Lesson2: Newton's Second Law

Section 1: Exploration

Ex1: Pulling a Mass with Constant Force

Directions: Use the video clips to answer the questions below.

1. Measure the acceleration of the cart in each of the three videos. You should use the ruler in the video and the fact that the time between consecutive frames is 0.03s. Remember that for an object that starts from rest and undergoes constant acceleration the displacement is given by $\Delta x = 1/2 \cdot a \cdot t^2$. It is easiest to use this relationship to get the acceleration.

2. How did the cart's acceleration change when the applied force was roughly doubled (compare video 1 and video 2)?

3. How did the cart's acceleration change when its mass was doubled (compare video 2 and video 3)?

4. What is the simplest relationship you can infer between force, mass and acceleration from your observations?

Ex2: Impulsive Forces versus Constant Forces

Directions: Use the two videos to answer the questions below.

1. Does the puck accelerate at any point during the first video clip? If so, when does the acceleration stop? How do you know?

2. Does the puck accelerate at any point during the second video clip? If so, when does the acceleration stop? How do you know?

Ex3: Force Can Change the Direction of Motion

Directions: Use the video clip to answer the questions below.

1. How does the vertical motion of the blue puck compare with the vertical motion of the red puck? Is either puck accelerating? How do you know?

2. How does the horizontal motion of the blue puck compare with the horizontal motion of the red puck? Is either puck accelerating? How do you know?

3. What forces act on the blue puck? The red puck?

4. Do forces in the horizontal direction affect the vertical motion, and vice versa?

Section 2: Discussion

This page is provided for note taking.

Section 3: Application

App1: Hammer and Feather Experiment on the Moon

Directions: Use the video clip to answer the questions below.

1. Which object has the greater acceleration? How can you tell?

2. Which object feels the greater force? How can you tell?

3. If the force on the hammer is 3.2N and its mass is 2kg, what is the acceleration due to gravity near the surface of the moon? What force would the 0.1kg feather then feel?

App2: Softball Hitter

Directions: Use the video clip to answer the questions below.

1. Does the ball appear to be accelerating before the batter hits it? How can you tell?

2. Does the ball appear to accelerate while it is in contact with the bat? How can you tell?

3. Does the ball appear to accelerate after it loses contact with the bat? How can you tell?

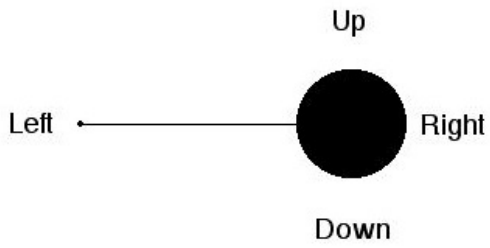
4. Careful observation will allow you to find the frame just prior to the bat and ball making contact and just after. The precise moment of contact cannot be seen. This sets an upper limit on the amount of time the ball can spend in contact with the bat. Use this information and estimates of the ball's speed prior to being hit, and after being hit to estimate the force exerted on the ball by the bat. A softball has a mass of 0.2kg.

App3: Uniform Circular Motion

Directions: Use the first video clip to answer the questions below. DO NOT PLAY THE OTHER TWO CLIPS UNITL YOU'VE ANSWERED THE QUESTIONS.

1. Watch the first video. Is the object accelerating? How can you tell? If so what is providing the force?

2. A snapshot of the massive object in uniform circular motion from the video clip is shown below. Use combinations of the labeled directions to indicate the instantaneous direction of the velocity and force, if applicable. Explain your answer using Newtons's first and/or second laws.



3. Use the labeled directions to indicate the motion of the puck if the string were cut. Explain you answer using Newton's first and/or second laws.