

Summer 2009

Concepts of this week's Module

- Mass and weight
- Projectile motion
- Tensions and Ropes



**Course
Concepts**

Mechanics Module 3, Activity 2

As preparation for this Module you took a ride on one of the elevators in the tower, paying attention to the reading of the spring scale for six different cases:

- Starts from rest and starts moving to a higher floor.
- Is moving uniformly up.
- Approaches the higher floor and starts slowing down.
- Starts from rest and starts moving to a lower floor.
- Is moving uniformly down.
- Approaches the lower floor and starts slowing down.

For each of the six cases:

- Describe the reading of the scale.
- Sketch a Free Body Diagram of all the forces acting on the mass during the motion being investigated. Use the diagram to explain the reading of the scale.
- Suppose that instead of a single mass suspended from a spring scale, the apparatus consisted of a *pan balance* with two masses with equal values on the pans. What would be the motion of this balance for each of the six cases you investigated? Explain.



**Course
Concepts**

Mechanics Module 3, Activity 5

Wilma, queen of the drag strip, is about to race her Corvette Z06. She is stationary on the track, waiting for the lights to go green so she can accelerate down the strip. For luck, she always has a pair of fuzzy dice of mass m hanging from the rear view mirror.



We will model the dice hanging from the rear view mirror with the supplied ball and string.

One of your Team should hold the string with the ball hanging down. This person then begins walking forward at a fairly high speed.

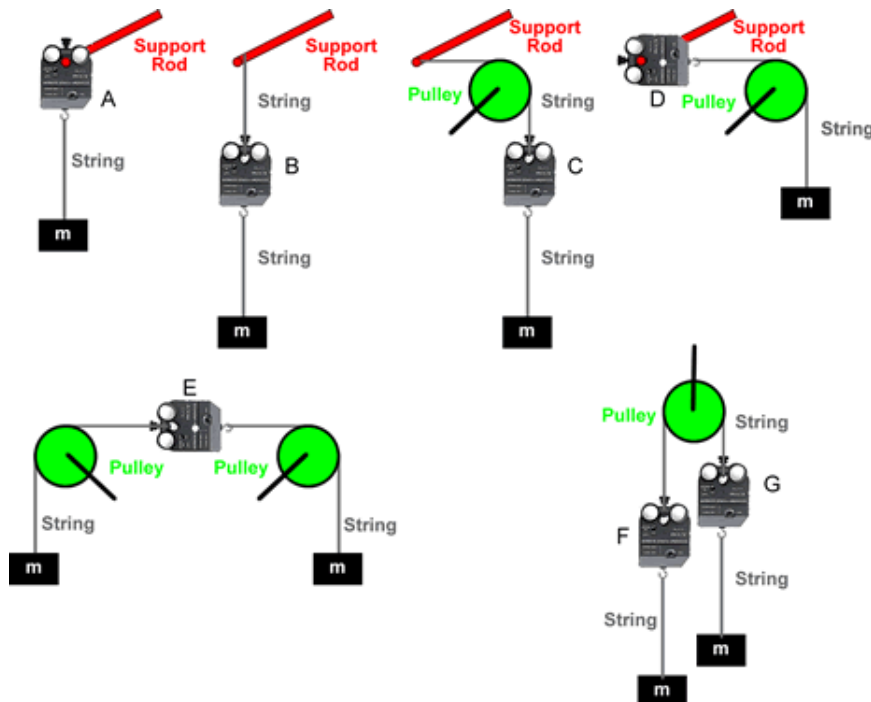
- Before the person started walking sketch a Free Body Diagram of all the forces acting on the ball.
- Initially the ball was at rest for all of you. Newton's First Law says that bodies at rest remain at rest until a force causes their state of motion to change. When the person holding the ball begins walking what does he/she see the ball do? Is this what Wilma would see the fuzzy dice do? Are these consistent with Newton's First Law? Explain.
- For those of you who were not holding the ball and string, what did you see the ball do when the person holding the string began walking? Is this consistent with Newton's First Law? Explain.
- Assume Wilma is accelerating at a constant rate a . For you, standing beside the track, the dice reach a steady state where they are not hanging straight down, but make an angle θ with the vertical as shown. Draw the Free Body diagram of all external forces acting on the dice.
- What is the angle θ ?



Course Concepts

Mechanics Module 3, Activity 12

Suppose you were to hang masses of $m = 0.5$ kg from the Force Sensors with light strings in the configurations shown below.



Predict the readings of the Force Sensors for each of A – G.
Check your prediction by doing the measurements. The sensor tends to “drift” in time.
Therefore, before *each* measurement you should:

1. Have zero force being exerted on the sensor.
2. Press the *Tare* button on the sensor.



**Course
Concepts**

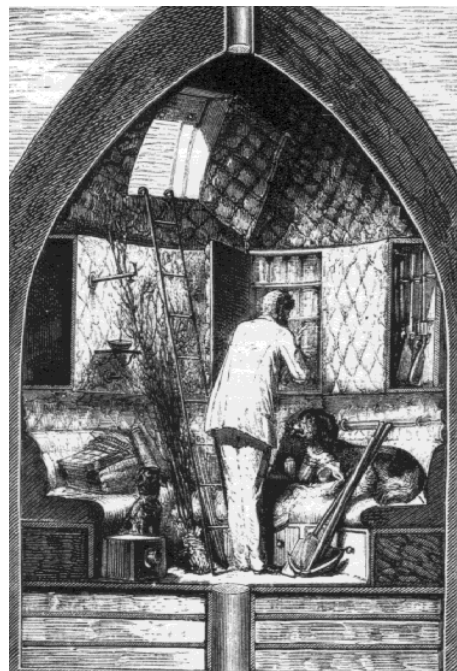
If you have time: Mechanics Module 3, Activity 3

[**STOP!** Please go back and take a second look at what you have recorded in your notebook for the mandatory activities. Is there anything missing? Can anything be improved? Does your TA have advice on what you might be able to do better? Please do not attempt this “If you have time” activity until you feel confident that the other activities are completed to the best of your ability, and you have obtained permission from one of your TAs.]

In Jules Verne’s **From the Earth to the Moon** (1865) a huge cannon fires a projectile at the moon. Inside the projectile was furniture, three people and two dogs. The figure is from the original edition.

Verne reasoned that at least until the projectile got close to the Moon it would be in the Earth’s gravitational field during its journey. Thus the people and dogs would experience normal gravity, and be able to, for example, sit on the chairs just as if the projectile were sitting on the Earth’s surface.

One of the dogs died during the trip. They put the dog’s body out the hatch and into space. The next day the people looked out the porthole and saw that the dog’s body was still floating just beside the projectile.



- A. Is there a contradiction between the inhabitants inside the projectile experiencing normal gravity and the dog’s body outside the projectile not falling back to the Earth?
- B. If your answer to Part A is yes, where did Verne make his mistake? If your answer is no, explain.

Last revision to this write-up: May 24, 2009 by Jason Harlow.

The Mechanics Module 3 Guide was written in July 2007 by David M. Harrison, Dept. of Physics, Univ. of Toronto. Some parts are based on Priscilla W. Laws et al., **Workshop Physics Activity Guide** (John Wiley, 2004), Unit 7. Christos Josephides and Andrew Zasowski have participated in development of the Mechanics Modules 1 – 4, and wrote much of Activity 9 of this Module. Last revision: October 16, 2008.