PHYS 1001:

Oscillations and Waves

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Module Outline

- 10 Lectures
- Lab + tutorials + assignments
- Assignment #6 due 6 June
- "University Physics", Young & Freedman
- Ch. 14: Periodic Motion
- Ch. 15: Mechanical Waves
- Ch. 16: Sound and Hearing

Overview

L1: Intro to Simple Harmonic Motion (SHM)
L2: Applications of SHM; Energy of Oscillations
L3: Simple and Physical Pendulums; Resonance
L4: Intro to Mechanical Waves
L5: Wave Equation and Wave Speed
L6: Interference and Superposition
L7: Standing Waves; Normal Modes
L8: Sound Waves; Perception of Sound
L9: Interference; Beats
L10: Doppler Effect; Shock Waves

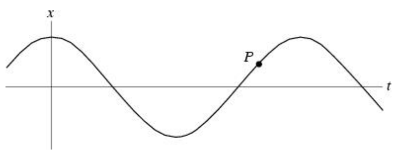
What is an oscillation?

- Any motion that repeats itself
- Described with reference to an
  equilibrium position
  where the net force is zero, and a
  restoring force
  which acts to return object to equilibrium
- Characterised by:
  – Period (T) or frequency (f) or angular freq (ω)
  – Amplitude (A)

§14.1

Test your understanding

A mass attached to a spring oscillates back and forth as indicated in the position vs. time plot below.



Simple Harmonic Motion

Suppose the restoring force varies linearly with displacement from equilibrium
$F(t) = -k\,x(t)$

Then the displacement, velocity, and acceleration are all sinusoidal functions of time

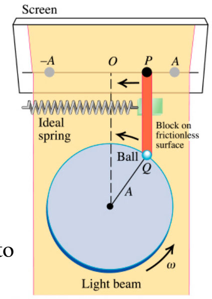
This defines Simple Harmonic Motion (SHM)

- Period/frequency depend only on k and m with
  $\omega = \sqrt{k/m}$
  (does not depend on amplitude!)

§14.2

SHM & circular motion

- An object moves with uniform angular velocity ω in a circle.
- The projection of the motion onto the x-axis is
  $x(t) = A\cos(\omega t + \phi)$
- The projected velocity & acceleration also agree with SHM.
- Every kind of SHM can be related to a motion around an equivalent reference circle.



§14.2

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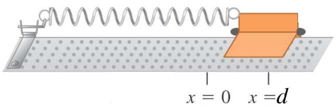
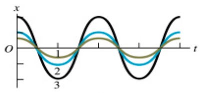
A block on a frictionless table is attached to a wall with a spring. The block is pulled a distance d to the right of its equilibrium position and released from rest. It takes a time t to get back to the equilibrium point.



If instead the mass is pulled a distance $2d$ to the right and then released from rest, how long will it take to get back to the equilibrium point?

Period and Amplitude

Identical Periods
Different Amplitudes



(a)

Identical Amplitudes
Different Periods

(b)

§14.1

Next lecture

Applications of SHM

Read §14.1–14.3