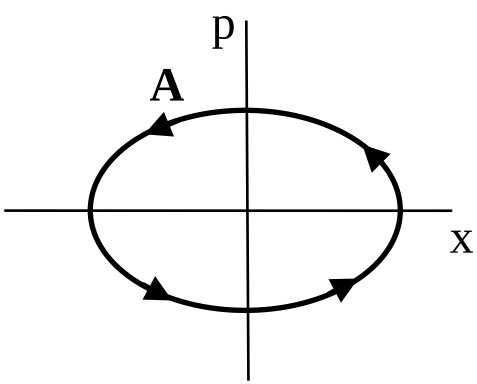
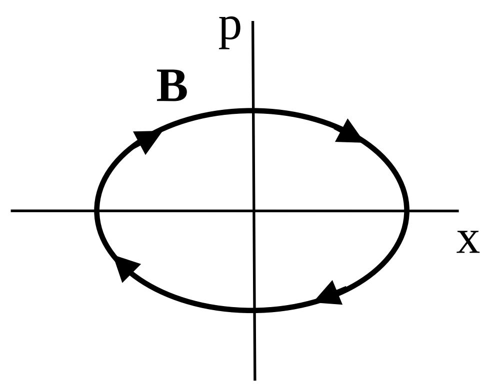
Physics 3210

Week 4 clicker questions

Consider the phase plane of a mass-on-a-spring harmonic oscillator. Phase paths A and B both attempt to describe the motion. Which phase path is physically possible?

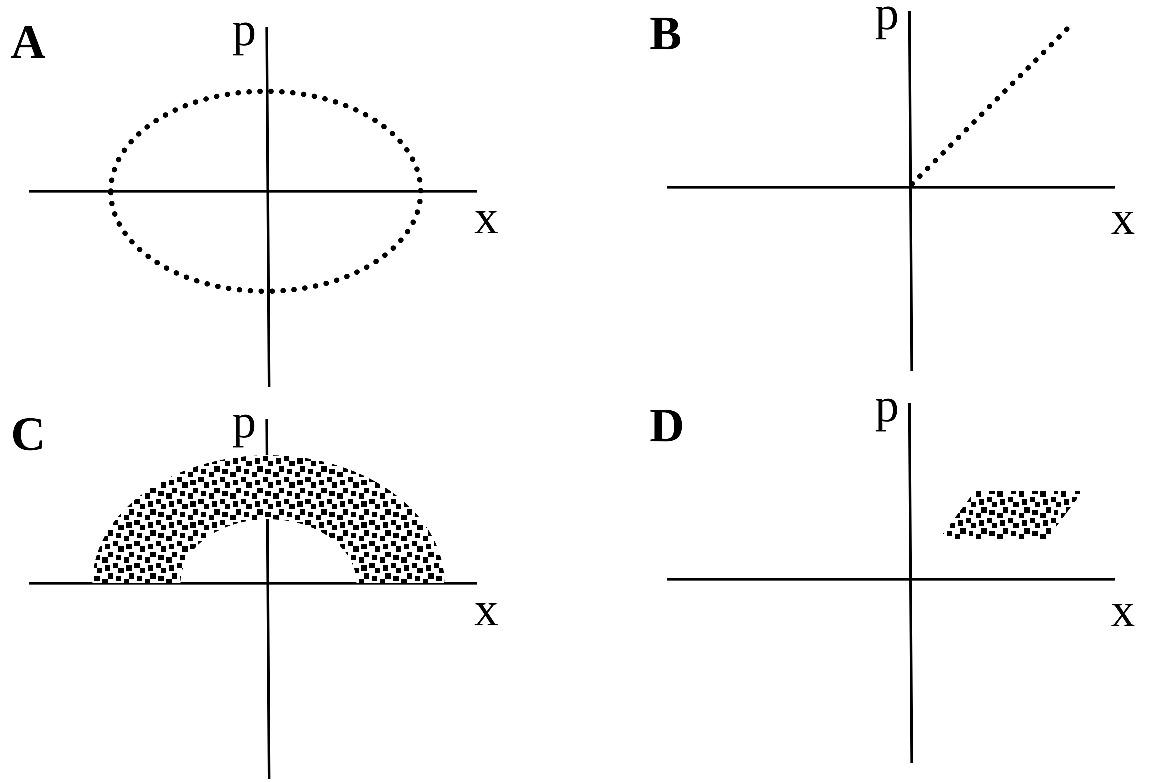




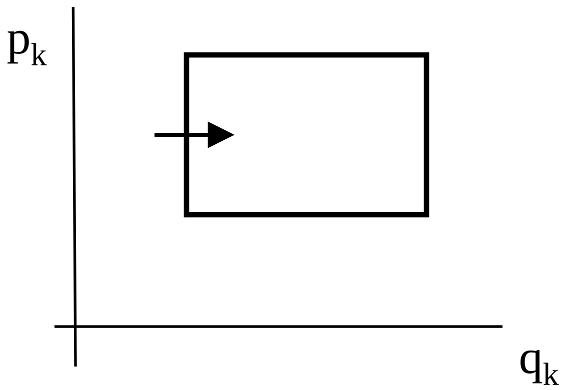
C. Both are possible.

D. Neither is possible.

Consider a collection of harmonic oscillators which all have the **same energy** but **different relative phases**. Which collection of phase points represents this system (at a given instant in time)?



Consider an area element in phase space. What physically must happen for a particle to move into the area across the left boundary?



A. The momentum p_k increases but the position q_k is constant.
B. The momentum p_k decreases but the position q_k is constant.
C. The momentum p_k and the position q_k increase.
D. The momentum p_k and the position q_k are constant.
E. The position q_k increases but the momentum p_k is constant.

Hamilton's canonical equations are: $$\dot{q}_k = \frac{\partial H}{\partial p_k}$$

$$\dot{p}_k = -\frac{\partial H}{\partial q_k}$$

What does this tell you about the derivatives $\frac{\partial \dot{q}_k}{\partial q_k} + \frac{\partial \dot{p}_k}{\partial p_k}$?

A. $\frac{\partial \dot{q}_k}{\partial q_k} + \frac{\partial \dot{p}_k}{\partial p_k} = 1$

C. $\frac{\partial \dot{q}_k}{\partial q_k} + \frac{\partial \dot{p}_k}{\partial p_k} = H$

B. $\frac{\partial \dot{q}_k}{\partial q_k} + \frac{\partial \dot{p}_k}{\partial p_k} = 0$

D. $\frac{\partial \dot{q}_k}{\partial q_k} + \frac{\partial \dot{p}_k}{\partial p_k} = -H$

Physics 3210

Week 3 - Friday clicker questions

What is the result of rewriting the central-force Lagrangian

$$\mathcal{L} = \frac{1}{2}\mathrm{m}_1|\dot{\mathbf{r}}_1|^2 + \frac{1}{2}\mathrm{m}_2|\dot{\mathbf{r}}_2|^2 - \mathrm{U}(\mathrm{r})$$

using

$$\mathbf{r}_1 = \frac{\mathrm{m}_2}{\mathrm{m}_1 + \mathrm{m}_2}\mathbf{r}, \qquad \mathbf{r}_2 = \frac{-\mathrm{m}_1}{\mathrm{m}_1 + \mathrm{m}_2}\mathbf{r}$$

A. $\mathcal{L} = \frac{1}{2}(\mathrm{m}_1 + \mathrm{m}_2)|\dot{\mathbf{r}}|^2 - \mathrm{U}(\mathrm{r})$

B. $\mathcal{L} = \frac{1}{2}(\mathrm{m}_1 - \mathrm{m}_2)|\dot{\mathbf{r}}|^2 - \mathrm{U}(\mathrm{r})$

C. $\mathcal{L} = \frac{\mathrm{m}_1\mathrm{m}_2}{\mathrm{m}_1 + \mathrm{m}_2}|\dot{\mathbf{r}}|^2 - \mathrm{U}(\mathrm{r})$

D. $\mathcal{L} = \frac{1}{2}\frac{\mathrm{m}_1\mathrm{m}_2}{\mathrm{m}_1 + \mathrm{m}_2}|\dot{\mathbf{r}}|^2 - \mathrm{U}(\mathrm{r})$

The central-force Lagrangian $\mathcal{L} = \frac{1}{2}\mu|\dot{\mathbf{r}}|^2 - U(r)$

is spherically symmetric (it doesn't change if the coordinate system is rotate). What does this imply?

A. Energy is conserved.

B. Momentum is conserved.

C. Angular momentum is conserved.

D. Momentum and angular momentum are conserved.

E. Momentum and energy are conserved.

The central-force Lagrangian $\mathcal{L} = \frac{1}{2}\mu\left(\dot{r}^2 + r^2\dot{\theta}^2\right) - U(r)$

is **cyclic** in θ (θ doesn't appear in the Lagrangian). What does this imply?

A. The generalized coordinate θ is constant.

B. The generalized coordinate r is constant.

C. The generalized momentum p_θ is constant.

D. The generalized momentum p_r is constant.