  Investigation 13

Work and Kinetic Energy

Consider a jet on the deck of an aircraft carrier. In order to take off, a catapult is attached to the jet and it is flung off the deck. An F-18 has a gross weight of approximately 17,000 kg and must reach speeds of about 270 km/hr by the end of the 150 m deck. The catapults on aircraft carriers must be able to launch a variety of aircraft that have different masses and minimum air speeds for flight! How would you ensure that you provide enough energy to the aircraft to get it safely off the deck of the aircraft carrier?



Figure 1

Preliminary Observations

Observe the low-friction cart being pushed for some distance and allowed to roll freely. What factors affect the speed of the object after release? What is the relationship between the work done on the cart and the amount of energy the cart has?

Procedure

1. Discuss and decide what variables you will use to describe the energy of a system, along with any energy gained from or lost to the environment.
   * Consider any previous models of energy you have developed.
   * Be able to argue persuasively that the example objects truly gain their kinetic energy from the work being applied.
2. Develop a purpose and a procedure for your investigation.
   * Your purpose should ask a question or propose relationship between the work done to a system and the energy contained in that system.
   * Include the measurement equipment you will use.
   * Decide how much data or observation to take in order to have enough information to satisfy your purpose and stand up to questioning by your peers.
3. Carry out the investigation and record your data and observations. Make sure all group members have access to the data.

Analysis

Prepare your data in an organized fashion to support your proposed energy model. Examine your graphs of motion for objects with a constant work input and those whose work input was varied. Look for consistent patterns in each situation. Develop a method for determining if work is being done on a system. You may wish to look back at your previous work in class or do some additional research.

Consider graphing the energy of the system vs. the work done on the system. Is this a linear relationship? What is the mathematical equation for this relationship?

Extensions

1. Consider other methods to accomplish the same work input. Does the source of the work change the result?
2. Devise a way to test this relationship when an object has some non-zero, initial speed.