UNIT 8
WORK

Objectives

- Understand the mathematical definition of work
- To be able to calculate the work done by different forces and the total work

Equipment:
None

1.1

a. Define work in your own words. (Write a very general definition in every day language.)

b. Would your definition change, if you considered only physical work?

Equipment:
1 piece of cloth

1.2

a. What measurable physical quantities might a mathematical definition of work depend on? Explain.

b. Push or pull a person sitting on a piece of cloth 2m. Push or pull two people on a cloth 2m. In which case are you doing more work?

c. Push or pull a person sitting on a piece of cloth 4s. Push or pull two people on a cloth 4s. In which case are you doing more work?

d. In which of the situations in parts **b** and **c** are you doing more work? Explain. What other experiments could you do in order to define a mathematical definition of work? Perform those experiments.

Work is defined as follows:

> The work done on an object by an agent exerting a constant force on the object is the product of the component of the force in the direction of the displacement and the magnitude of the displacement.

Mathematically,

$$W = F_{\parallel} d$$

where $F_{||}$ is the component of the force parallel to the displacement. If the component of the force is in the direction of the displacement, the work is positive. If the component of the force is opposite to the direction of displacement, the work is negative. If the force is perpendicular to the displacement, the work is zero.

Work is measured in Joules (J). One Joule is one Newton-meter (J = Nm).

Equipment:

- 1 wooden block with hook
- Motion Detector
- Force sensor
- LoggerPro software
- LabPro computer interface

1.3

a. Drop a wooden block (with a hook on it) from table height to the floor. Calculate the work done by the gravitational force while the block is falling. Show your work.

b. Pull the block along the floor at constant velocity with a force sensor. Calculate the work done by you while the block is being pulled at constant velocity. Show your work. Calculate the work done by the gravitational force while the block is being pulled at constant velocity. Show your work. Calculate the work done by the force of friction while the block is being pulled at constant velocity. Show your work.

c. Raise the block from the floor to table height at constant velocity. Calculate the work done by you while the block is being raised at constant velocity. Show your work. Calculate the work done by the gravitational force while the block is being raised at constant velocity. Show your work.

d. Pull the block along the table at constant velocity with a force sensor. Calculate the work done by you while the block is being pulled at constant velocity. Show your work. Calculate the work done by the gravitational force while the block is being pulled at constant velocity. Show your work. Calculate the work done by the force of friction while the block is being pulled at constant velocity. Show your work.

e. If you were to start the block at a height 1.1m meters above the floor, drop it, move it 1m across the floor at constant velocity (as in part **b** above), raise it at constant velocity, then move it back to the starting point, what would be the net work done by the gravitational force? Show your work. Explain.

Equipment:

- 1 piece of cloth
- 1 strong spring

1.4

a. Pull a person sitting on a cloth with a strong spring at an angle (the force should not be parallel to the floor). Calculate the work done by you in pulling the person 2m.

b. Calculate the work done by the frictional force for the person pulled by the cloth with the spring at an angle in part **a** Show your work.

Discuss with an instructor.

c. Work the following problem:

> A block of mass 2.50kg is pushed 2.20m along a frictionless horizontal table by a constant 16.0N force directed 25° below the horizontal. Determine the work done by (i) the applied force, (ii) the normal force exerted by the table on the block, and (iii) the force of gravity. (iv) Determine the total work done on the block.

SUMMARY

You should understand the mathematical definition of work and to be able to calculate the work done by different forces and the total work.