# Freefall Motion

Pre-Class Questions:

Problem Set (due next time)
Ch 2 – 48, 49, 52, 57

Lecture Outline
1. The Rule of Falling Bodies
2. Examples of Falling Bodies

The Rule of Falling Bodies:

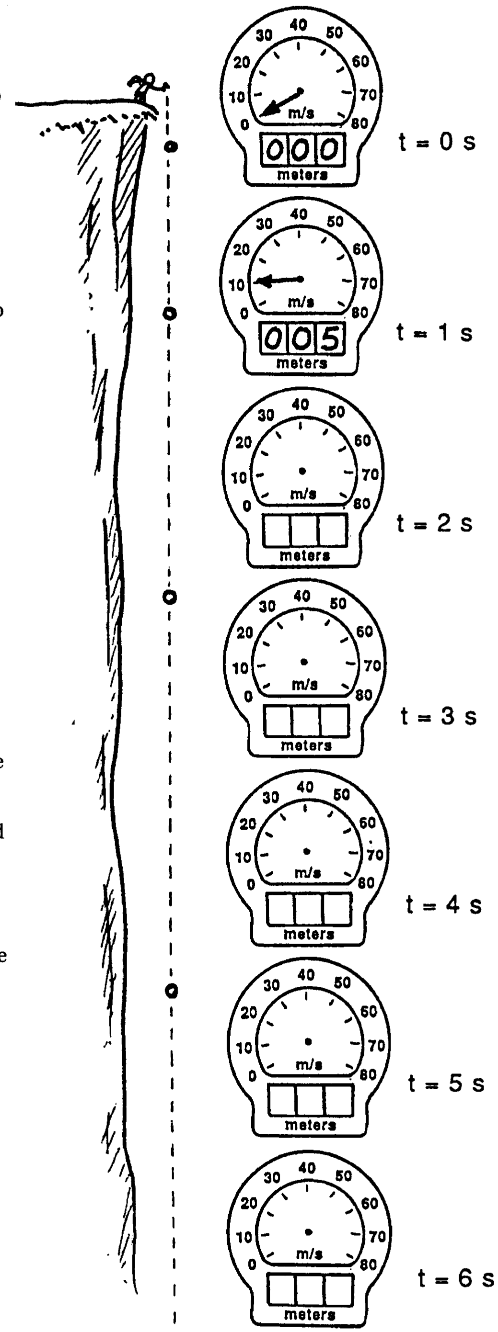
All objects fall toward Earth with an acceleration of $9.80 m/s^2$ in the absence of air resistance.

- This value is called the "acceleration due to gravity" $g = 9.80 m/s^2$.
- This value is only good near the surface of Earth.
- The mass of the falling object doesn't matter (we'll figure out why later).
- This is a rule not a law because it can be deduced from a more basic law as we shall see.

http://www.youtube.com/watch?v=5C5_dOEyAfk

*Free Fall*

A rock dropped from the top of a cliff picks up speed as it falls. Pretend that a speedometer and odometer are attached to the rock to show readings of speed and distance at 1-second intervals. Both speed and distance are zero at time = zero (see sketch). Note that after falling 1 second the speed reading is 10 m/s and the distance fallen is 5 m. The readings for succeeding seconds of fall are not shown and are left for you to complete. So draw the position of the speedometer pointer and write in the correct odometer reading for each time. Use $g = 10\ \text{m/s}^2$ and neglect air resistance.



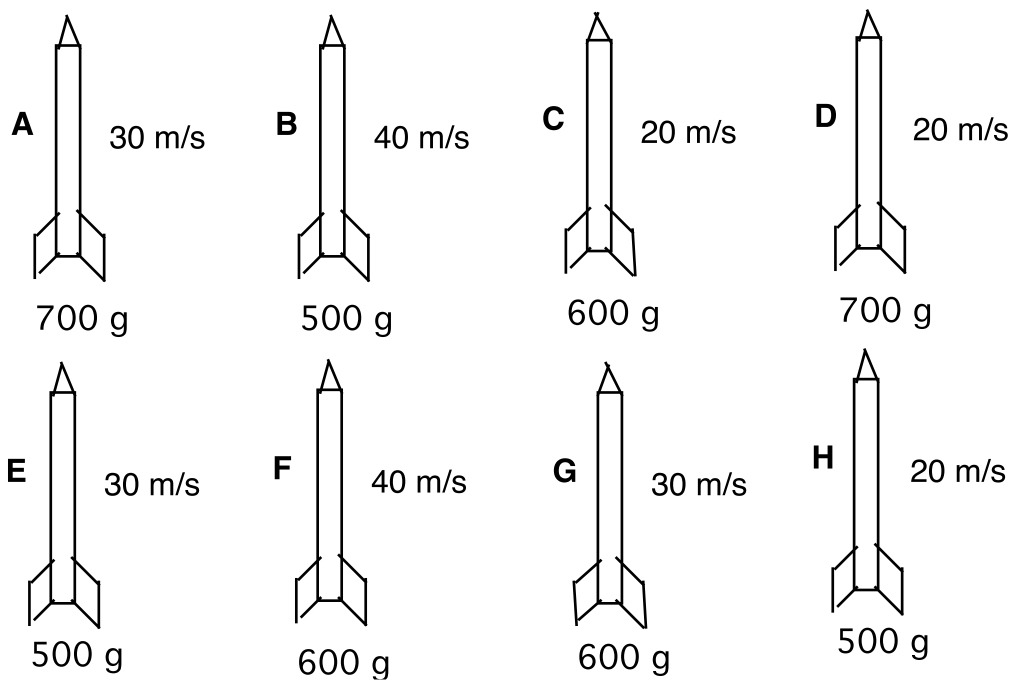

a. The speedometer reading increases by the same amount, _______ m/s, each second. This increase in speed per second is called __________________________.

b. The distance fallen increases as the square of the ________________.

c. If it takes 7 seconds to reach the ground, then its speed at impact is _________ m/s, the total distance fallen is ______ m, and its acceleration of fall just before impact is _______ $\text{m/s}^2$.

The eight figures below depict eight model rockets that have just had their engines turned off. All of the rockets are aimed straight up, but their speeds differ. All of the rockets are the same size and shape, but they carry different loads, so their masses differ. The specific mass and speed for each rocket is given in each figure. (In this situation, we are going to ignore any effect air resistance may have on the rockets.) At the instant when the engines are turned off, the rockets are all at the same height.

Rank these model rockets, from greatest to least, on the basis of the maximum height they will reach.




Highest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ 7_____ 8______ Lowest

Or, all rockets reach the same height. ______

Please carefully explain your reasoning.

*Example 1:A ball is thrown upward with a speed of 15.0m/s. Find (a)the maximum altitude and (b)the time it takes to get there.*

*Example 2:A ball is thrown upward with a speed of 15.0m/s. It reaches a maximum height of 11.5m in a time of 1.53s. Find (a)the time it takes to get back to the ground and (b)the velocity when it gets there.*

*Example 3:A student throws a set of keys vertically up to her roommate at the top of the stairs 4.00m above. The keys are in the air for 1.50s. Find (a)the initial velocity of the keys and (b)the velocity of the keys just before they are caught.*

# Lecture 04 - Summary

The Rule of Falling Bodies:

All objects fall toward Earth with an acceleration of $g = 9.80 m/s^2$ in the absence of air resistance.

- This value is called the "acceleration due to gravity" $g = 9.80 m/s^2$.
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Since the acceleration is constant, the kinematic equations can be used.