Block and tackle formed from a loose and a fixed pulley (Item No.: P1001000)

Curricular Relevance

Area of Expertise: Physik

Education Level: Klasse 7-10

Topic: Mechanik

Subtopic: Kräfte, einfache Maschinen

Experiment: Flaschenzug aus einer losen und einer festen Rolle

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	20 Minutes	2 Students

Additional Requirements:

- Scissors

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

The students should recognize on a simple block and tackle that the force required to lift a specific load can be reduced by half compared with the weight (force) by using an arrangement of 2 pulleys. However, a longer distance must be covered. By comparing the products load × load distance and force × force distance they should recognize that both are equal large.

The term “(slotted) weight" is incorrect inasmuch as we are dealing with a mass which becomes a weight (in reality “a weight-force") under the influence of the earth’s gravity. The term “mass piece" used here is better.

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

Block and tackle formed from a loose and a fixed pulley (Item No.: P1001000)

Task and equipment

Task

Does a block and tackle reduce force?

Set up a block and tackle with a moveable and a fixed pulley, and become familiar with its mode of operation.
Lift various loads with it and determine the value of load and force for each case.
Lift a certain load with the block and tackle and determine the load and force distances.

Equipment

Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
3	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with	02035-00	1
3	Boss head	02043-00	1
4	Weight holder for slotted weights	02204-00	1
5	Slotted weight, black, 10 g	02205-01	4
5	Slotted weight, black, 50 g	02206-01	3
6	Pulley,movable,dia.65mm,w.hook	02262-00	1
7	Pulley,movable,dia.40mm,w.hook	03970-00	1
8	Rod for pulley	02263-00	1
9	Spring balance,transparent, 2 N	03065-03	1
10	Measuring tape, l = 2 m	09936-00	1
10	Fishing line, l. 20m	02089-00	1

Set-up and procedure

Set-up

First screw the splitt support rod together (Fig. 1). Set up a stand with the support base (Fig. 2). Push the 25 cm support rod through the hole of the support base and tighten it with the lever (Fig. 3). Put the long support rod in the support base (Fig. 4).

Fig. 1

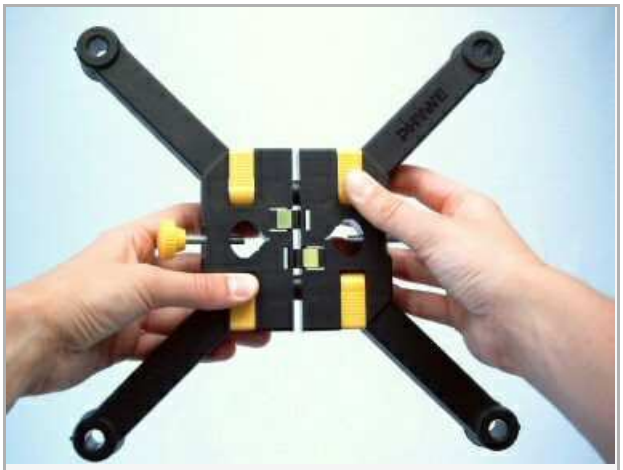

Fig. 2

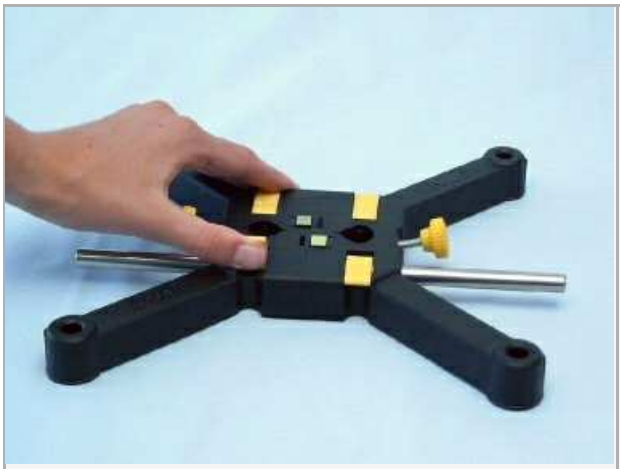

Fig. 3

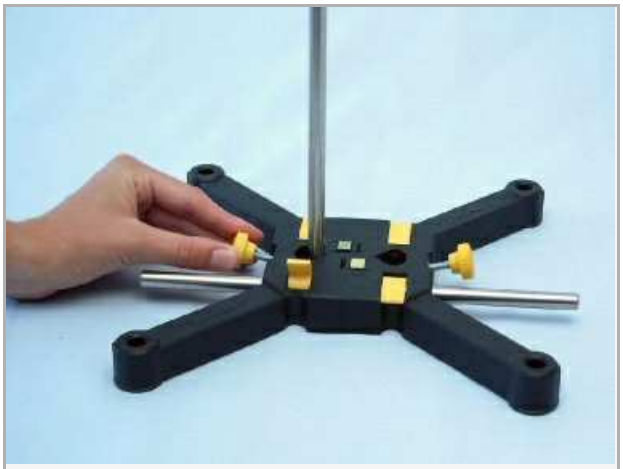

Fig. 4

Fix the pulley (d = 65 mm) to the "rod for pulley" (Fig. 5). Tie a loop in each end of a 120 cm long piece of fish line. Fix one end of the fish line on the rod for pulley (Fig. 6). Clamp the rod with the bosshead on the long support rod (Fig. 7).


Fig. 5

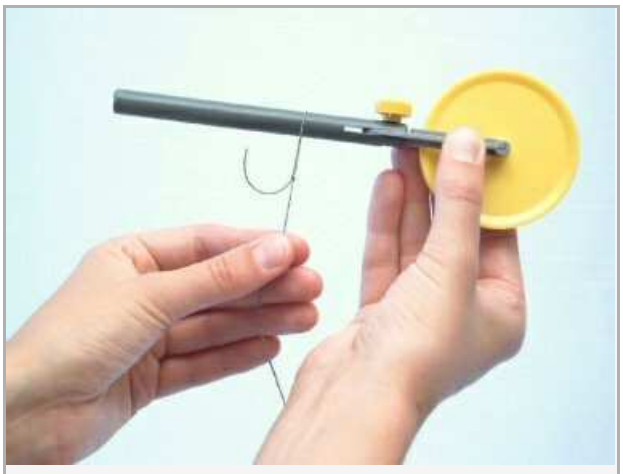
Fig. 6

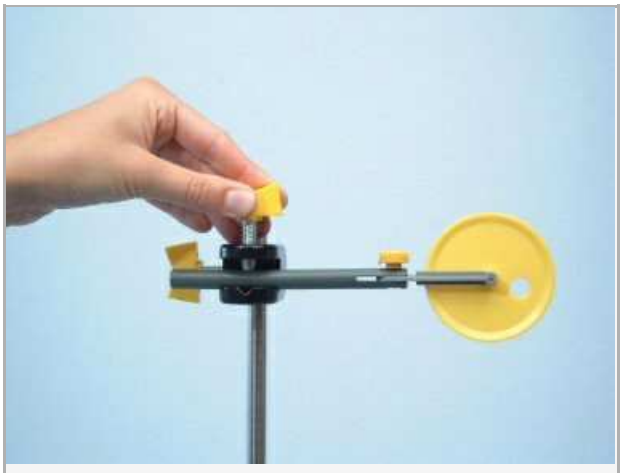
Fig. 7

Use the small pulley as movable pulley, hang the second end of the fish line on the 2 N spring balance and fix it on the 25 cm support rod (Fig. 8).


Fig. 8

Procedure

Determine the weight (force) F_r of the movable pulley and note it in the report. After that, hang the weight holder on the movable pulley; add mass pieces so that the load is 50, 100, 150 and 200 g (Fig. 9). For hanging the slotted weight up the weight holder, you should slip the slotted weight over the top of the weight holder (Fig. 10).

Fig. 9

Fig. 10

Determine the force F for each mass on the loose end of the line with the spring balance (Fig. 11); record the measured values in Table 1.

Fig. 11

- Use 100 g as a load and remove the spring balance.
- Allow the load to rest on the table and pull the line taut.
- Turn the fixed pulley so that its marking point points to the right.
- Tie a knot in the line at the location of the fixed pulley's marking point (Fig. 12).
- Pull on the free end of the line diagonally downward as far as possible; measure the length of the line s_f between the marking knot and the right side of the fixed pulley.
- Measure the distance s_l which the load has been raised (Fig. 13).
- Record the measured values in the report.

Fig. 12

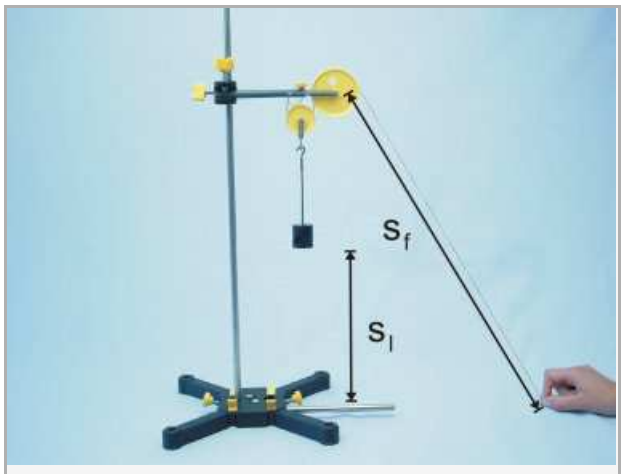

Fig. 13

In order to disassemble the support base you should press the yellow buttons (Fig. 14).

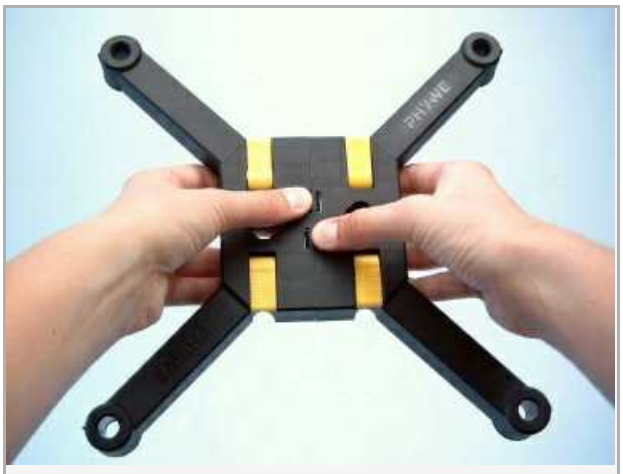

Fig. 14

Report: Block and tackle formed from a loose and a fixed pulley

Results – Question 1

Enter the weight (force) here: F_r = ... N

Results – Table 1

Enter the measured values in the table 1.

Calculate the total weight (force) of the load F_g from the weight (force) F_m of the mass pieces and from that of the movable pulley F_r. Add these values to table 1.

m in g	F in N	F_m in N	F_g in N
50	1 ±0	1 ±0	1 ±0
100	1 ±0	1 ±0	1 ±0
150	1 ±0	1 ±0	1 ±0
200	1 ±0	1 ±0	1 ±0

Results - Question 2

Part 2

Enter measured values here:

m = 100 g

s_l = ... cm

s_f = ... cm

$s_l \cdot F_g$ = ... Ncm

$s_f \cdot F$ = ... Ncm

Evaluation – Question 1

Compare F_g with F. What do you notice?

.....

.....

.....

.....

Evaluation – Question 2

Compare s_l with s_f. What relationship do you see between the two?

.....

.....

.....

.....

Evaluation – Question 3

Calculate the product of the load x load distance and force x force distance. Record these results under "Results - Question 2" and compare them with each other. What statement can be made about them?

.....

.....

.....

.....

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com

Evaluation – Question 4

Express the results in 1. and 2. in a short sentence.

.....

.....

.....

.....

Evaluation – Question 5

Is it possible to reduce force with a simple block and tackle?

.....

.....

.....

.....

Evaluation – Question 6

How do the distances change?

.....

.....

.....

.....

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com