Discuss and Answer:

Describe an example of one of the following (your choice)

1) Both mechanical energy and momentum are conserved
2) Only momentum is conserved
3) Only mechanical energy is conserved
4) Neither are conserved

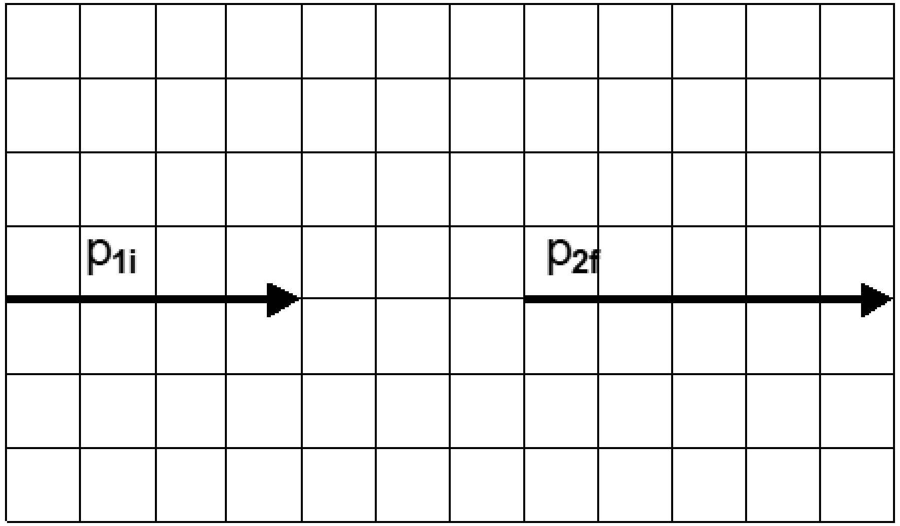
Notes

- Homework on Gravity due Friday
- Exam II will be Nov 20 (Momentum, Rotational Motion - Dynamics, and Gravity)

  →We'll briefly review Momentum today, rotation Friday
- Next Monday, Nov 18 will be a review day as usual.

Recap: Momentum and Collisions

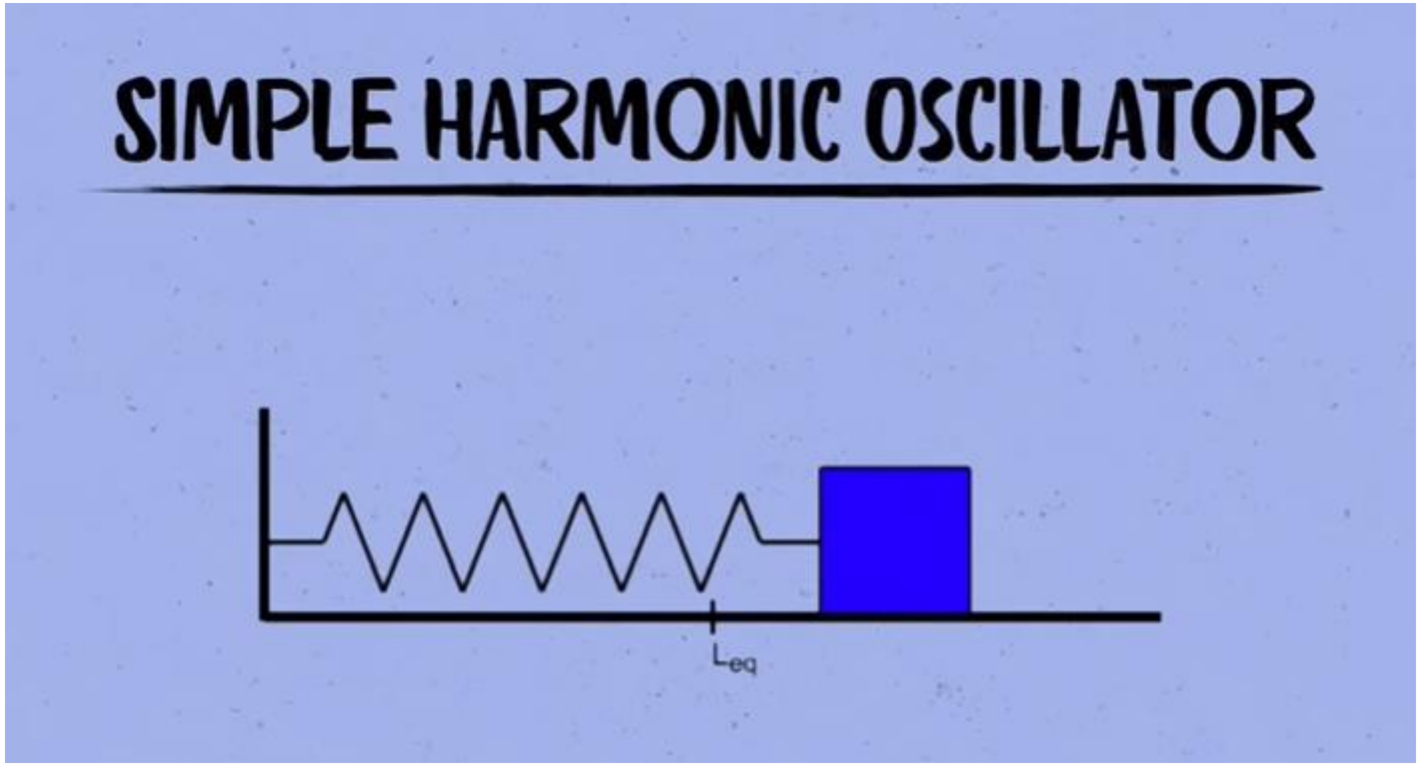
Ball 1 strikes stationary Ball 2 in 1D elastic collision. They both have the same mass. The initial momentum of Ball 1, $\vec{p}_{1i}$, and the final momentum of Ball 2, $\vec{p}_{2f}$, are shown on the graph.



What is the magnitude of the x-component of $\vec{p}_{1f}$?

A) 0 B)1 C)2 D)3
E) This is impossible F) None of these

Prelecture Review: Small Oscillations



$$x(t) = A\cos\omega t + B\sin\omega t$$

Energy near an equilibrium:

$$U \approx U_0 + \frac{1}{2}kx^2 + \cdots$$

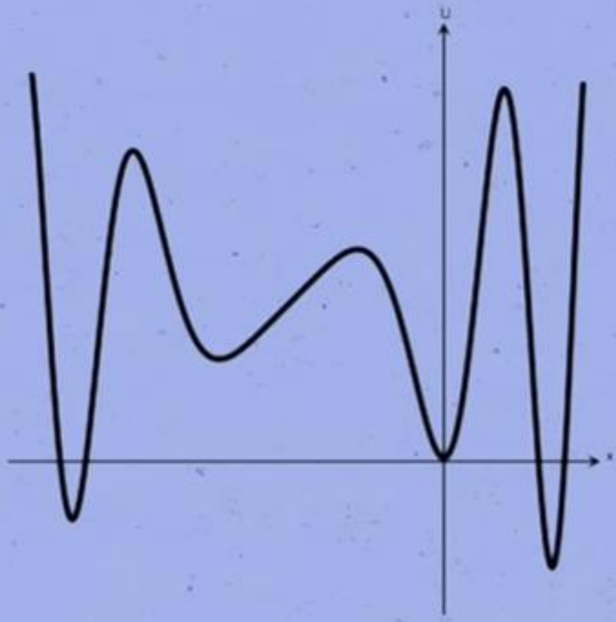
Oscillations:

$$\ddot{x} = -\omega^2 x$$

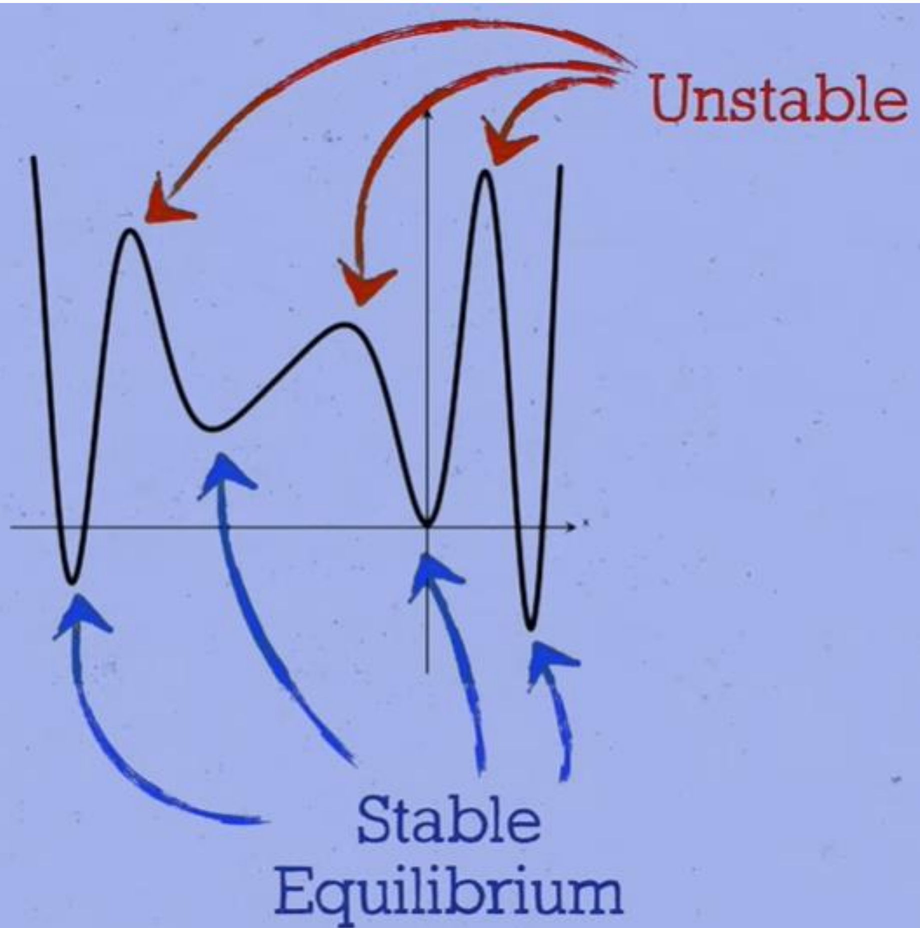
Natural Frequency

$$\omega = \sqrt{\frac{k}{m}}$$

What are our comments and questions?



$$m\frac{d^2x}{dt^2} = -\frac{dU}{dx} \rightsquigarrow x(t) = \cdots$$



Comments and Questions

- What I wonder is if that harmonic oscillating pattern applies for all angles, or up to a certain angle.
- Does hookes law explain why the earth spins in an elipse instead of a perfect circle?
- How would the behavior of the system change if we were to include damping forces, such as friction, and how would this affect our understanding of small oscillations in both classical and quantum contexts?
- I'm confused by the introduction of sin and cos from omega squared; does this come from the pythagorean theorem or a different trig identity?

My comments and Questions

- Comment: “Empty” space in our universe is near equilibrium. Particles are, in some sense, oscillations of fields about this equilibrium in the same way.

- Question: How can we describe systems that a far from equilibrium? We have to go beyond approximations like Taylor series, which is challenging.

Discuss and Answer:

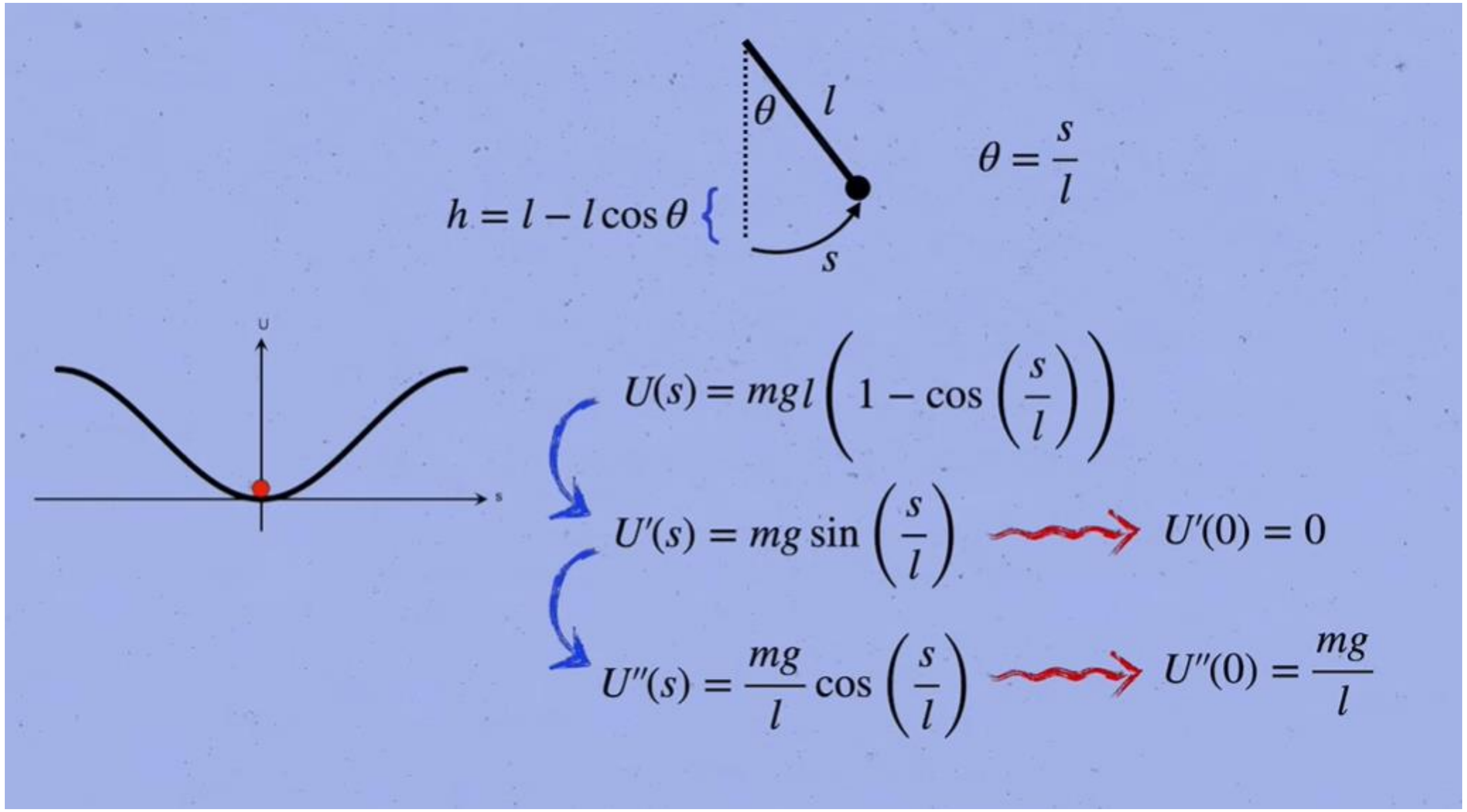
A mass on a spring oscillates with a certain amplitude and a certain period T. If the mass is doubled, the spring constant of the spring is doubled, and the amplitude of motion is doubled, the period …

A: increases

B: decreases

C: stays the same.

Example: Pendulum



$$U(s) \approx \frac{1}{2}U''(0)s^2$$

$$k = \frac{mg}{l}$$

$$\Omega = \sqrt{\frac{g}{l}}$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$g\left(\frac{T}{2\pi}\right)^2 = l?$$

Discuss and Answer:

What will happen if the pendulum is given a tangential velocity (See board). What path will it traverse? What/will there be an associated period?