Class 34

Simple harmonic motion
Waves
Announcements

- Don’t forget to give feedback through the online SOCT forms. Check your MSU email for the link. Closes 12/10/04
Mechanical equilibrium

- $\Sigma \mathbf{F}=0$
  - For extended objects we also must satisfy $\Sigma \tau=0$

- Stable equilibrium: when the object moves away from the equilibrium position it feels a force returning it (e.g., mass on a spring)

- Unstable equilibrium: when the object moves away from the eqm position it feels a force pushing it further away (e.g., spoon on a nose)
An object is in equilibrium when the net force and the net torque on it is zero. Which of the following statements is/are correct for an object in an inertial frame of reference?

A. Any object in equilibrium is at rest.
B. An object in equilibrium need not be at rest.
C. An object at rest must be in equilibrium.
An object can oscillate around

1. any equilibrium point.
2. any stable equilibrium point.
3. certain stable equilibrium points.
4. any point, provided the forces exerted on it obey Hooke’s law.
5. any point.
At which point (A, B, C, D, E) is the velocity negative and the acceleration positive
At which point (A, B, C, D, E) is the velocity negative and the acceleration zero?
At which point (A, B, C, D, E) is the velocity zero and the acceleration positive
A mass attached to a spring oscillates back and forth as indicated in the position vs. time plot below. At point $P$, the mass has

1. positive velocity and positive acceleration.
2. positive velocity and negative acceleration.
3. positive velocity and zero acceleration.
4. negative velocity and positive acceleration.
5. negative velocity and negative acceleration.
6. negative velocity and zero acceleration.
7. zero velocity but is accelerating (positively or negatively).
8. zero velocity and zero acceleration.
A mass suspended from a spring is oscillating up and down as indicated. Consider two possibilities: (i) at some point during the oscillation the mass has zero velocity but is accelerating (positively or negatively); (ii) at some point during the oscillation the mass has zero velocity and zero acceleration.

1. Both occur sometime during the oscillation.
2. Neither occurs during the oscillation.
3. Only (i) occurs.
4. Only (ii) occurs.
An object hangs motionless from a spring. When the object is pulled down, the sum of the elastic potential energy of the spring and the gravitational potential energy of the object and Earth.

1. increases.
2. stays the same.
3. decreases.
A person swings on a swing. When the person sits still, the swing oscillates back and forth at its natural frequency. If, instead, two people sit on the swing, the new natural frequency of the swing is

1. greater.
2. the same.
3. smaller.
A person swings on a swing. When the person sits still, the swing oscillates back and forth at its natural frequency. If, instead, the person stands on the swing, the new natural frequency of the swing is

1. greater.
2. the same.
3. smaller.
Types of waves

Is the wave moving or stationary in space (it must be moving in time!)

• **Traveling wave:** the “disturbance” moves

• **Stationary wave:** objects vibrate up and down but the center of the oscillation doesn’t move in space
Types of waves II

Separate in your head the direction of travel of the wave and the direction of motion of the object vibrating

- **Transverse**: objects move in a perpendicular direction to the wave propagation
- **Longitudinal**: objects vibrate parallel to propagation direction
Wavelength, amplitude, velocity

- $\nu = f \lambda$