3.6 Block and tackle formed from a loose and a fixed pulley

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.

Use the space below for your own notes.

Material

Material from "TESS advanced Physics Set Mechanics 1, ME-1" (Order No.15271-88)

Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel 18/8, *l* = 250 mm *d* = 10 mm	02031-00	1
2	Support rod, split in 2 rods, *l* = 600 mm	02035-00	1
3	Bosshead	02043-00	1
4	Weight holder for slotted weights, 10 g	02204-00	1
5	Slotted weight, black coloured, 10 g	02205-01	4

5	Slotted weight, black coloured, 50 g	02206-01	3
6	Pulley, movable, *d* = 65 mm, with hook	02262-00	1
7	Pulley, movable, *d* = 40 mm, with 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	Fish line, in reel, *d* = 0.7 mm, 20 m	02089-00	130 cm
Additional Material			
	Scissors		1

Material required for the experiment

Setup

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

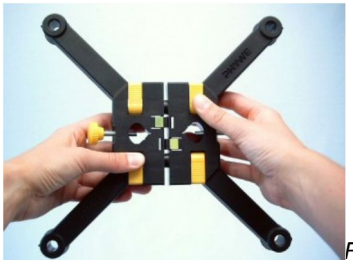
Fig.2

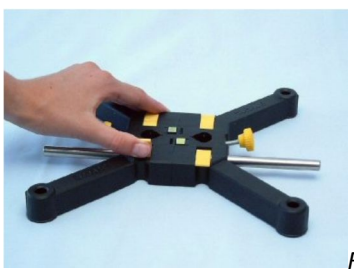
Fig.3

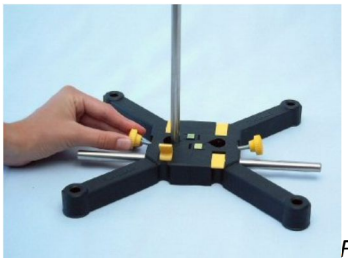
Fig.4

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

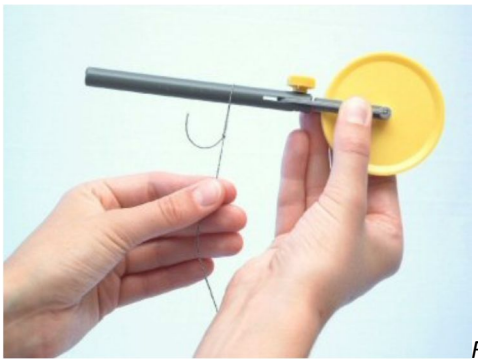
Fig. 6

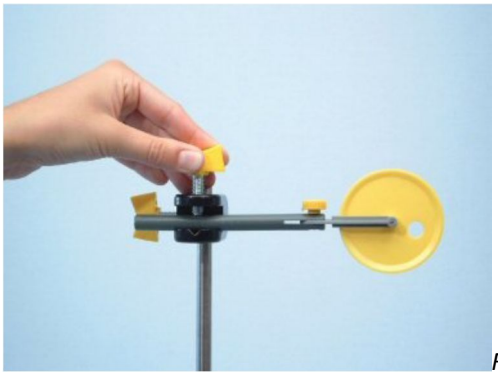
Fig. 7

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

Action

Determine the weight (force) F_r of the movable pulley and note it above Table 1 on the Results page. 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

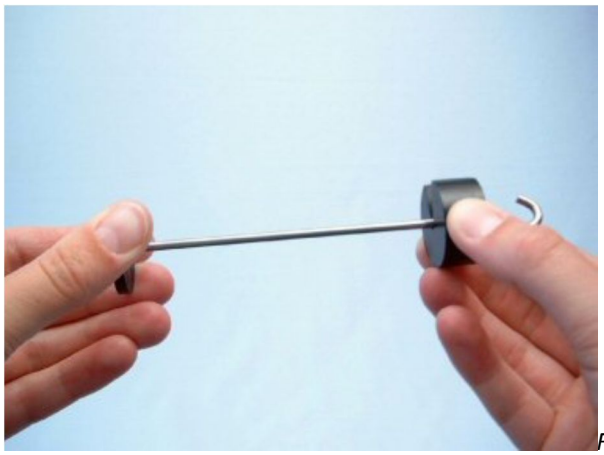
Fig. 10

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 Table 2 on the Results page.

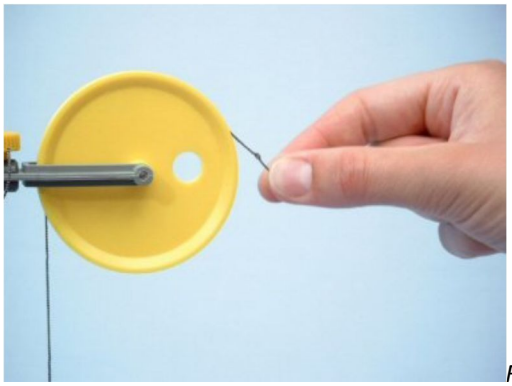
Fig. 12

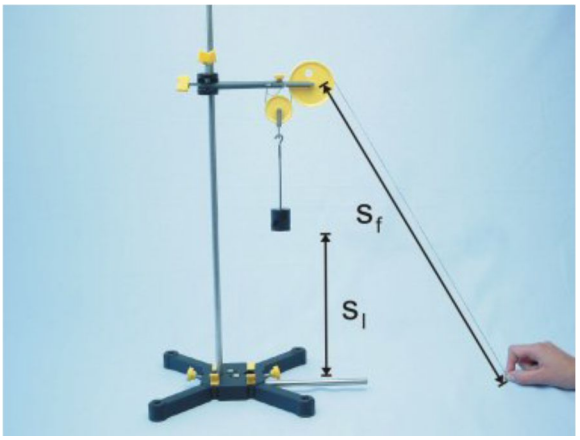

Fig. 13

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

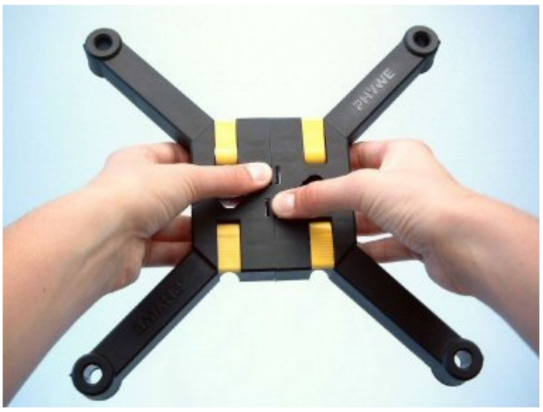

Fig. 14

Results

Table 1

F_r = ☐ N

***m* in g**	***F* in N**	**F_m in N**	**F_g in N**
50			
100			
150			
200			

Table 2

s_l =		***Cm***
s_f =		**Cm**
$s_l \times F_g$ =		**Ncm**
$s_f \times F$ =		**Ncm**

Evaluation

Question 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 on the Results page.

Question 2:

Compare F_g with F. What do you notice?

Question 3:
Compare s_l with s_f. What relationship do you see between the two?

Question 4:
Calculate the product of the load x load distance and force x force distance. Record these results in Table 2 and compare them with each other. What statement can be made about them?

Question 5:
Express the results in 2. and 3. in a short sentence.

Question 6:
Is it possible to reduce force with a simple block and tackle?

Question 7:
How do the distances change?