HOLT PHYSICS

Discovery Lab

Exploring Work and Energy

SAFETY

- Set up the apparatus, and attach all masses securely. Perform this experiment in a clear area. Swinging or dropped masses can cause serious injury.
- Tie back long hair, secure loose clothing, and remove loose jewelry to prevent their being caught in moving or rotating parts.

MATERIALS

- ✔ clamps
- ✔ cord, 1.00 m
- ✔ force meter
- ✔ inclined plane
- ✔ masking tape
- ✔ meterstick
- ✔ set of hooked masses
- ✔ stopwatch

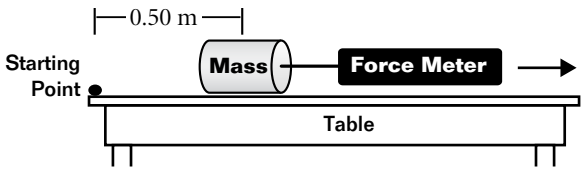
OBJECTIVES

- Measure the force required to move a mass over a certain distance using different methods.
- Compare the force required to move different masses over different time intervals.

Pulling masses

Procedure

1. At one edge of the tabletop, place a tape mark to represent a starting point. From this mark, measure exactly 0.50 m and 1.00 m. Place a tape mark at each measured distance.
2. Securely attach the 1 kg mass to one end of the cord and the force meter to the other end. The force meter will measure the force required to move the mass through different displacements.
3. Place the mass on the table at the starting point. Hold the force meter parallel to the tabletop so that the cord is taut between the force meter and the mass. Carefully pull the mass at a constant speed along the surface of the table to the 0.50 m mark (this may require some practice). As you pull, observe the force measured on the force meter.
4. Record the force and distance in your notebook using the appropriate SI units.
5. Repeat steps 3 and 4 for a distance of 1.00 m.
6. Repeat steps 3, 4, and 5 with a 0.2 kg mass.



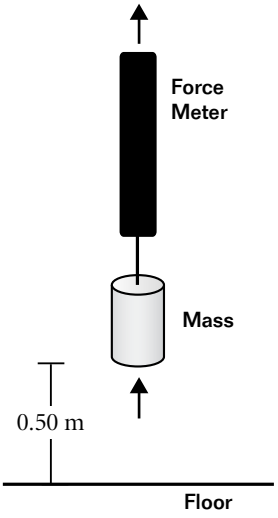
Analysis

A. Did you exert the same force on the 1 kg mass as you did on the 0.2 kg mass to move them an equal distance?

B. Did it require more force to move the mass 1.00 m than to move the same mass 0.50 m?

C. What force did you pull against?

Lifting masses



Procedure

7. Using masking tape, secure a meterstick vertically against the wall with the 0.00 m end on the floor.

8. Securely attach the 1 kg mass to one end of the cord and the force meter to the other end.

9. Place the mass on the floor beside the meterstick. Hold the force meter parallel to the wall so that the cord is taut between the force meter and the mass. Carefully lift the mass vertically at a constant speed to the 0.50 m mark on the meterstick. Be sure that the mass does not touch the wall during any part of the process. As you lift, observe the force measured on the force meter. Be careful not to drop the mass.

10. Record the force and distance in your notebook using the appropriate SI units.

11. Repeat steps 9 and 10 for a vertical distance of 0.25 m.

12. Replace the 1 kg mass with the 0.2 kg mass, and repeat steps 9, 10, and 11.

Analysis

D. Did you exert the same force on the 1 kg mass as you did on the 0.2 kg mass to move them an equal distance?

E. Did it require more force to lift the mass 0.50 m than was required to lift the same mass 0.25 m?

F. What force did you lift against?

G. Did it require a different force to *lift* a mass than it did to *pull* the same mass across the table an equal distance?

Displacing masses using an inclined plane

Procedure

13. Carefully clamp an inclined plane to the tabletop so that the base of the inclined plane rests on the floor. Make sure the inclined plane is in a location where it will not obstruct traffic or block aisles or exits.

14. Measure vertical distances of 0.25 m and 0.50 m above the level of the floor. Use masking tape to mark each level on the inclined plane. Also measure the distance along the inclined plane to each mark. Record all distances in your notebook using the appropriate SI units. Be sure to label the vertical distance and the distance along the inclined plane.

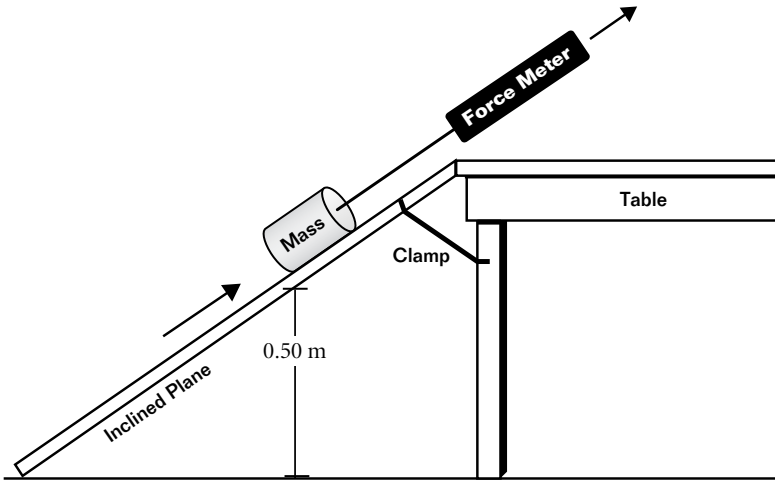
15. Attach the 1 kg mass to the lower end of the cord and the force meter to the other end.

16. Place the mass at the base of the inclined plane. Hold the force meter parallel to the inclined plane so that the cord is taut between the force meter and the mass. Carefully pull the force meter at a constant speed parallel to the surface of the inclined plane until the mass has reached the vertical 0.50 m mark on the inclined plane. As you pull, observe the force measured on the force meter.

17. Using the appropriate SI units, record the force and distance in your notebook.

18. Repeat steps 16 and 17 for a vertical distance of 0.25 m.

19. Repeat steps 16, 17, and 18 for the 0.2 kg mass.



Analysis

H. Did you exert the same force on the 1 kg mass as you did on the 0.2 kg mass to move them an equal distance?

I. Did it require more force to lift the same mass 0.50 m along the inclined plane as it did to lift it 0.25 m?

J. What forces did you pull against?

K. Compare the force required to lift a mass using an inclined plane with the force required to lift the same mass to the same vertical displacement using only the force meter. Why are the values different?

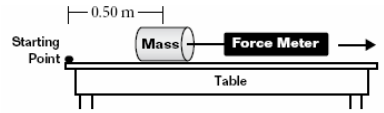
L. How can you adjust the inclined plane so that moving the mass through the same vertical displacement requires less force?

Name _____ Regents Physics
Chapter 5 Work and Energy

Exploring Work and Energy Discovery Lab Answer Sheet

Directions: Place your answers to the Work and Energy Discovery Lab on this answer sheet.

Pulling Masses



Step 4. Record the force and distance using the appropriate SI units.

Mass	Force for 0.5 m distance	Force for 1.0 m distance
1-Kg mass		
0.2 Kg mass		

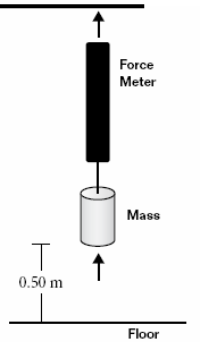
Analysis

A. Did you exert the same force on the 1 kg mass as you did on the 0.2 kg mass to move them an equal distance?

B. Did it require more force to move the mass 1.00 m than to move the same mass 0.50 m?

C. What force did you pull against?

Lifting Masses



Mass	Force for 0.25 m distance	Force for 0.5 m distance
1-Kg mass		
0.2 Kg mass		

Analysis

D. Did you exert the same force on the 1 kg mass as you did on the 0.2 kg mass to move them an equal distance?

E. Did it require more force to lift the mass 0.50 m than was required to lift the same mass 0.25 m?

F. What force did you lift against?

G. Did it require a different force to *lift* a mass than it did to *pull* the same mass across the table an equal distance?

Displacing Masses using an Inclined Plane

Mass	Force for 0.25 m distance	Force for 0.5 m distance
1-Kg mass		
0.2 Kg mass		

Analysis

H. Did you exert the same force on the 1 kg mass as you did on the 0.2 kg mass to move them an equal distance?

I. Did it require more force to lift the same mass 0.50 m along the inclined plane as it did to lift it 0.25 m?

J. What forces did you pull against?

K. Compare the force required to lift a mass using an inclined plane with the force required to lift the same mass to the same vertical displacement using only the force meter. Why are the values different?

L. How can you adjust the inclined plane so that moving the mass through the same vertical displacement requires less force?