1. The diagrams at right can be used to represent the motion of several different types of 2-D oscillators.



For each case below, identify which diagram could be used to represent that situation. If more than one diagram could apply in a particular case, **specify them all.** If none of the diagrams apply, state so explicitly. Briefly explain how you decided your answer in each case.

a. the 2-D trajectory *(y* vs. *x)* of an oscillator for which *kx* = *ky*

b. the 2-D trajectory *(y* vs. *x)* of an oscillator for which *kx* > *ky*

c. the 2-D trajectory *(y* vs. *x)* of an oscillator for which *kx* < *ky*

2. (Parts A and B of this problem may be done independently.)

A. At *t* = 0, an isotropic 2-D oscillator is launched with velocity 0.4** m/s in the –*y* direction from the point labeled *P* in the diagram at right. (Here, ** is the angular frequency of oscillation along either axis.)



Determine ***x(t)* = *A* cos*(t* + *)*** and   
***y(t)* = *B* cos*(t* + ** + *)*** as functions of *t.* (That is, determine the parameters *A, B, ,* and *,* with correct units.) Clearly show all work.

*A* =

*B* =

** =

** =

B. Now consider a *different* 2-D oscillator for which the ratio of the force constants is *ky*/*kx* = 4. This oscillator starts to move in the +*y* direction from the point labeled *Q* in the diagram.



On the diagram at right, draw a qualitatively correct trajectory for the oscillator that is consistent with the given information. Briefly explain the reasoning you used to determine your answer.

3. Consider a 2D oscillator whose *x-y* trajectory is shown at right. The oscillator started its motion at the point *(xo* = 4*A,* *yo* = –*A)* and was given an initial velocity in the –*y* direction. Subsequently, the oscillator takes 3.0 s to retrace its path, which is enclosed in a rectangle of length 8*A* and width 4*A.*

In answering the questions below, use the following equations to represent the motion of the oscillator along the *x*- and *y*-axes:



*x(t)* = (4*A*) cos*(1t* + *)*

*y(t)* = (2*A*) cos*(2t* + ** + *)*

Determine the values of *1,* *2,* *,* and *.* Show all work.

4. A two-dimensional (undamped) isotropic oscillator is given the following initial conditions:  =   
(2*d,* 3*d*) and  = (+*d,* –*d*), where ** is the angular frequency of the oscillation.

Determine expressions for *x(t)* and *y(t)* that fit the functional forms shown below. (Treat ** and *d* as known quantities.) Show all work.

*x(t)* = *A1* cos*(t* + *ϕ); y(t)* = *A2* cos*(t* + *ϕ* + *)*