

### Sample Problem:

A porter pulls a 10-kg luggage along a level road for 5m by exerting a force of 20N at an angle of 30 degrees with the horizontal shoulder through a vertical distance of 1.5m and carries it for another 5m. How much work does he do in (a) pulling, (b) lifting and (c) carrying the luggage on his shoulder?

- a. Pulling the luggage

Given:  $F = 20 \text{ N}$

$$\theta = 30^\circ$$

$$d = 5 \text{ m}$$

Find:  $W$

Solution:

$$W = (F \cos\theta)d$$

$$W = (20\text{N})(\cos 30^\circ)(5 \text{ m})$$

$$\mathbf{W = 87 \text{ J}}$$

- b. Lifting the luggage

Given:  $m = 10 \text{ kg}$

$$d = 1.5 \text{ m}$$

Find:  $W$

Solution:

First, determine the weight of the luggage.

$$F = mg$$

$$F = (10 \text{ kg})(9.8 \text{ m/s}^2)$$

$$F = 98 \text{ kg} \cdot \text{m/s}^2 \text{ or } 98 \text{ N}$$

Then, solve for  $W$ .

$$W = F \cdot d$$

$$W = (98 \text{ N})(1.5 \text{ m})$$

$$\mathbf{W = 147 \text{ J}}$$

- c. Carrying the luggage

The force on the luggage is perpendicular to the direction of motion. The distance moved in the direction of force is zero. Therefore, work is zero. Hence, the porter does no work in carrying the luggage.

### WORK AND POWER

Power is the rate of doing work. In equation,

$$\text{Power} = \frac{\text{work done}}{\text{time}}$$

When you go up the stairs fast, you expend more power in a shorter time than when you go slowly. Power is measured in joules per second (J/s) or watts (W). Other related units are used:

$$1 \text{ joule/second} = 1 \text{ watt}$$

$$1000 \text{ watts} = 1 \text{ kilowatt}$$

1 horsepower = 746 watts

Sample Problem:

Regie climbs a flight of stairs in 1.5 min. If he weighs 450 N and the stairs is 10 m from the ground, how much power will he develop?

Given:  $t = 1.5 \text{ min} = 90 \text{ s}$

$F = 450 \text{ N}$

$d = 10 \text{ m}$

Find: P

$$\text{Solution: } P = \frac{W}{t}$$

$$P = \frac{F \cdot d}{t}$$

$$P = \frac{(450 \text{ N})(10 \text{ m})}{90 \text{ s}}$$

$$\mathbf{P = 50 \text{ N} \cdot \text{m/s or } 50 \text{ W}}$$

## POWER AND VELOCITY

When a constant force performs work on an object and moves it at a constant rate, the power developed is equal to the product of the force and velocity. In terms of force,

$$P = \frac{F \cdot d}{t}$$

and

$$v = \frac{d}{t}$$

Therefore,  $P = F \cdot v$

This equation reveals that a powerful machine is both strong (big force) and fast (big velocity). Which means that a machine that is strong enough to apply a large amount of force to cause a large displacement in a short period of time is a powerful machine.

Sample Problem:

How much power is developed by a jumbojet cruises at 250 m/s when the thrust of its engine is 100 000 N?

Given:  $v = 250 \text{ m/s}$

$F = 100 \text{ 000 N}$

Find: P

Solution:

$$P = F \cdot v$$

$$P = (100 \text{ 000 N})(250 \text{ m/s})$$

$$\mathbf{P = 25 \text{ 000 000 N} \cdot \text{m/s or } 25 \text{ 000 000 W}}$$

- Go to library and study the book “Physics Modular Approach”. Author: Padua & Crisostomo
- Read and analyze the sample problems about work, energy, power, and velocity.
- Try to answer the “Self check” part in each topic. It will help you in your upcoming long quiz.