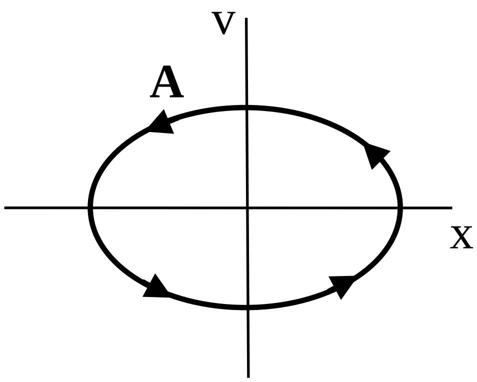
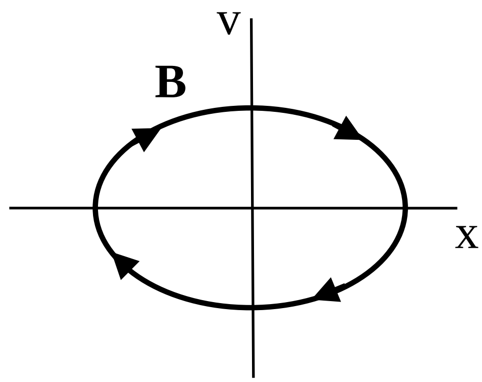
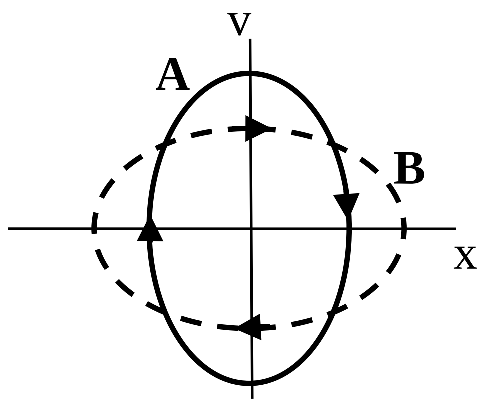
CT4-1. Phase paths A and B both attempt to describe a mass-on-a-spring harmonic oscillator. Which phase path is physically possible?





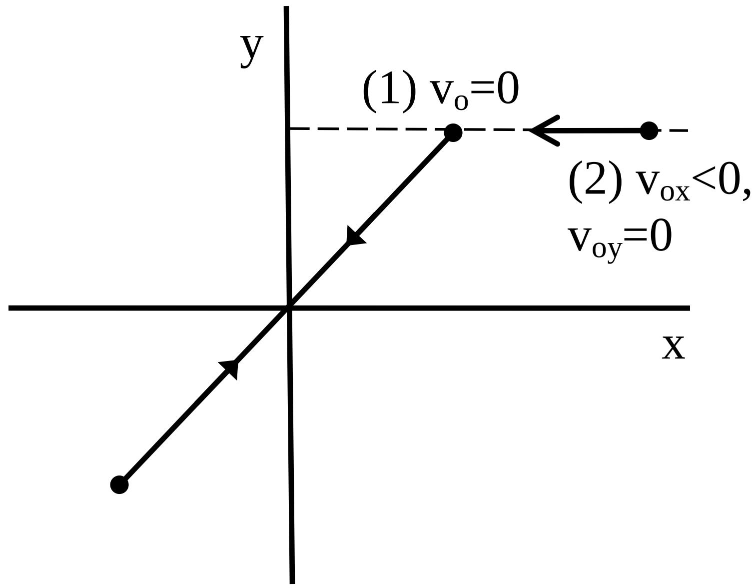
C) Both are possible D) Neither is possible.

CT4-2. Phase paths A and B both describe a mass-on-a-spring harmonic oscillator with the **same** mass m. Which path describes the system with the stiffer spring (bigger spring constant k)?



C) Both have the same stiffness

CT4-3. Compare the motion of a two-dimensional 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 amplitude of the x and y motion?

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

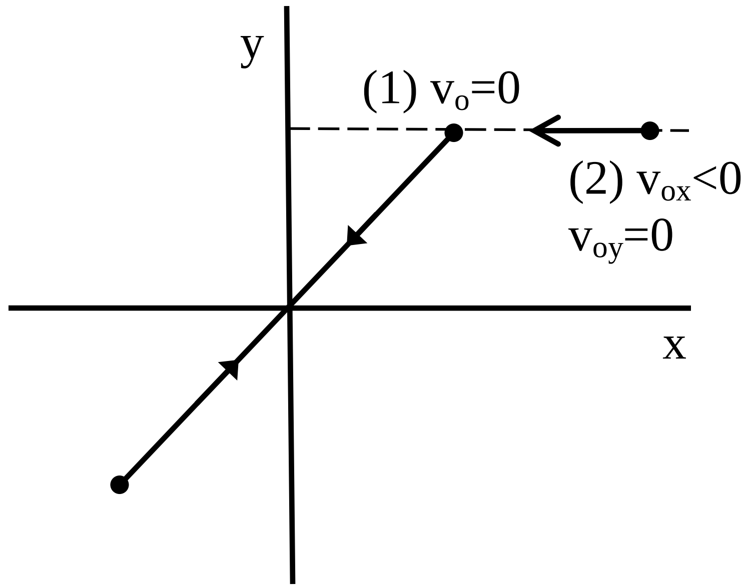
B) $A_{x1} < A_{x2}, \quad A_{y1} = A_{y2}$

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

D) $A_{x1} > A_{x2}, \quad A_{y1} = A_{y2}$

E) $A_{x1} < A_{x2}, \quad A_{y1} < A_{y2}$

CT4-4. Compare the motion of a two-dimensional 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) $\omega_{x1} > \omega_{x2}$, $\omega_{y1} > \omega_{y2}$

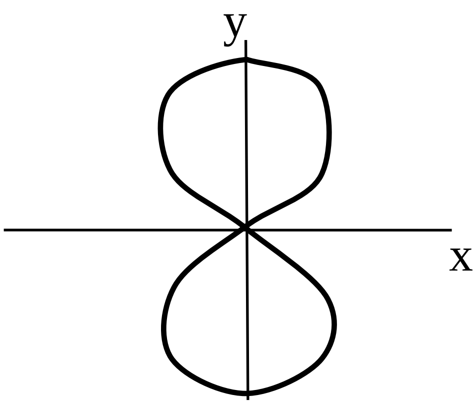
B) $\omega_{x1} < \omega_{x2}$, $\omega_{y1} < \omega_{y2}$

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

D) $\omega_{x1} = \omega_{x2}$, $\omega_{y1} < \omega_{y2}$

E) $\omega_{x1} = \omega_{x2}$, $\omega_{y1} = \omega_{y2}$

CT4-5. A two-dimensional oscillator traces out the following path in the x-y 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) $\omega_x = \frac{1}{4}\omega_y$

E) $\omega_x = \frac{1}{2}\omega_y$

CT4-6. The force on a mass attached to a spring, with damping, is given by $\vec{F}_{net} = -k\,x - b\,\dot{x}$ where k, b > 0. The differential equation describing a damped simple harmonic oscillator has the form: $y'' + \alpha\cdot y' + \beta\cdot y = 0$. What must be the signs of α and β?

A) α, $\beta > 0$
B) α, $\beta < 0$
C) $\alpha > 0$, $\beta < 0$
D) $\alpha < 0$, $\beta > 0$
E) Depends on the initial conditions.

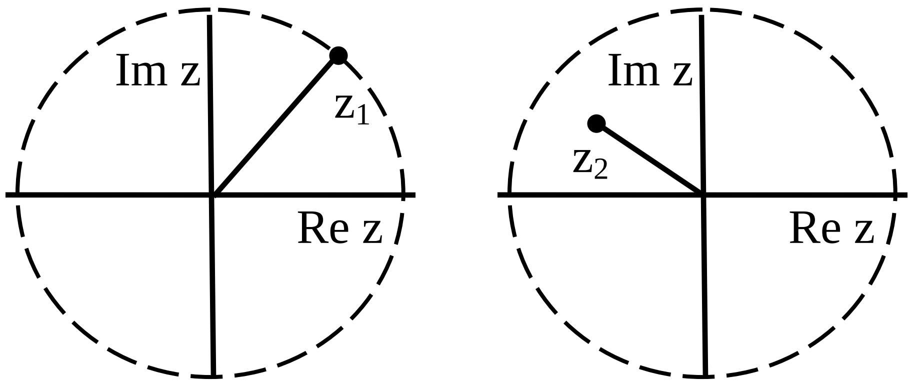
CT4-7. The differential equation describing a damped simple harmonic oscillator has the form:

$$y'' + \alpha \cdot y' + \beta \cdot y = 0 .$$

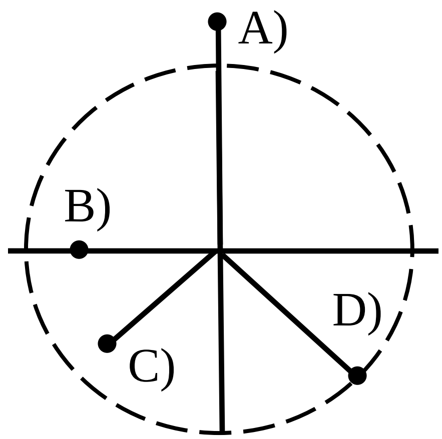
What must be the signs of α and β?

A) Depends on the initial conditions.
B) α , $\beta < 0$
C) $\alpha > 0$, $\beta < 0$
D) $\alpha < 0$, $\beta > 0$
E) α , $\beta > 0$

CT4-8. Consider the following two complex numbers z_1 and z_2, sketched in the complex plane. The dotted circle is the unit circle, on which |z|=1.

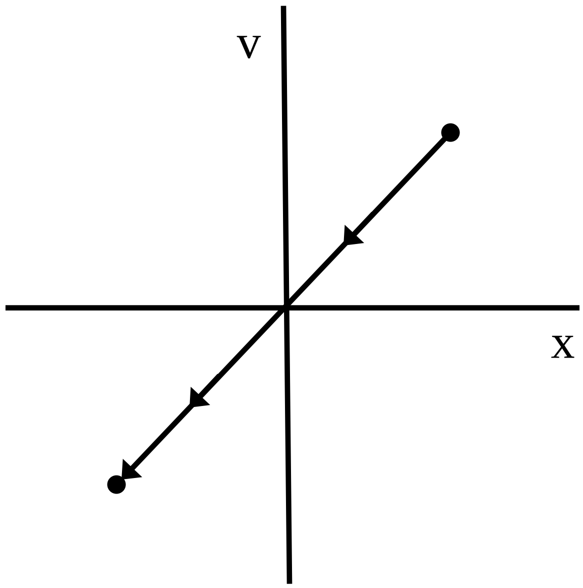


Which figure shows the product (z1 z2)?



E) I have no idea

CT4-9. What kind of damped undriven simple harmonic oscillator does this phase path show?



A) overdamped

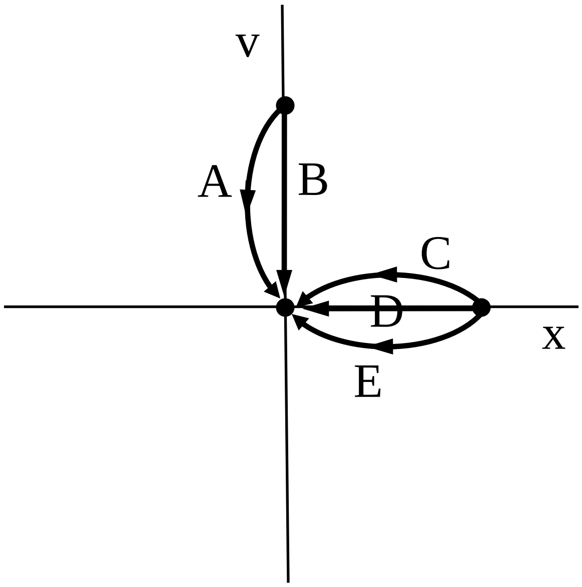
B) underdamped

C) critically damped

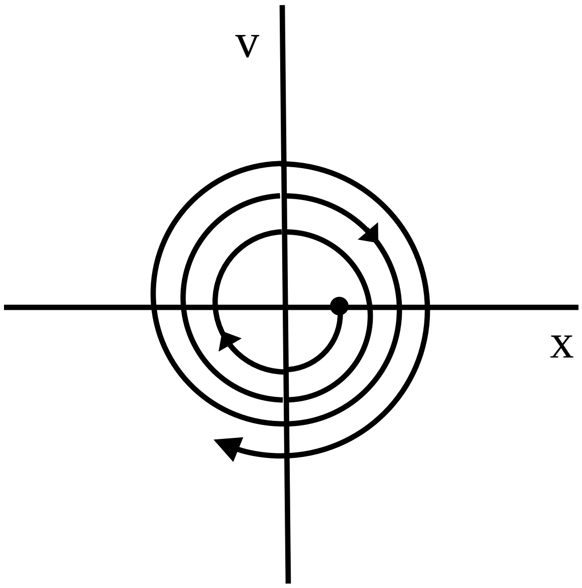
D) Impossible to tell the amount of damping

E) None of these. This phase path is impossible.

CT4-10. Which phase path describes an overdamped harmonic oscillator released from rest?



CT4-11. What kind of damped undriven simple harmonic oscillator does this phase path show?



A) overdamped .

B) underdamped.

C) critically damped.

D) Impossible to tell the amount of damping.

E) None of these. This phase path is impossible.

(For Later) What is the approximate Q of the simple harmonic oscillator shown in class?

A) ~1 B) ~100 C) ~0.01 D) ~10^{-4} E) ~ 10^{+4}

