Concepts this Week

Relevant Lectures for Discussion:

- Lecture 1: 1-D kinematics
    1. Definitions of displacement, velocity, and acceleration
    2. 1-D kinematics with constant acceleration
- Lecture 2: 2-D kinematics
    1. Vectors
    2. Projectile motion
    3. Reference Frames

Current PreLectures: PreLectures 1 and 2

Key concepts this week:

- 1-D Kinematics (Prelecture 1)
    - Motion with constant acceleration
    - Average and instantaneous velocity and acceleration
- Algebraic solutions for problems (Prelecture 2)
    - Choosing names (symbols) for quantities in problem
    - Writing answer in terms of quantities in problem
- Projectile Motion (Prelecture 2)
    - Independence of horizontal and vertical motion

Acceleration due to gravity is constant & vertically downward

Bonnie and Clyde

(from Minnesota Cooperative Group Problems #12)
In your new job, you are the technical advisor for the writers of a gangster movie about Bonnie and Clyde. In one scene Bonnie and Clyde try to flee from one state to another. If they get across the state line, they could evade capture, at least for a while until they become Federal fugitives. In the script, Bonnie is driving down the highway at 108 km/hr and passes a concealed police car that is 1 km from the state line. The instant Bonnie and Clyde pass the patrol car, the cop pulls onto the highway and accelerates at a constant rate of 2 m/s^2. The writers want to know if they make it across the state line before the pursuing cop catches up with them.

Catching the Train

You are going to Chicago for the weekend and you decide to go first-class by taking the AmTrak train. Unfortunately, you are late finishing your mathematics exam, so you arrive late at the train station. You run as fast as you can, but just as you reach the platform your train departs, 30 meters ahead of you down the platform. You can run at a maximum speed of 8 m/s and the train is accelerating at 0.8 m/s^2. You can run along the platform for 50 meters before a barrier prevents you from going further. Will you catch your train?

Falling Brick

As you are cycling to classes one day, you pass a construction site on Green Street for a new building and stop to watch for a few minutes. A crane is lifting a batch of bricks on a pallet to an upper floor of the building. Suddenly, a brick falls off while the pallet is rising. You clock the time it takes the brick to hit the ground at 2.4 seconds. The crane, fortunately, has height markings, and you see the brick fall off the pallet at a height of 13 meters above the ground. A falling brick, as we all know, can be dangerous, and you wonder how fast the brick was going when it hit the ground. Since you are taking physics, you quickly calculate the answer.

Escape from Burning Building

Your friend, a world-class long jumper, is trapped on the roof of a burning building. His only escape route is to jump to the roof of the next building. Fortunately for him, he is in telephone contact with you, a Physics 211 student, for advice on how to proceed. He has two options. He can jump to the next building by using the long-jump technique where he jumps at 45^{o} to the horizontal. Or, he can take his chances by staying where he is in the hopes that the fire department will rescue him. You learn from the building engineers that the next building is 10 m away horizontally and the roof is 3 m below the roof of the burning building. You also know that his best long-jump distance is 7.9 m. What do you advise him to do?

Skydivers

The U of I Skydiving Club has asked you to plan a stunt for an air show. In this stunt, two skydivers will step out of opposite sides of a stationary hot air balloon 5,000 feet above the ground. The second skydiver will leave the balloon 20 seconds after the first skydiver, but you want them both to land on the ground at the same time. The show is planned for a day with no wind so you may assume all motion is vertical. To get a rough idea of the situation, assume that a skydiver will fall with a constant acceleration of 32 ft/sec^2 before the parachute opens. As soon as the parachute is opened, the skydiver falls with a constant speed of 10 ft/sec. If the first skydiver, Sue, waits 3 seconds after stepping out of the balloon before opening her parachute, how long must the second skydiver, Joe, wait after leaving the balloon before opening his parachute?

Kinematics

$g = 9.81 \frac{\text{m}}{\text{s}^2} = 32.2 \frac{\text{ft}}{\text{s}^2}$

$\vec{v} = \vec{v}_0 + \vec{a}t$

$\vec{x} = \vec{x}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$

$v^2 = v_0^2 + 2a\left(x - x_0\right)$

$\vec{v}_{A,B} = \vec{v}_{A,C} + \vec{v}_{C,B}$