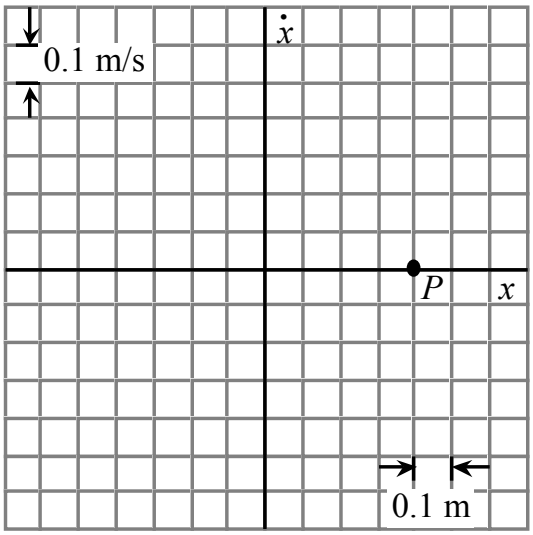
Homework: Phase space diagrams: Simple harmonic motion Name _____

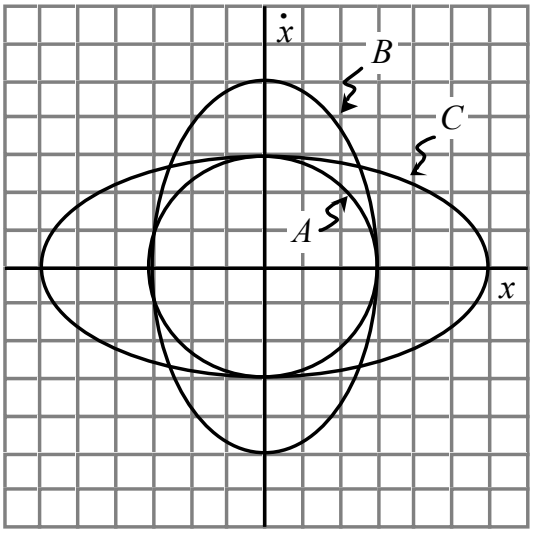
1. A mass m = 750 g is connected to a spring with spring constant k = 1.5 N/m. At t = 0 the mass is set into simple harmonic motion (no damping) with the initial conditions represented by the point P in the phase space diagram at right.



   a. Using the given information, sketch an *accurate* phase space plot for the oscillator. Explain your reasoning and show all work.

   b. On the phase space trajectory you have drawn, label the point Q that represents the position and velocity of the oscillator *one-quarter period after t = 0.* Explain your reasoning.

2. Consider the phase space plots *(A, B,* and *C)* shown below.



   a. Could all three plots correspond to the same simple harmonic oscillator (*i.e.,* same mass and same spring constant)? Explain why or why not.

   b. Which pair of plots could be used to show the effect of keeping the *total energy constant* but *increasing the spring constant?* Clearly indicate which plot would correspond to the larger spring constant. Explain *without* performing any calculations.

   c. Which other pair of plots could be used to show the effect of keeping the *total energy constant* but *decreasing the mass?* Clearly indicate which plot would correspond to the smaller mass. Explain *without* performing any calculations.

3. Consider again phase space **trajectory B** shown in problem 2. Suppose that each unit along the horizontal axis corresponded to 10 cm and that each unit along the vertical axis corresponds to 10 cm/s. Using m = 400 g, determine the following quantities for the oscillator represented by trajectory B. Explain your reasoning and show all work.

   (i) angular frequency, (ii) period, (iii) total energy, (iv) spring constant