Purdue University Department of Physics

Physics 22000

General Physics

Lecture 12 – Review of Concepts

Fall 2016 Semester

Prof. Matthew Jones

First Midterm Exam

Tuesday, October 4th, 8:00-9:30 pm
Location: PHYS 112 (10:30 section)
WTHR 200 (11:30 section)

Covering material in chapters 1-6
(but probably not too much from chapter 6)

Multiple choice, probably about 25 questions, 15 will be conceptual, 10 will require simple computations.

A formula sheet will be provided.

You can bring one page of your own notes.

I put a couple exams from previous years on the web page.

SUPPLEMENTAL INSTRUCTION

Free Study Sessions!

Rachel Hoagburg

Come to SI for more help in **PHYS 220**

Tuesday and Thursday	7:30-8:30PM Shreve C113

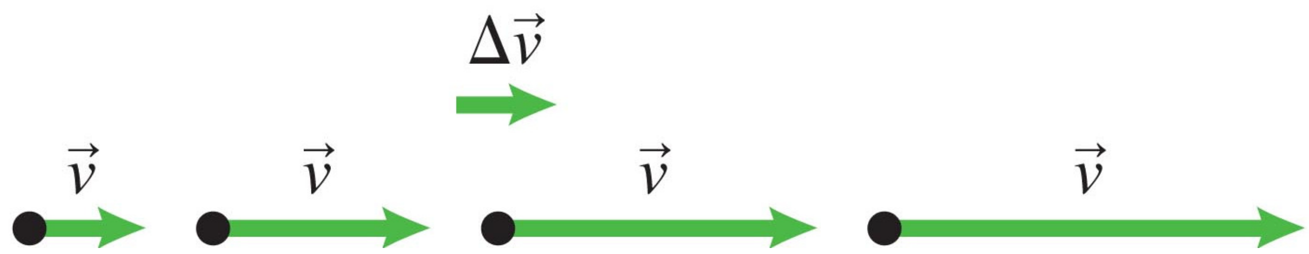
Office Hour

Tuesday 1:30-2:30 4th floor of Krach

For other SI-linked courses and schedules, visit purdue.edu/si or purdue.edu/boilerguide

Review of Concepts – Linear Motion

- Make sure you know how to define a reference frame:
  - Define the origin
  - Define the direction of positive linear motion
  - Define t=0 on the clock
- Motion diagrams



Review of Concepts – Linear Motion

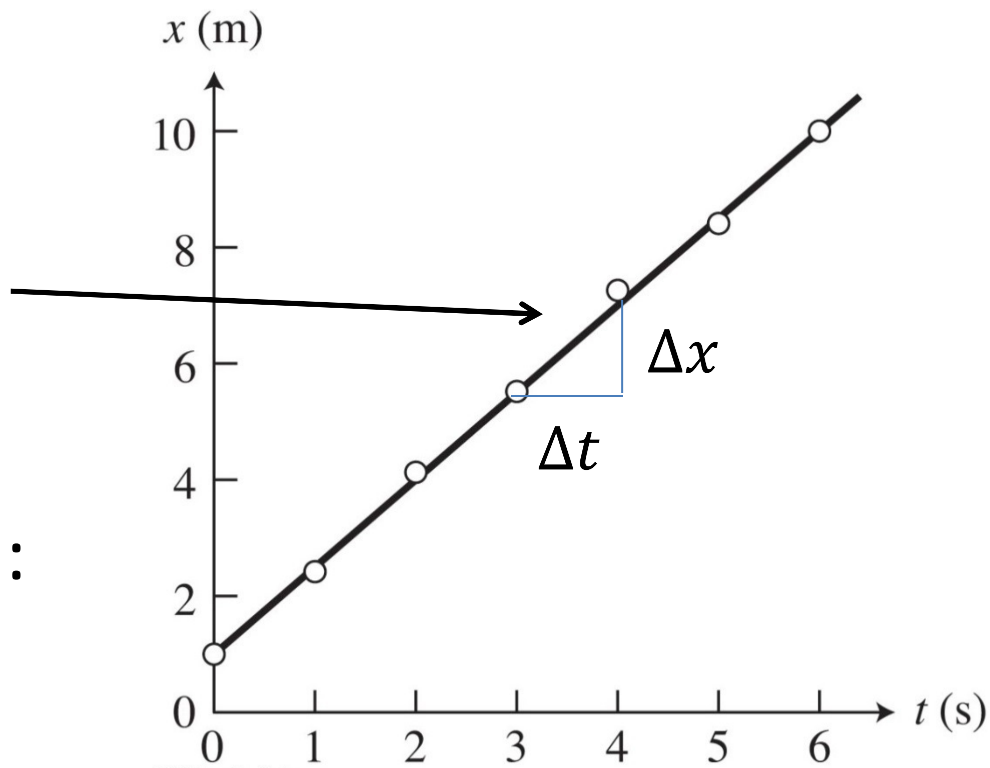
- Make sure you understand the meanings of and subtle differences between the following concepts:
  - Position
  - Displacement
  - Distance
  - Path Length
  - Instantaneous velocity
  - Average velocity
  - Speed
  - Instantaneous acceleration
  - Average acceleration

Review of Concepts – Linear Motion

The slope is,

$$k = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

$$x(t) = x_0 + v_x t$$



Make sure you understand:

- Instantaneous velocity
- Average velocity
- Speed
- Average acceleration

Review of Concepts: Linear Motion

- Distance vs time graphs
- Velocity vs time graphs

$$(x - x_0) = v_x(t - t_0)$$

- Slope is acceleration:

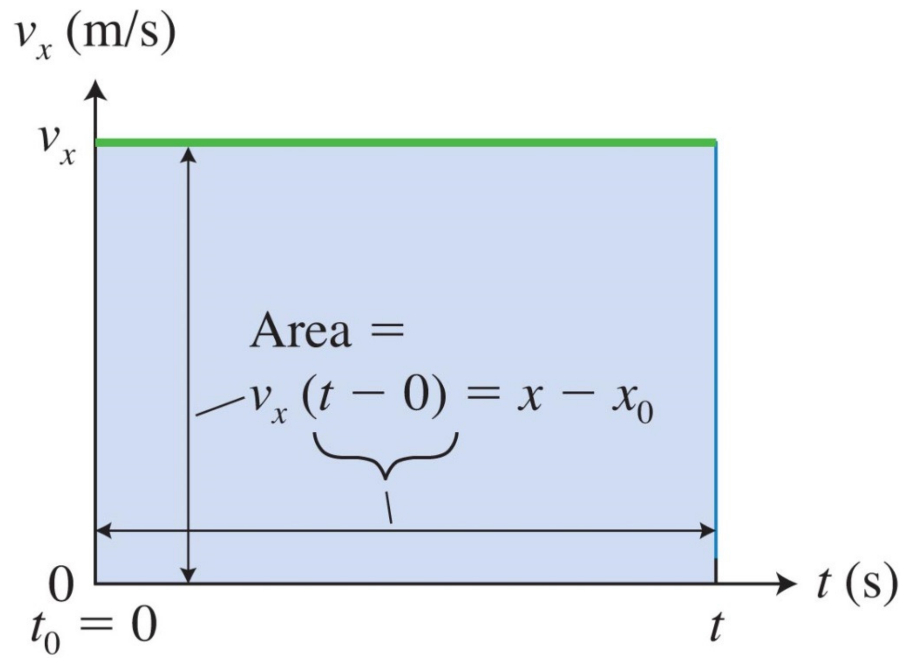
$$\boldsymbol{v_x(t) = v_{0x} + a_x t}$$

- Displacement:

$$\boldsymbol{x(t) = x_0 + v_{0x}t + \frac{1}{2}a_x t^2}$$

- Combining these eqn's:

$$\boldsymbol{2\,a_x(x - x_0) = v_x^2 - v_{0x}^2}$$



An object's displacement $x - x_0$ between $t_0 = 0$ and time t is the area between the v_x-versus-t curve and the t axis.

Review - Newtonian Mechanics

- Make sure you understand how to classify objects into a *system* and its *environment*
- Make sure you can identify *internal* and *external* interactions
- Drawing force diagrams
  - Normal forces
  - Weight
  - Tension in strings
  - Friction (static and kinetic)
- Make sure you understand what an inertial reference frame is…

Review – Newtonian Mechanics

- Newton's Laws
  1. The motion of objects in inertial reference frames remains unchanged when no forces act on them
  2. $\sum \vec{\boldsymbol{F}} = \boldsymbol{m}\vec{\boldsymbol{a}}$
  3. $\vec{\boldsymbol{F}}_{\boldsymbol{object\ 1\ on\ object\ 2}} = -\vec{\boldsymbol{F}}_{\boldsymbol{object\ 2\ on\ object\ 1}}$
- Forces are vector quantities:
  – Make sure you understand how to add their components independently along x- and y-axes.

Review – Projectile Motion

- Acceleration in the y-direction is constant:

$$a_y = -g$$

$$y(t) = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

(assumes +y points up)

- Constant velocity in the x-direction:

$$x(t) = x_0 + v_{0x}t$$

Review – Uniform Circular Motion

- Constant speed, but the direction of the velocity is always changing
  - It's always tangential to the path around the circle
- Acceleration always points towards the center of the circle

$$a = \frac{v^2}{r}$$

- The force needed to keep an object of mass m moving on a circular path is

$$F = ma = \frac{mv^2}{r}$$

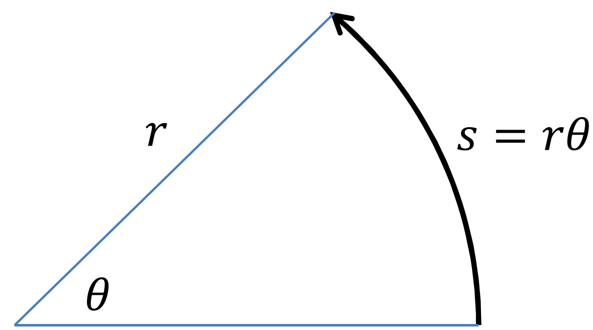
Review – Uniform Circular Motion

- Geometry:
  - Make sure you can calculate the arc length along a circular path:
  - Circumference:

    $C = 2\pi r$

  - Period of orbit:

    $T = C/v$



- Applications: banked highway curves
  - Ideally, the sum of the force of gravity and the radial force must be equal, otherwise you rely on static friction.

Review – Planetary Motion

- Newton's Universal Law of Gravitation:

$$F_{g\ 1\ on\ 2} = G\,\frac{m_1 m_2}{r^2}$$

$$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$$

- Kepler's Laws:
  1. Planets travel in ellipses with the sun at one of the foci
  2. Equal area in equal time law
  3. $T^2/r^3 = K$
- Application: geostationary satellites

Review – Impulse and Linear Momentum

- Linear momentum is a conserved quantity in any system:

$$\vec{p} = \sum m\vec{v}$$

- An external impulse can change the momentum of a system:

$$\vec{p}_f - \vec{p}_i = \sum \vec{F}(t_f - t_i) = \vec{J}$$

- Impulse:

$$\vec{J} = \vec{F}_{avg}\Delta t$$

Review – Work and Energy

- Total energy is a conserved quantity

  $$\text{Total Energy} = U = K + U_g + U_s + U_{int}$$

- Make sure you understand (and can calculate):
  - Kinetic energy
  - Gravitational potential energy
  - Elastic potential energy
  - Internal energy
- How to apply energy and momentum conservation to systems of objects.

Review

Any questions?