# Efficiency of Pulley Experiment

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**REQUIREMENTS:**

1. With the apparatus set up a pulley system

- with one fixed and one movable pulley
- with two fixed and two movable pulleys

Use a succession of masses as load, determine the work output and input, then determine the efficiency.

2. Make graphs plotting efficiency against load and describe how the efficiency of the pulley system varies with the set of load.

**EQUIPMENTS:**

Two double pulleys, strong cord, stand, clamp, meter stick, weights, spring balance.

**DATA COLLECTING:**

1. Set up the equipments as the diagram.

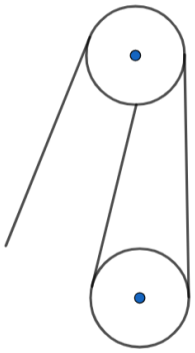

Figure 1: The pulley system with 1 fixed and 1 movable pulley.

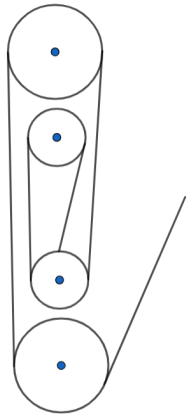

Figure 2: The pulley system with 2 fixed and 2 movable pulley.

2. Pull the string and make the weights rise with constant velocity
3. Read the value on the spring balance and collect the data and change the number of weights every time.
4. Organize the raw data in a data table with units and uncertainties.

## 1 The efficiency of the pulley system with 1 fixed and 1 movable pulley

| | #1 | #2 | #3 | #4 | #5 | #6 |
|---|---|---|---|---|---|---|
| weight (N) | 0.49 | 0.98 | 1.47 | 1.96 | 2.45 | 2.94 |
| pulling force (N) | 0.30± 0.05 | 0.60± 0.05 | 0.85±0.05 | 1.12±0.05 | 1.40±0.05 | 1.70±0.05 |

Because there are 2 string attached on the movable pulley, the height of the weight moved : the length of the string moved = 1:2.

$$\Delta W_{out} = 2 \times \pm 0.05 = \pm 0.10$$

So

$$\eta = \frac{W_{out}}{W_{in}} = \frac{2 \times \text{pulling force}}{\text{weight}}$$

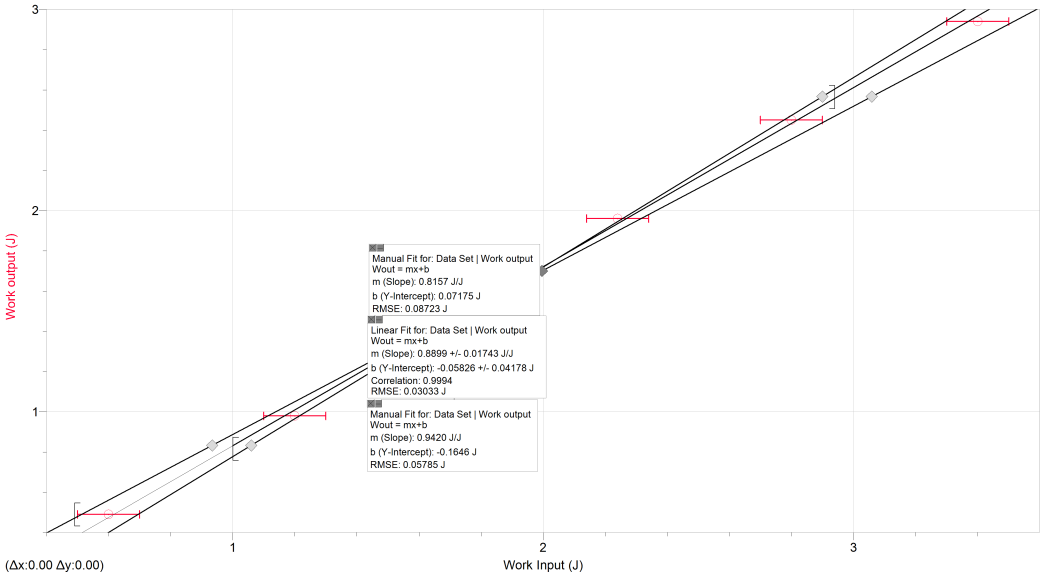


Figure 3: The work output- work input graph, the gradient is the efficiency of the 4 pulleys system.

The efficiency $\eta$ is equal to the gradient of the line. So the mean value is 88.99% and the error is $\pm 7\%$. So $\eta = (89 \pm 7)\%$.

## 2 The efficiency of the pulley system with 2 fixed and 2 movable pulley

| | #1 | #2 | #3 | #4 | #5 | #6 |
|---|---|---|---|---|---|---|
| weight (N) | 0.49 | 0.98 | 1.47 | 1.96 | 2.45 | 2.94 |
| pulling force (N) | 0.20±0.05 | 0.40±0.05 | 0.60±0.05 | $0.80 \pm 0.05$ | $1.00 \pm 0.05$ | $1.30 \pm 0.05$ |

Because there are 5 strings attached on the movable pulley, the height of the weight moved : the length of the string moved = 1:5.

$$\Delta W_{out} = 5 \times \pm 0.05 = \pm 0.25$$

So

$$\eta = \frac{W_{out}}{W_{in}} = \frac{5 \times \text{pulling force}}{\text{weight}}$$

The efficiency $\eta$ is equal to the gradient of the line. So the mean value is 45.46% and the error is $\pm 4\%$. So $\eta = (45 \pm 4)\%$.

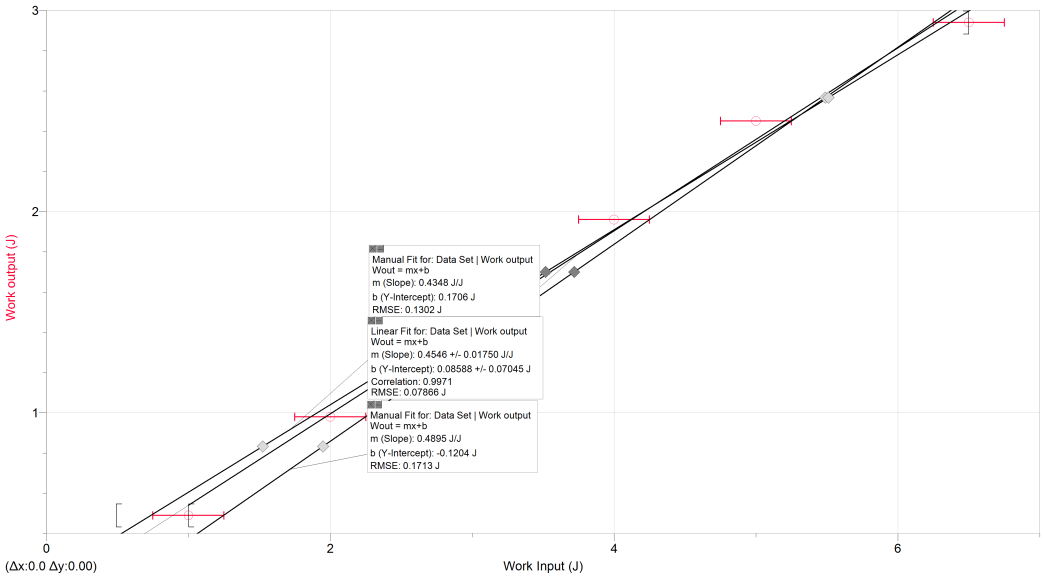


Figure 4: The work output- work input graph, the gradient is the efficiency of the 4 pulleys system.