Physic² 121:
Fundament°ls of Phy²ics I

October 4, 2006

Front Page of Exam

$$\bar{v} = \frac{\Delta x}{\Delta t} \qquad v = v_0 + at$$

$$\bar{a} = \frac{\Delta v}{\Delta t} \qquad x = \tfrac{1}{2} a t^2$$

$$g = 9.8 \frac{m}{s^2} \qquad x = x_0 + v_0 t + \tfrac{1}{2} a t^2$$

$$\Delta x = v_0 t + \tfrac{1}{2} a t^2$$

$$v^2 = v_0^2 + 2a\Delta x$$

- Newton's Laws
  - 1) An object moves with a velocity that is constant in magnitude and direction, unless acted on by a nonzero net force.
  - 2) The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.
  - 3) If object 1 and object 2 interact, the force exerted by object 1 on object 2 is equal in magnitude but opposite in direction to the force exerted by object 2 on object 1.

Exam Topics

- Dimensional Analysis
- Motion
  - Position
  - Velocity
  - Acceleration
- Motion Graphs in 1-D
- Equations of Motion in 1-D
- Newton's Laws of Motion
- Gravity as a force
- Free-body diagrams (force diagrams)
- Anything covered in tutorial

Projectile Motion

- An object may move in both the x and y directions simultaneously
  - It moves in two dimensions
- The form of two dimensional motion we will deal with is called **projectile motion**

Assumptions of Projectile Motion

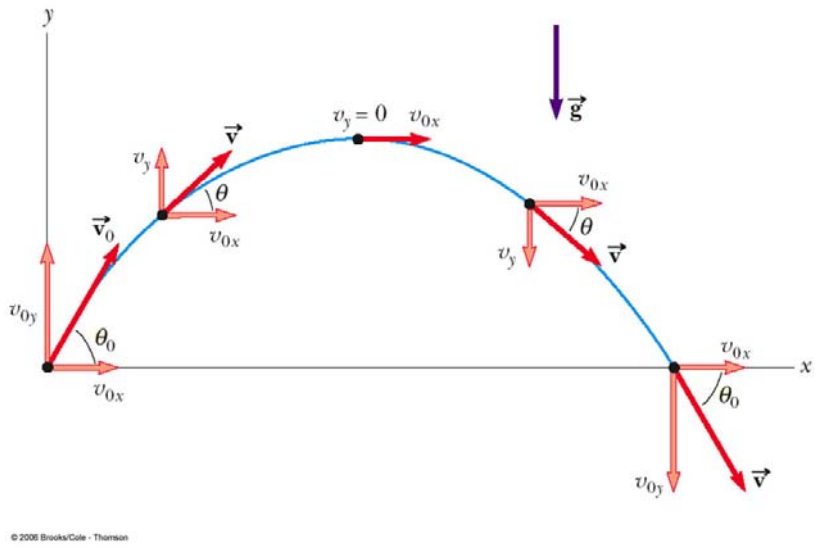
- We may ignore air friction
- We may ignore the rotation of the earth
- With these assumptions, an object in projectile motion will follow a parabolic path

Rules of Projectile Motion

- The x- and y-directions of motion are completely independent of each other
- The x-direction is uniform motion
  - $a_x = 0$
- The y-direction is free fall
  - $a_y = -g$
- The initial velocity can be broken down into its x- and y-components
  -

$$v_{Ox} = v_O \cos\theta_O \qquad v_{Oy} = v_O \sin\theta_O$$

Projectile Motion



Some Details About the Rules

- x-direction
  - $a_x = 0$
  - $v_{xo} = v_o \cos \theta_o = v_x = \text{constant}$
  - $x = v_{xo} t$
    - This is the only operative equation in the x-direction since there is uniform velocity in that direction

More Details About the Rules

- y-direction
  - $v_{yo} = v_o \sin\theta_o$
  - free fall problem
    - a = -g
  - take the positive direction as upward
  - uniformly accelerated motion, so the motion equations all hold

Problem-Solving Strategy

- **Select** a coordinate system and sketch the path of the projectile
  - Include initial and final positions, velocities, and accelerations
- **Resolve** the initial velocity into x- and y-components
- **Treat** the horizontal and vertical motions independently

Problem-Solving Strategy, cont

- **Follow** the techniques for solving problems with constant velocity to analyze the horizontal motion of the projectile
- **Follow** the techniques for solving problems with constant acceleration to analyze the vertical motion of the projectile

Some Variations of Projectile Motion

- An object may be fired horizontally
- The initial velocity is all in the x-direction
  - $v_o = v_x$ and $v_y = 0$
- All the general rules of projectile motion apply