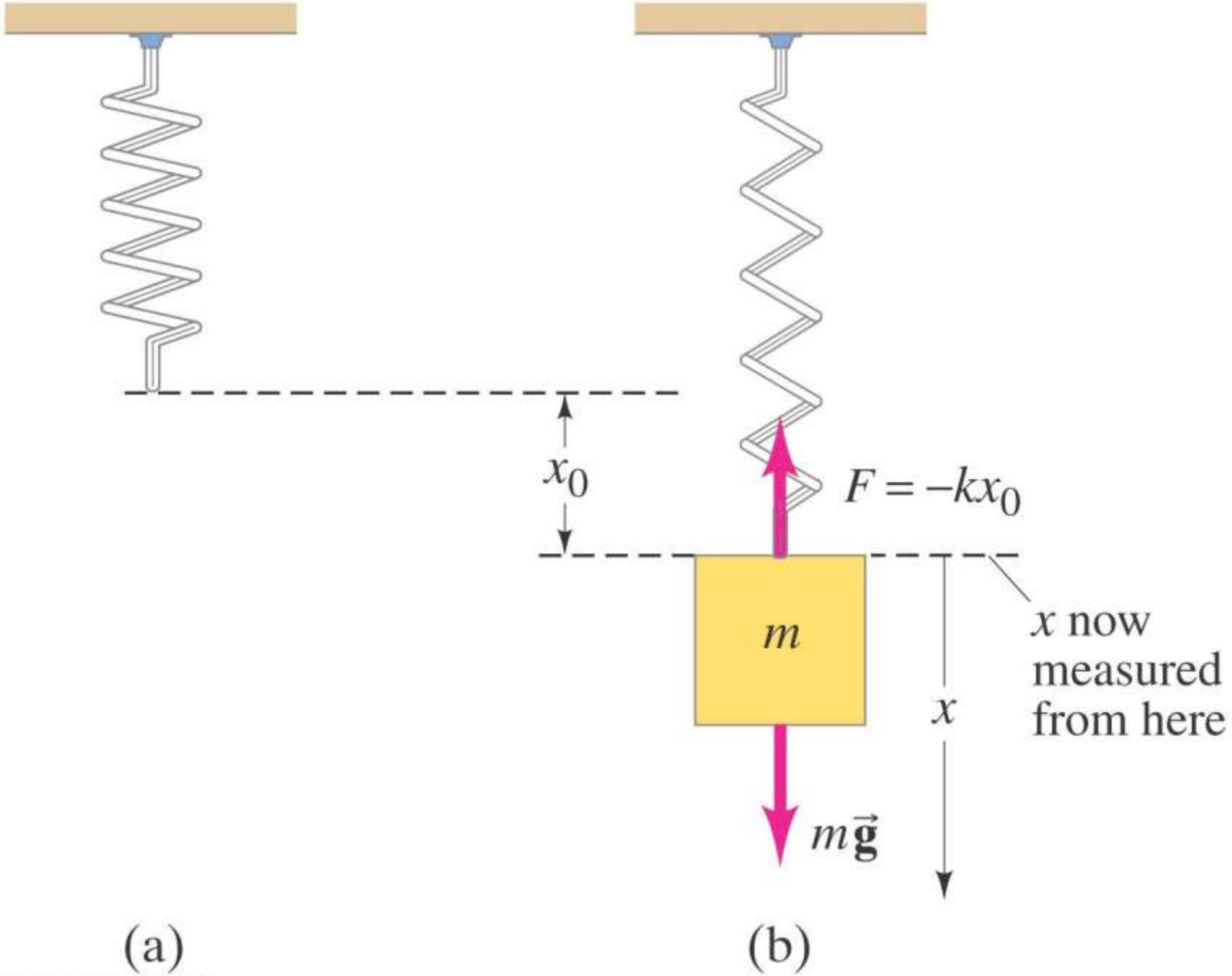
$$\frac{\theta}{2\pi} = \frac{t}{T}$$

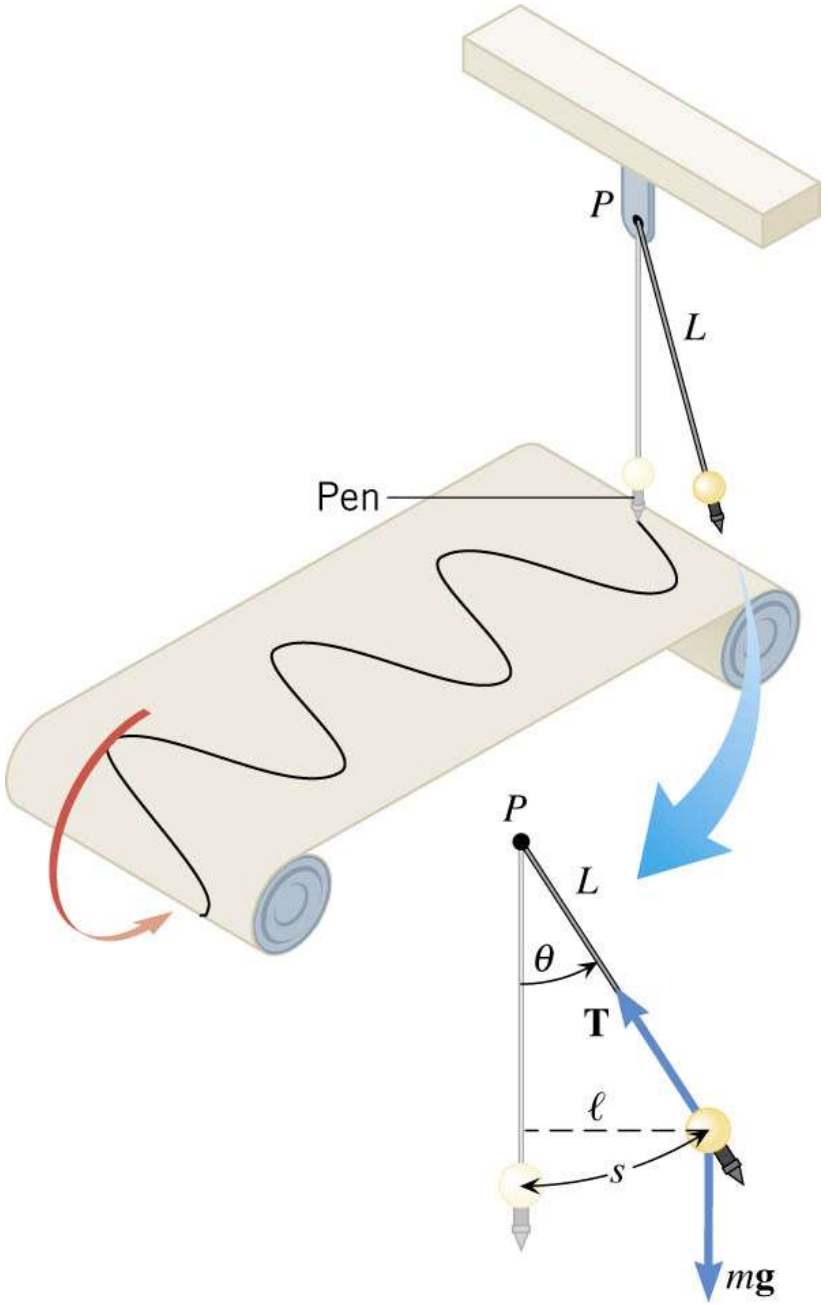
Q. If T = 4 s and $\phi = 30°$, when does B occur?

A. $\frac{30}{360} = \frac{t}{4} \rightarrow t = \frac{4}{12}\ sec$

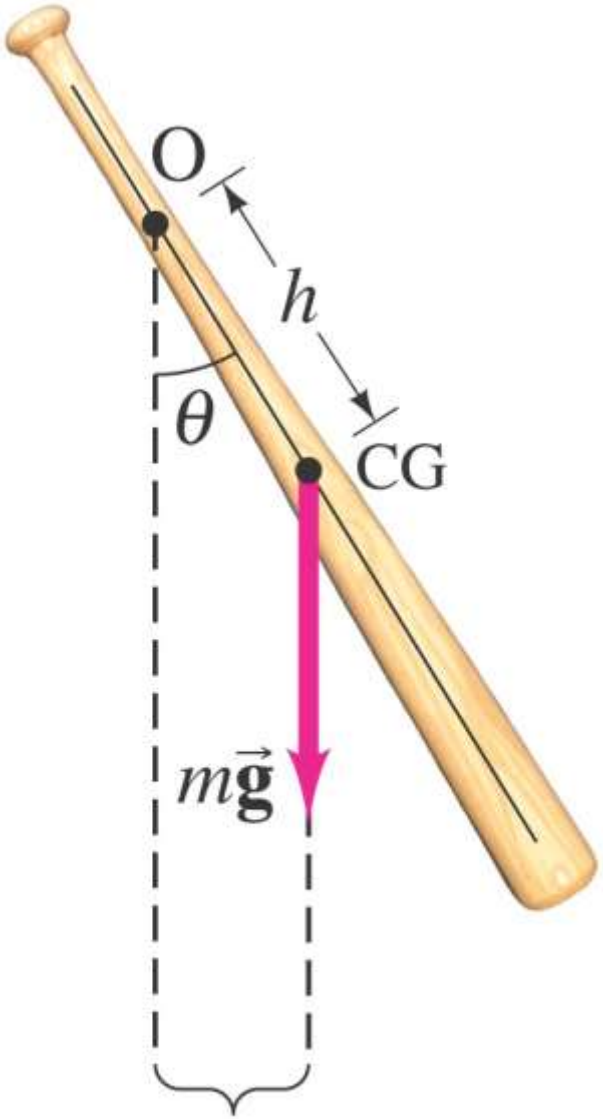


Questions

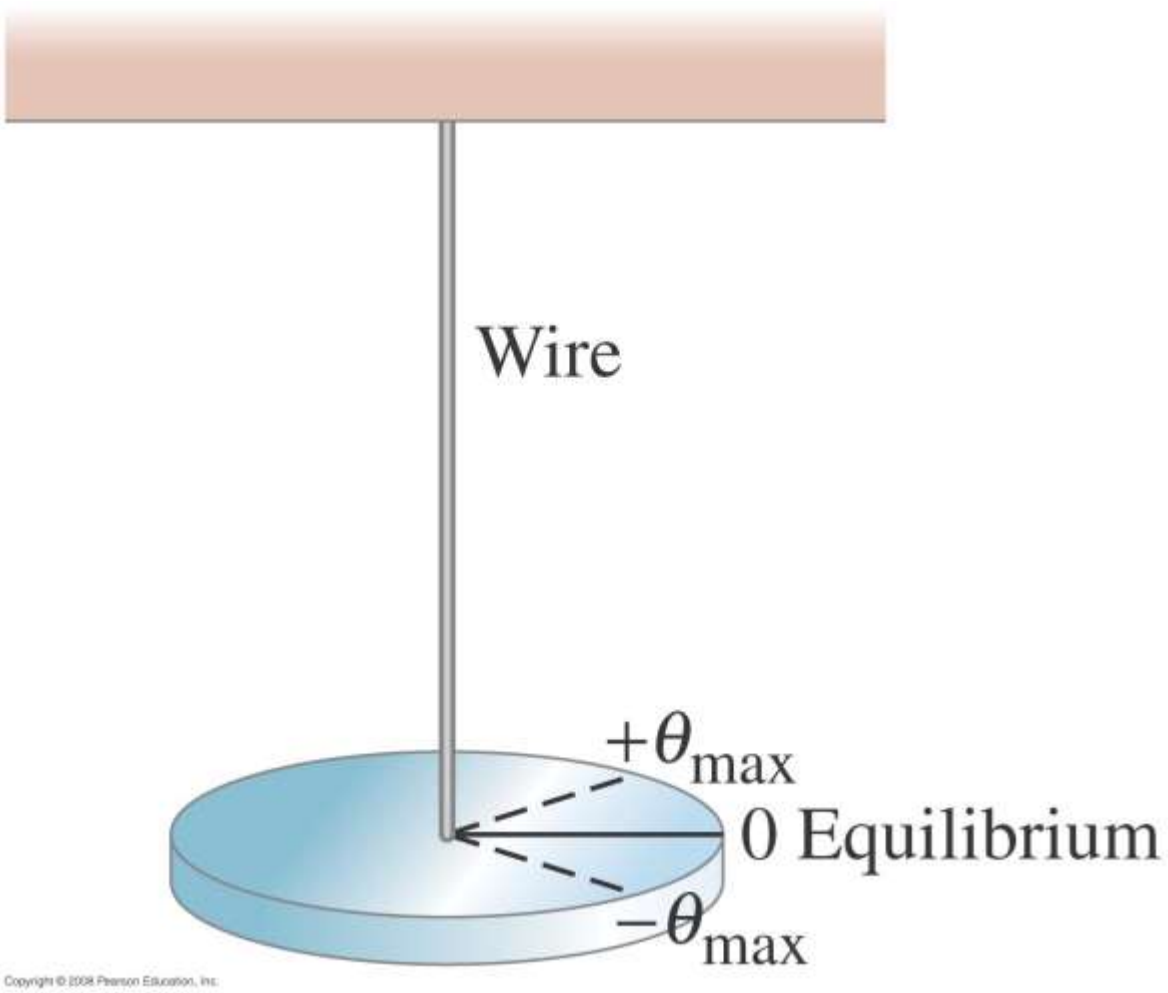




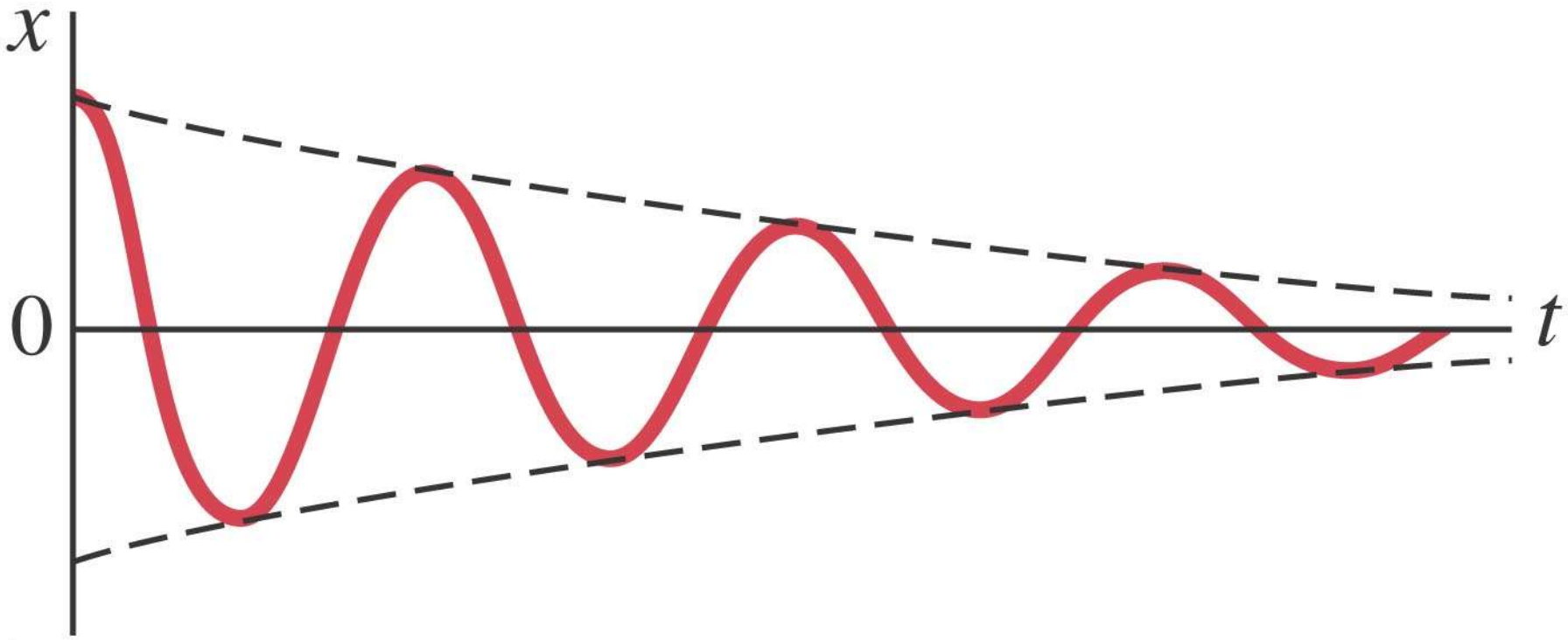
Questions

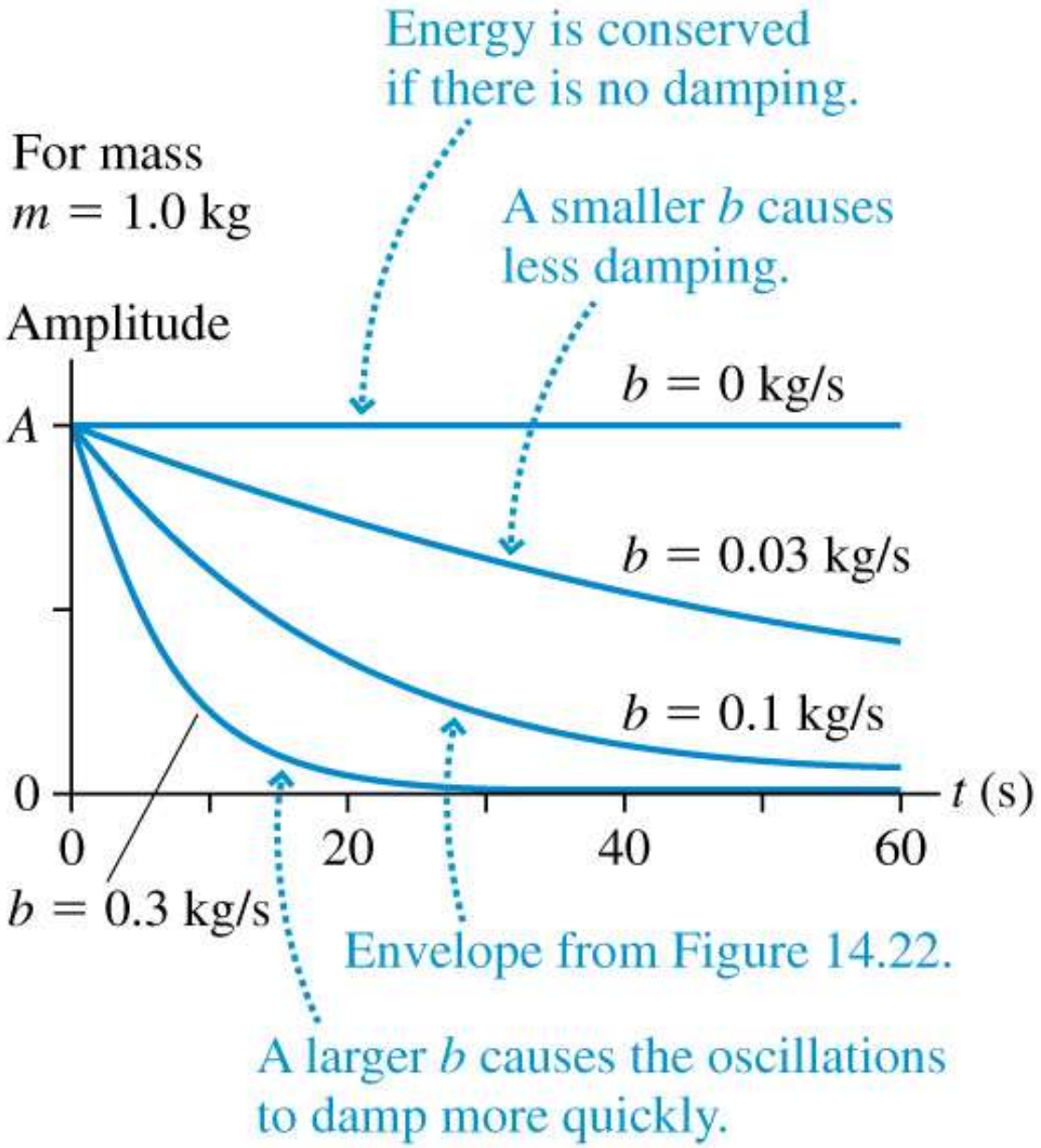


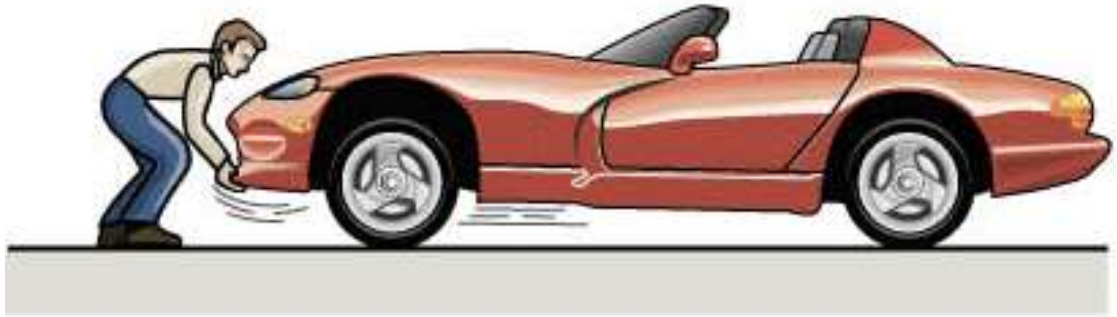
$\omega = \sqrt{\frac{mgh}{I}}$, I is rotaional inertia

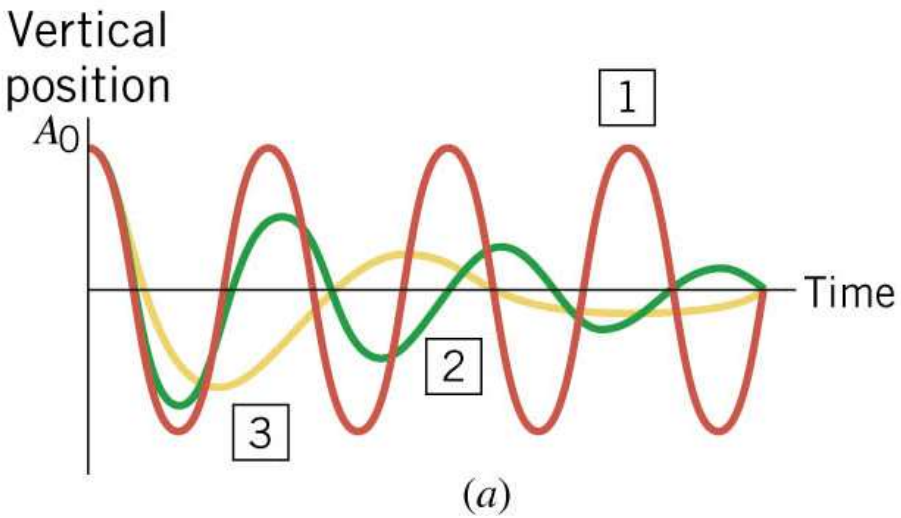


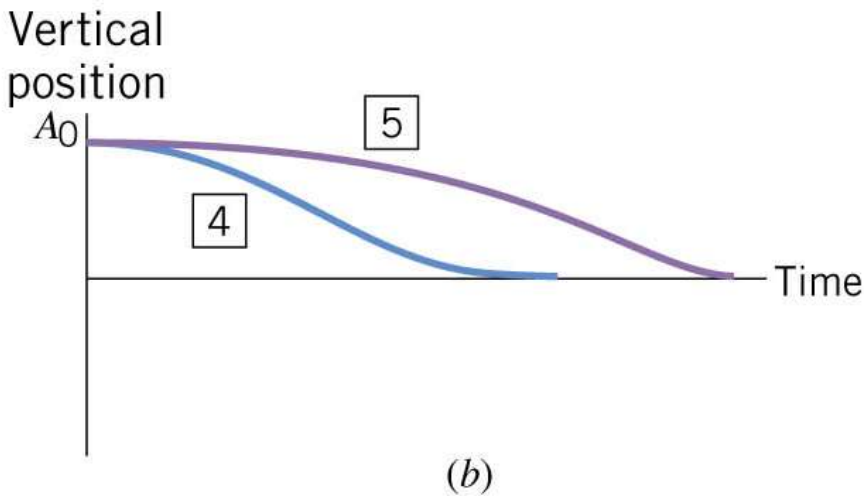
$\omega = \sqrt{\frac{K}{I}}$, K wire stiffness



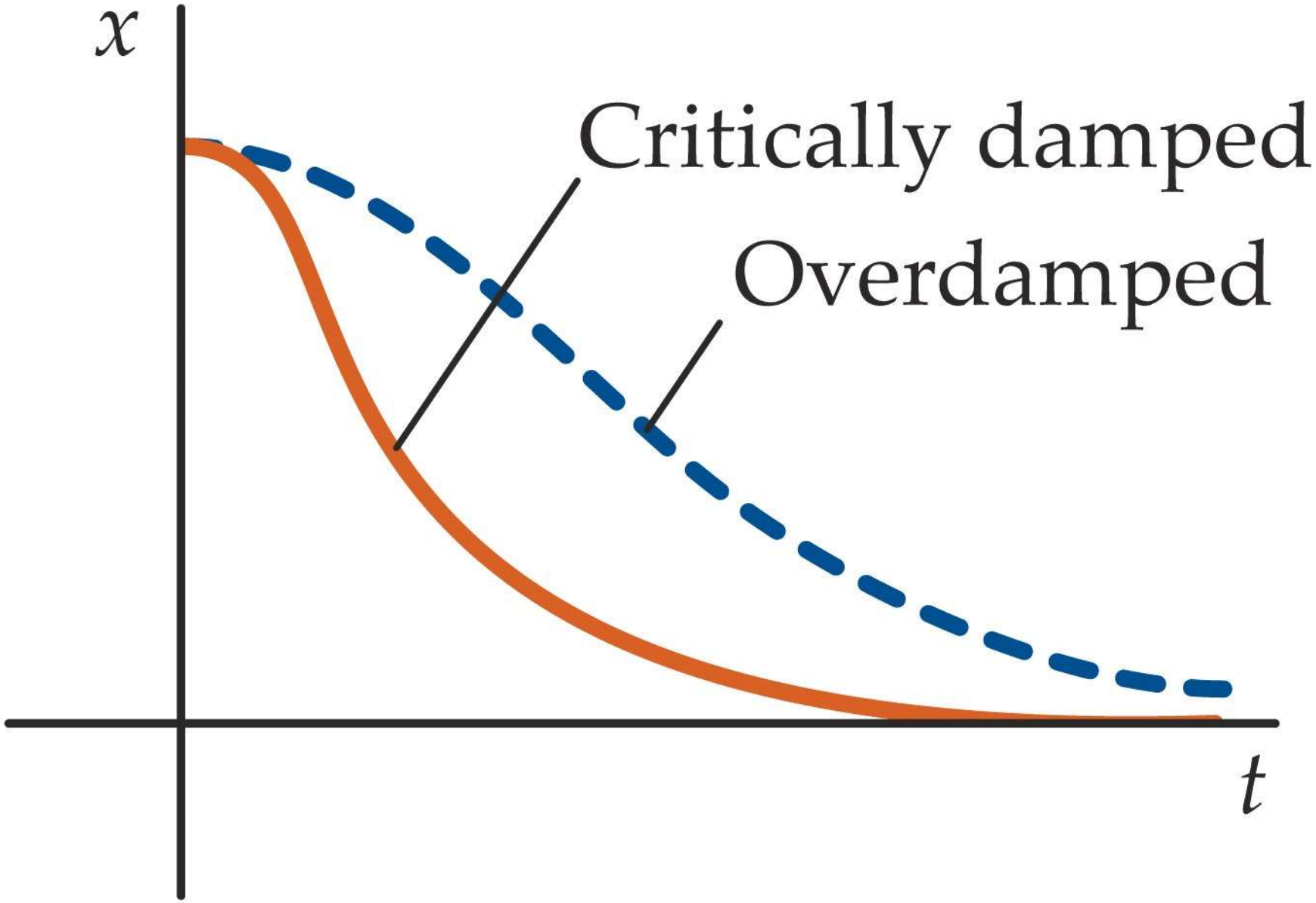


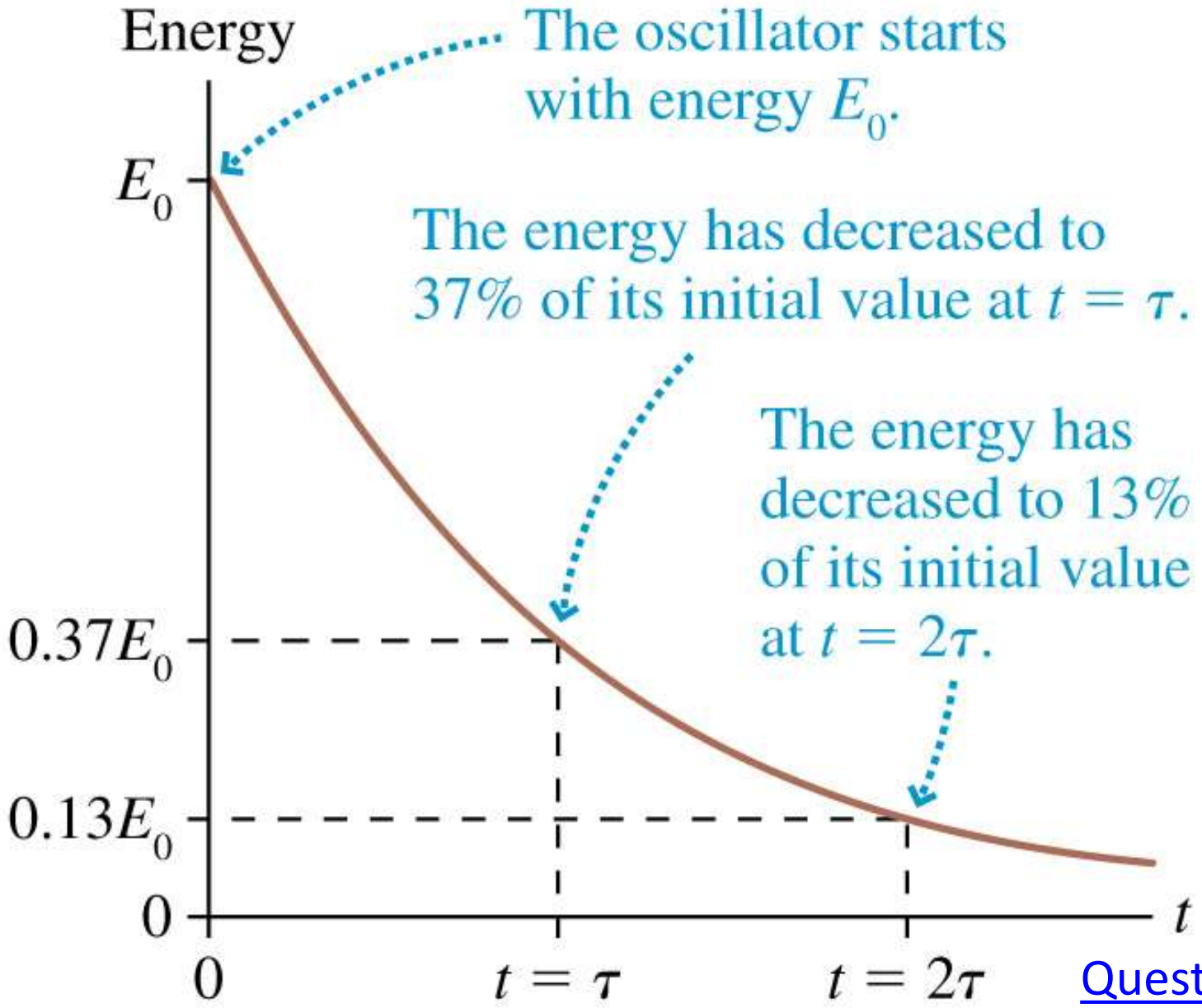



Vertical position
A_0
1
2
3
Time
(a)

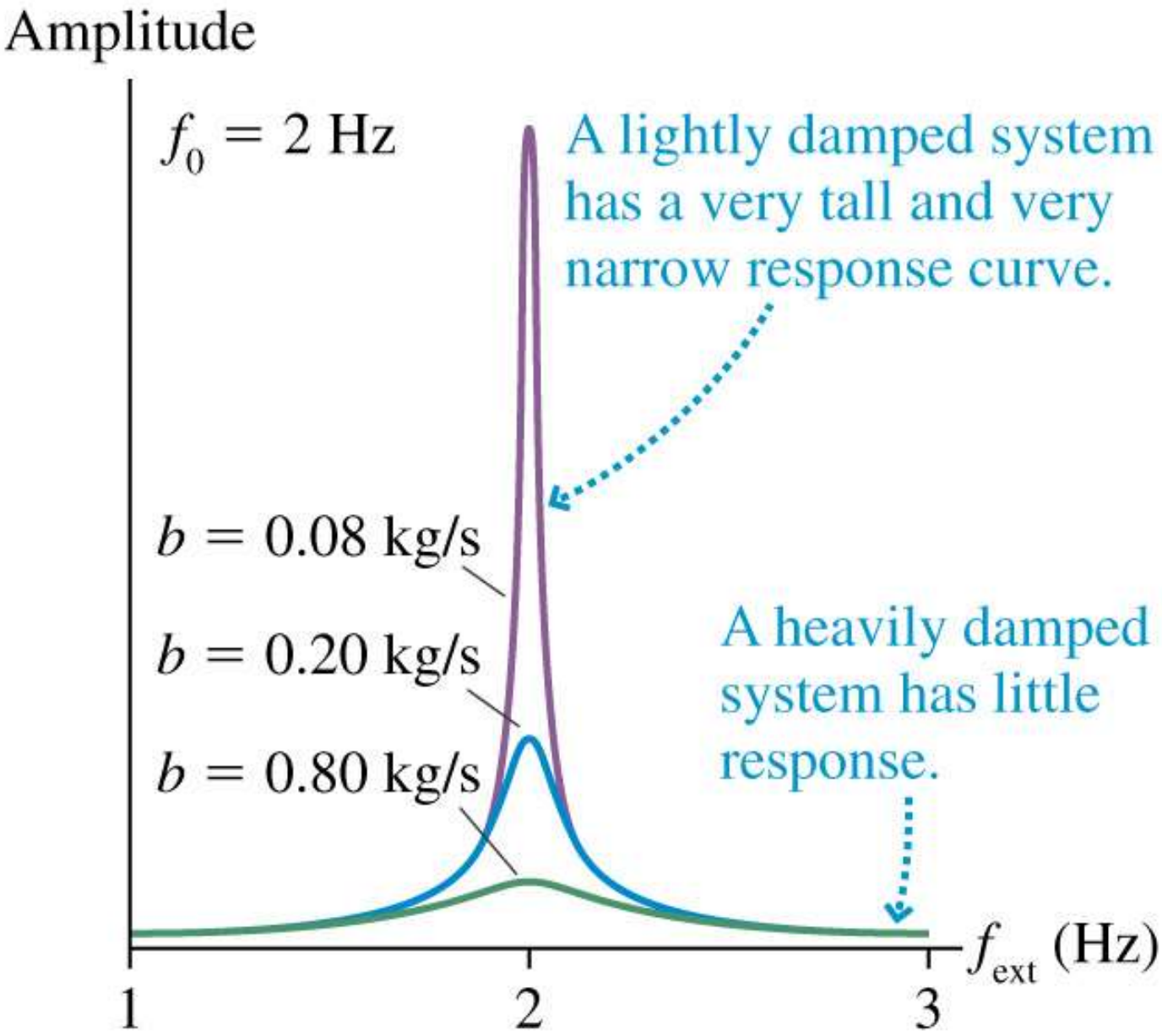

Vertical position
A_0
5
4
Time
(b)

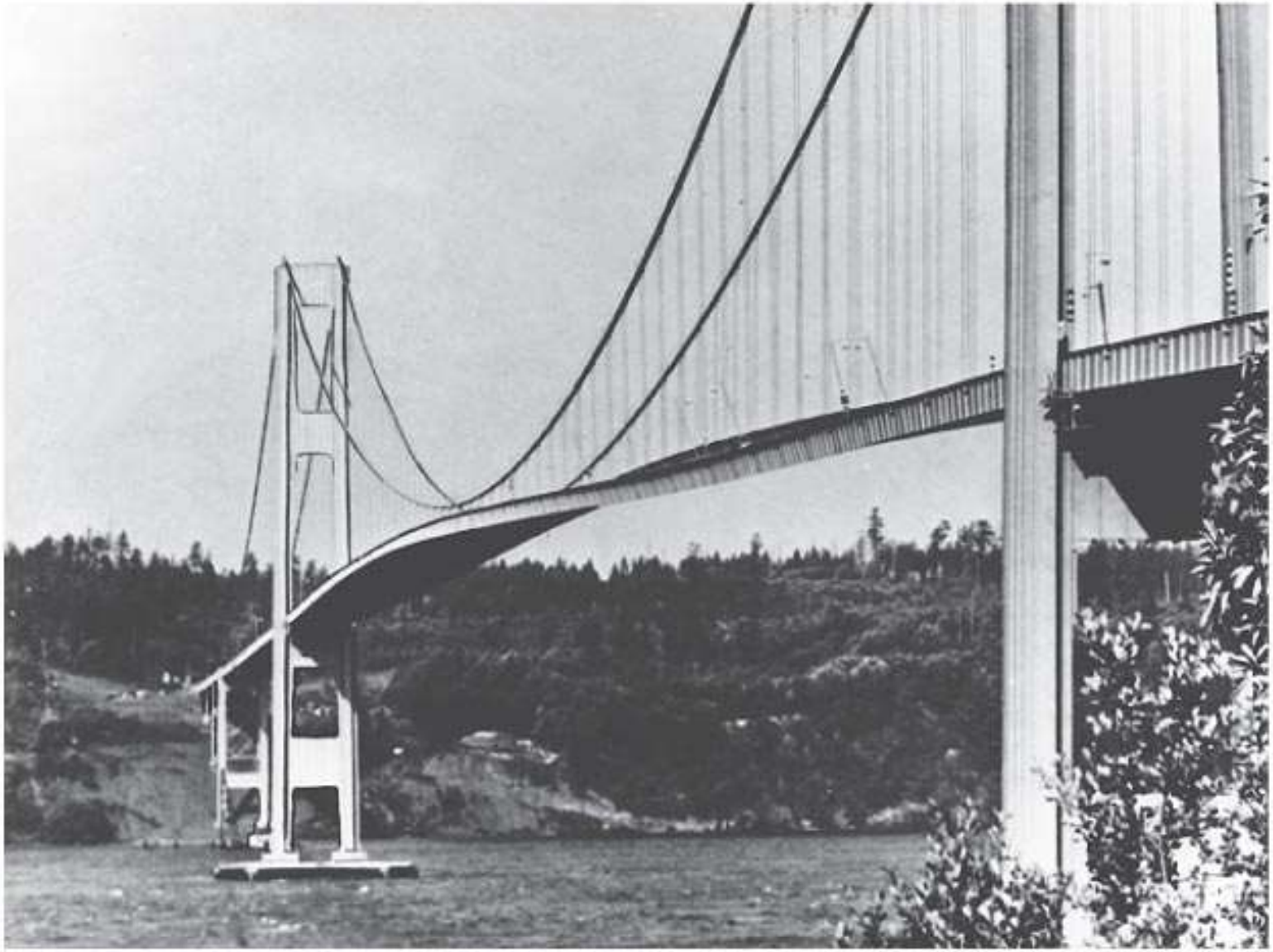
Questions


x
Critically damped
Overdamped
t



Questions





(a)

YouTube Video