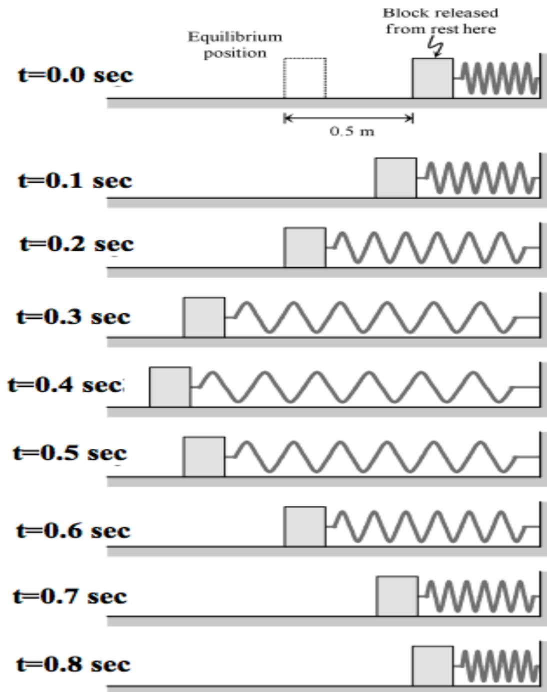
Based on the pictures what is the period of motion of the block?



A) .2 s
B) .4 s
C) .6 s
D) .8 s
E) None of these/ not enough info!

For a simple harmonic oscillator (mass on a spring), what happens to the period of motion if the spring constant is increased?

A) Increases
B) decreases
C) unchanged

2- 2

Want to be an LA?

LA Program

You are cordially invited to attend an Informational Session to learn more about becoming a Learning Assistant.

When: **Wednesday, March 9, 2011, at 6 p.m.**

Where: UMC 235 (hall right of Reception Desk)

RSVP: By March 4 to olivia.holzman@colorado.edu

Refreshments will be served, while they last.

Applications for Fall 2011 available March 9 - 23

Goto: http://laprogram.colorado.edu/applications

Get more information from faculty and LAs in these departments:

Applied Math	Math	Mechanical Engineering
MCDBiology	Chemistry	Geological Sciences
Physics	Astronomy	***And MORE!!***

University of Colorado **Boulder**

2-

Dep'tal Colloquium tomorrow:
Jim Faller
A new measurement of G

(G1B20, 4 PM. Cookies at 3:50)

2- 4

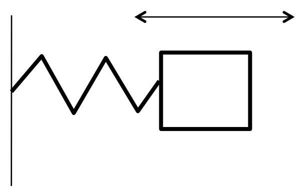
For a simple harmonic oscillator (mass on a spring), what happens to the period of motion if the mass is increased by 4?

A) Increases by 2x
B) Increases by 4x
C) unchanged
D) Decreases by 2x
E) Decreases by 4x

For a simple harmonic oscillator (mass on a spring), what happens to the period of motion if the initial displacement is increased by 4?

A) Increases by 2x
B) Increases by 4x
C) unchanged
D) Decreases by 2x
E) Decreases by 4x

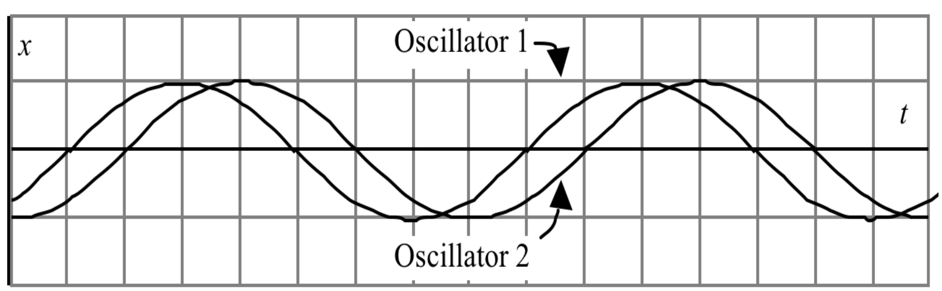
A mass m oscillates at the end of a spring (constant k)
It moves between x=.1 m to x=.5 m.
The block is at x=0.3 m at t=0 sec, moves out to x=0.5 m and returns to x=0.3 m at t=2 sec.



Write the motion in the form $x(t)=x_0+A\cos(\boldsymbol{\omega} t+\varphi)$, and find numerical values for x_0, A, $\boldsymbol{\omega}$, and φ

If time:
Write the motion in the form $x(t)=x'_0+A'\sin(\boldsymbol{\omega'} t+\varphi')$, and find numerical values for x'_0, A', $\boldsymbol{\omega'}$, and φ'

2- 7



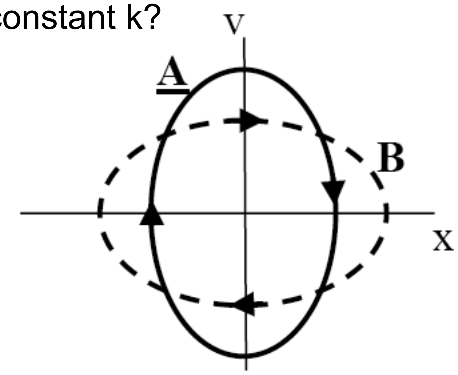
Oscillators have $x_i(t)=A_i\cos(\omega_i t+\varphi_i)$ (for i=1, 2)
Which parameters are *different*?

What is the difference between φ_1 and φ_2?
Which is larger (more positive?)

2- 8

If you finish early:

1) Phase paths A and B both describe a harmonic oscillator with the same mass m. Which path describes the system with a bigger spring constant k?

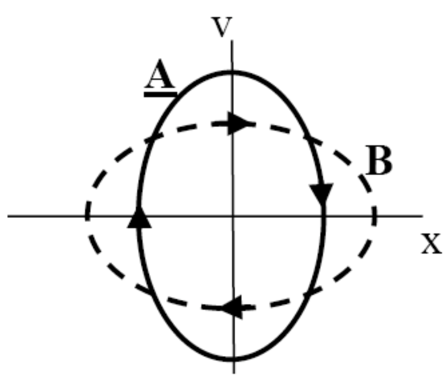


2) How does a phase space diagram change, if you start it with a bigger initial stretch?

3) How does a phase space diagram change, if the phase "δ" in $x(t)=A\cos(\omega t-\delta)$ changes?

2- 9

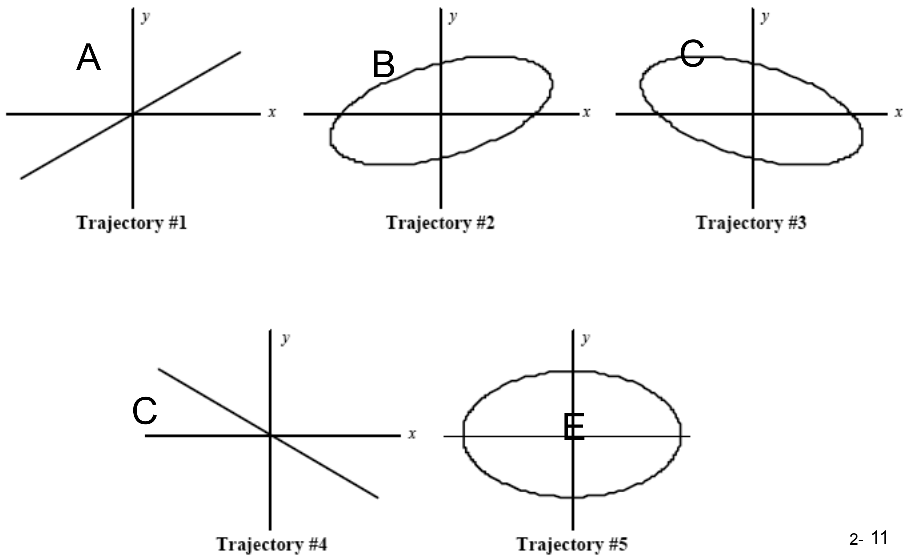
Phase paths A and B both describe a harmonic oscillator with the same mass m. Which path describes the system with a bigger spring constant k?



C) both are the same
D) Not enough info/???

2- 10

Shown below are several trajectories for a 2D oscillator. For which one is $\delta_x=\delta_y=0$?



2- 11

Compare the motion of a 2D harmonic oscillator with two different sets of initial conditions. In case (1) the particle is released from rest and oscillates along the path shown. In case (2) the particle starts with a larger x position and with a negative x component of the velocity.

What can you say about the amplitudes of the x and y motion?

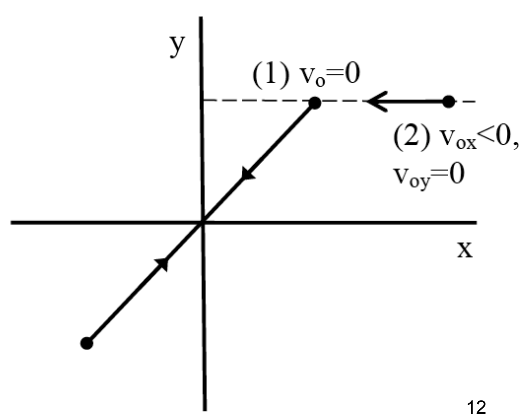
A) $A_{x1}>A_{x2}$, $A_{y1}>A_{y2}$

B) $A_{x1}<A_{x2}$, $A_{y1}=A_{y2}$

C) $A_{x1}=A_{x2}$, $A_{y1}>A_{y2}$

D) $A_{x1}<A_{x2}$, $A_{y1}<A_{y2}$

E) $A_{x1}=A_{x2}$, $A_{y1}=A_{y2}$

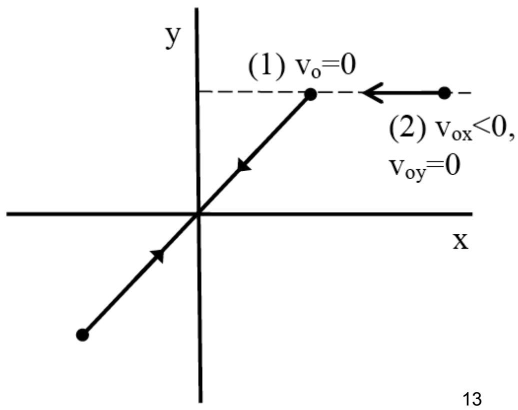


12

Compare the motion of a 2D harmonic oscillator with two different sets of initial conditions. In case (1) the particle is released from rest and oscillates along the path shown. In case (2) the particle starts with a larger x position and with a negative x component of the velocity.

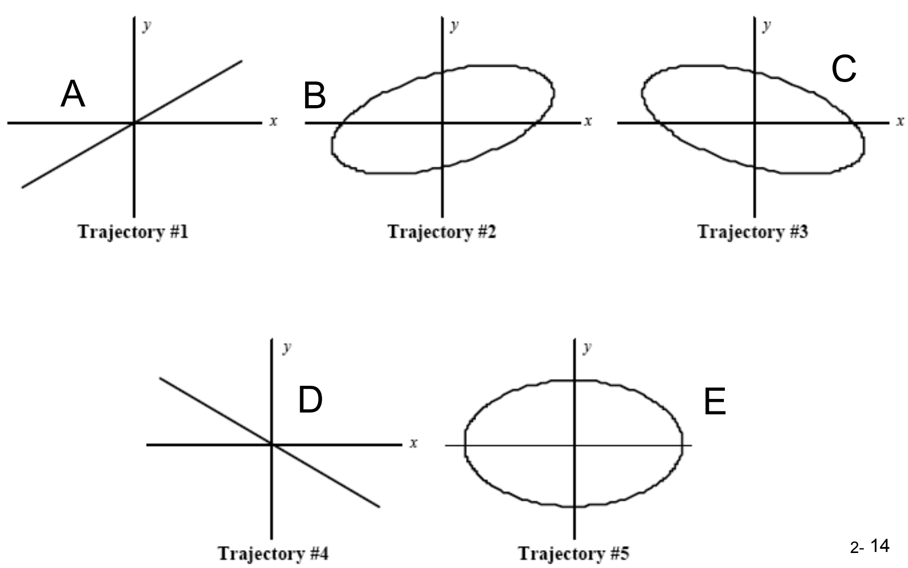
What can you say about the frequency of the x and y motion?

A) $\omega_{x1}>\omega_{x2}$, $\omega_{y1}>\omega_{y2}$
B) $\omega_{x1}<\omega_{x2}$, $\omega_{y1}=\omega_{y2}$
C) $\omega_{x1}=\omega_{x2}$, $\omega_{y1}>\omega_{y2}$
D) $\omega_{x1}<\omega_{x2}$, $\omega_{y1}<\omega_{y2}$
E) $\omega_{x1}=\omega_{x2}$, $\omega_{y1}=\omega_{y2}$



13

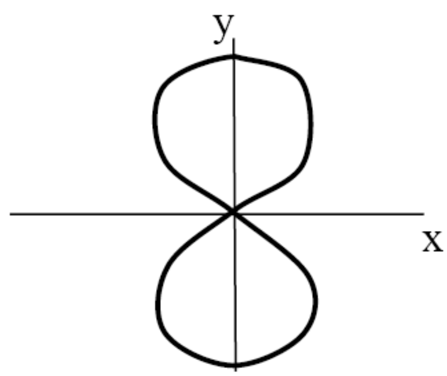
Which of the below trajectories most closely resembles case 2 in the last question, where $v_{y0}=0$ and $v_{x0}<0$ at the release point?



2- 14

A 2D oscillator traces out the following path in the xy-plane.
What can you say about the frequencies of the x and y motion?

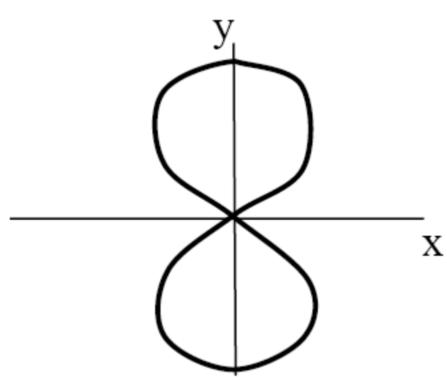
A) $\omega_x = 4\omega_y$
B) $\omega_x = 2\omega_y$
C) $\omega_x = \omega_y$
D) $\omega_x = 0.5\ \omega_y$
E) $\omega_x = 0.25\ \omega_y$



2- 15

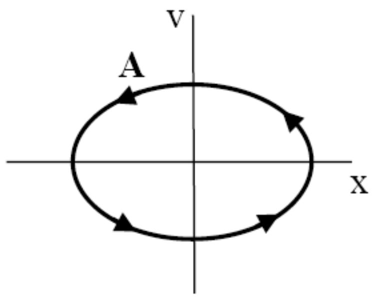
A 2D oscillator traces out the following path in the xy-plane.
What can you say about the Amplitudes of the x and y motion?

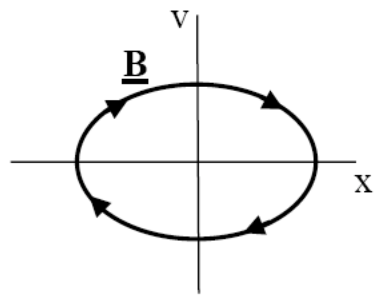
A) $A_x > A_y$
B) $A_x \approx A_y$
C) $A_x < A_y$



2- 16

Phase paths A & B below attempt to describe the mass-on-a-spring simple harmonic oscillator.
Which path is physically possible?





C) both are possible
D) neither is possible

2- 17

2- 18

What are the roots of the auxiliary equation
$D^2 + D - 2 = 0$?

A) 1 and 2
B) 1 and -2
C) -1 and 2
D) -1 and -2
E) Other/not sure...

2- 19

What are the roots of the auxiliary equation
$y''(t) + y(t) = 0$?

A) 1 and -1
B) 1 and 0
C) just 1
D) just i
E) i and -i

2- 20

Since cos(t) and cos(-t) are both solutions of $y''+y=0$, can we express the general solution asy(t)=$C_1\cos(t) + C_2\cos(-t)$

A) yes
B) no
C) ???

2- 21

Consider a super ball which bounces up and down on super concrete. After the ball is dropped from an initial height h, it bounces with no dissipation and executes an infinite number of bounces back to height h.

Is the motion of the ball in z simple harmonic motion?

A) yes
B) no
C) ???

2- 22

A mass on a spring has a small damping term added. When it passes through x=0, which is correct?

A) The mass is instantaneously speeding up
B) The mass is instantaneously slowing down
C) The mass is at a maximum speed (and is thus neither speeding up nor slowing down
D) The answer depends on which WAY it is passing through the origin.

2- 23

A mass on a spring has a small damping term added. What happens to the period of oscillation?

A) Slightly *larger* than the undamped case.
B) Slightly *smaller* than the undamped case
C) The *same* as the undamped case

2- 24

The ODE for damped simple harmonic motion is:

$$\frac{d^2y}{dt^2} + 2\beta\frac{dy}{dt} + \alpha y = 0$$

What are the signs of the constants α and β?

A) α,β>0
B) α,β<0
C) α<0, β>0
D) α>0, β<0
E) Depends!

2- 25

For a mass on a spring, with damping: $\mathbf{F} = -k\mathbf{x} - b\dot{x}$
with k, b>0.
The ODE for damped simple harmonic motion is:

$$\frac{d^2y}{dt^2} + 2\beta\frac{dy}{dt} + \alpha y = 0$$

What are the signs of the constants α and β?

A) α,β>0
B) α,β<0
C) α<0, β>0
D) α>0, β<0
E) Depends!

2- 26