higher education & training
Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

GAUTENG
Community Education and Training
CET COLLEGE

NATURAL SCIENCES (NATS4)

NOTES AND ACTIVITY – US 7509

LESSION 16 **UNPACKING SBA**

THEME: Energy and Change

TOPIC: Work and Power

At the end of this unit, you should be able to:

1. Define work done and power.
2. Explain the relationship between work done and power.
3. Apply formulae in calculations.

A. WORK

- When an applied force causes an object to move, ***work*** is being done on the object by the force
- Work is the measure of energy transfer when a **force (F)** moves an object through a **distance (d)**
- So when work is done, energy is being transferred from one form to another, i.e. energy transferred = work done
- Since work is a transfer of energy, work and energy are measured in the same unit called ***joule* (J)**, a unit named after an English scientist James Prescott Joule, who studied the relationship between *heat, work and energy.*

FORMULA FOR WORK DONE

$$work = force \times distance$$

Where : ***force*** is measured in ***newton (N)***
: ***distance*** is measured in ***meter (m)***

NOTE!!!

Force is a pull or push phenomenon and it is the product of an object's ***mass*** (measured in kg) and its ***acceleration*** (measured in $m.s^{-2}$):

Force = mass x acceleration

- For ***horizontal*** motion, the symbol for acceleration is, ***a***
- For ***vertical*** motion. The symbol for acceleration is, ***g*** = 10 $m.s^{-2}$

WORKED EXAMPLES

1. Determine whether work is done on the following:

SCENARIO	ANSWER	EXPLANATION
A lady pushes a trolley to buy groceries	Work is done	A lady *applies a pushing force* on the trolley and the trolley *moves a certain distance*
A school bag is left on top of a table	No work is done	A school bag *exerts a force* on the table but the *table nor the bag moves*

2. Calculate work done if

Solly is pulling a table with a force of 5 newtons over a distance of 10 meters.	**Data** Force = 5N Distance = 10m Work = ? W = F x d = 5 x 10 = 50 joules (J)
A toy car of mass 0.5.kg accelerates at 3 $m.s^{-2}$ covering a distance of 2 meters.	Data Mass = 0.5 kg Acceleration = 3 $m.s^{-2}$ Distance = 2 meters F = m x a = 0.5 x 3 = 4.5 N W = F x d = 4.5 x 2 = 9 J

B. POWER

Power is the rate at which work is done. It is a measure of how quickly one form energy is converted to another.

Power is measured in ***watt (W)***. The unit is named after James Watt.
A watt is a small unit, so we often use kilowatts (1kW = 1 000W)

FORMULA FOR POWER

$$\text{power (in watts)} = \frac{\text{work done (in joules)}}{\text{time(in seconds)}}$$

- *When 1 joule of work is done in 1 second then the power used is 1watt.*

WORKED EXAMPLE

A crane lifts a 2 000 kilogram load of concrete to a height of 8 metres in 16 seconds. How much power does it use?	**STEP 1**: *Calculate work done* **Work = force x distance** = mass x ***g*** x distance (***g = 10m.s^{-2}***) = 2 000 x 10 x 8 = 160 000 J **STEP 2**: *Substitute work done and time* $\text{power} = \frac{\text{work done}}{\text{time}}$ $= \frac{160\,000}{16}$ = 10 000 W = 10 kW **N.B**: *10 000 W is divided by 1000 to get 10 kW*

ACTIVITY

1. Study Figure 1 and 2, and determine whether work is done or not. (2)

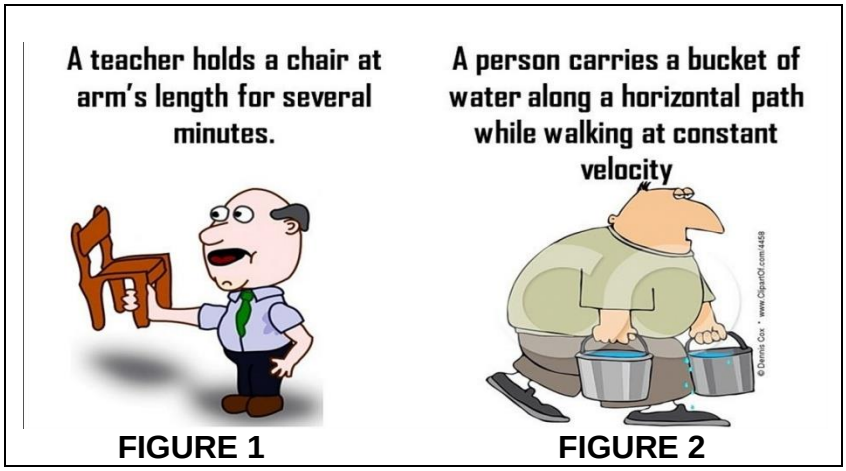

FIGURE 1 **FIGURE 2**

2. Study the diagram and answer the questions.

A lady pushes a trolley with a force of 50 N on a horizontal plane covering a 12 m distance.

2.1 Calculate the amount of work done by the lady. (3)

Work = force x distance

2.2 What is the name of the force acting in the opposite direction to the 50 N applied by the lady on the trolley? (2)

2.3 If the power is increased, does the work done **INCREASE**, **REMAIN CONSTANT** or **DECREASE**? Justify. (3)

Compiler: C Tshabalala