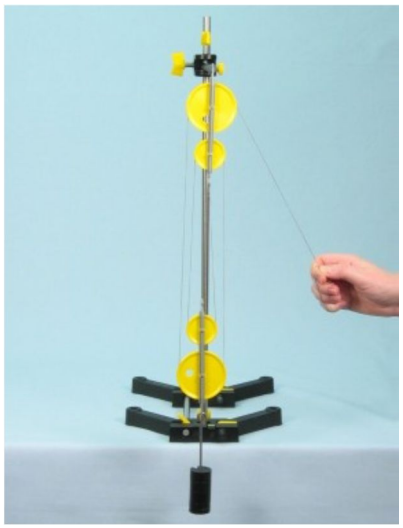
3.12 Power

Task

What is the difference between work and power?

In this experiment you will investigate the influence of time on power.
You will lift a load a specific distance and determine the work required. Then you will lift the same load the same distance, but in different ways: first with a pulley, then with a block and tackle.



Use the space below for your own notes.

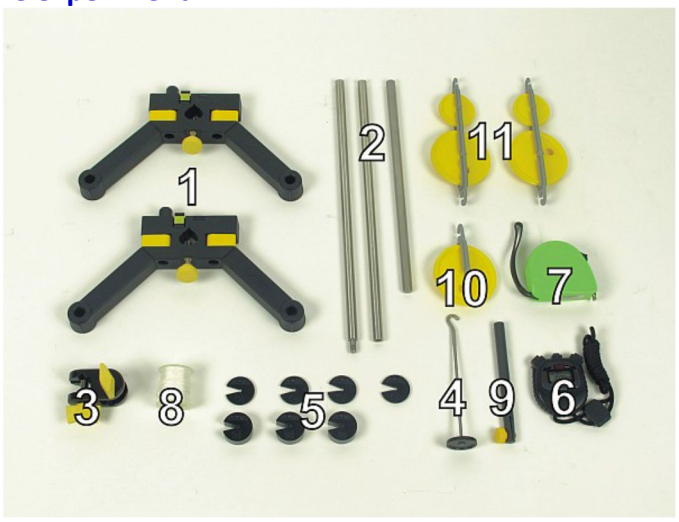
Material

Material from "TESS advanced Physics Set Mechanics 1, ME-1" (Order No.15271-88) and "TESS advanced Physics Supplement Set Mechanics 2, ME-2" (Order No. 15272-88)

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	Stop watch, digital, 24h, 1/100 s and 1 s	24025-00	1
7	Measuring tape, *l* = 2 m	09936-00	1
8	Fish line, in reel, *d* = 0.7 mm, 20 m	02089-00	
9	Rod for pulley	02263-00	1
10	Pulley, movable, *d* = 65 mm, with hook	02262-00	1
11	Pulleys, double in line	02266-00	2
Additional Material	Scissors		1

Material required for the experiment



Setup and Action

- First screw the splitt support rod together (Fig. 1). Connect the two halves of the support base with the 250 mm support rod (Fig. 2). By moving the locking lever up, you will be locking the support rod to the suport base.
- Set the 600 mm support rod into one of the support base halves and fix it with the locking screws (Fig. 3).

Fig. 1

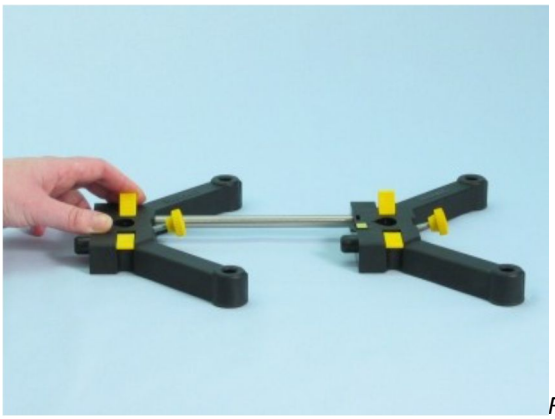


Fig. 2

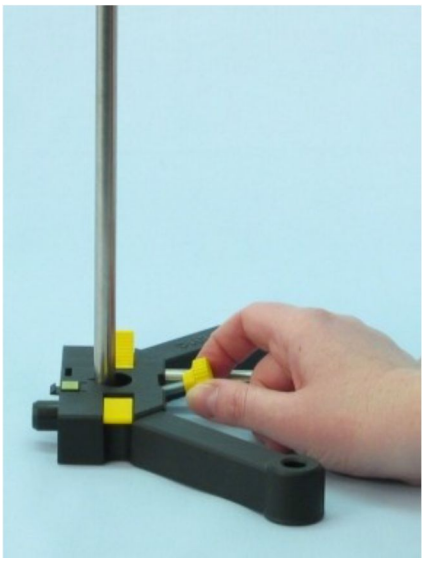


Fig. 3

- Fix the pulley in the rod for pulleys (Fig. 4) and clamp it to the 600 mm support rod with the bosshead (Fig. 5).


Fig. 4


Fig. 5

- Using the pulley, lift a mass of 50 g and then a mass of 200 g from the floor to the table top (Fig. 6). Wind the fish line around your hand while doing this. Take care to wind the line at a speed which is as constant as possible. Measure the distance, and record it as the height *h* in Table 2 on the Results page.
- Measure the time required. Record the measured values in Table 2 on the Results page.


Fig. 6

- Set up a block and tackle as shown in Fig. 7 to 10.

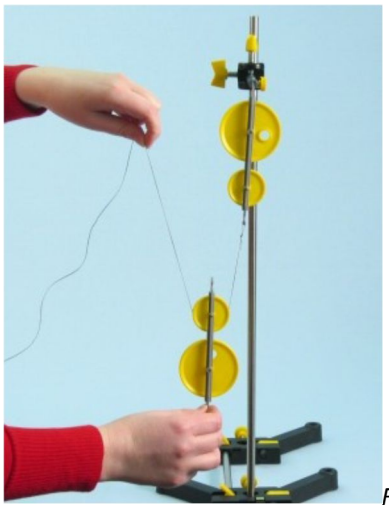


Fig. 7

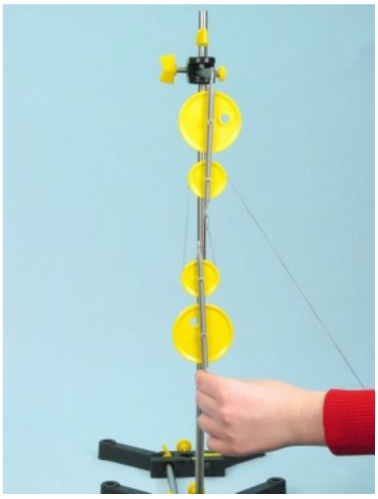


Fig. 8

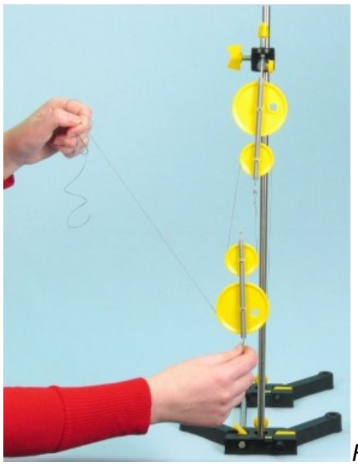


Fig. 9

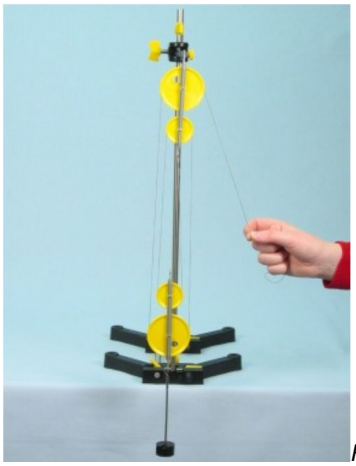


Fig. 10

- Pull the masses of 50 g and 200 g one after another from the floor to the table top by winding the line with approximately the same speed as before.
- Note that the mass of the lower double pulley (m_p = 20 g) contributes to the total mass. Therefore the additional load should be 30 g respectively 180 g (including the weight holder).
- Measure the times and record them in Table 3 on the Results page.

Results

Table 1: Lifting

h = ____ cm

***m* in g**	**F_g in N**	***W* in Ncm**
50		
200		

Table 2: Fixed pulley

h = _____ cm

m in g	t in s	F_g in N	h in cm	W in N cm	P in N cm s^{-1}
50					
200					

Table 3: Block and tackle

h = _____ cm

m in g	t in s	F_g in N	h in cm	W in N cm	P in N cm s^{-1}
50					
200					

Evaluation

Question 1:

Calculate the weight (force) F_g and the lifting work $W = F_g \times h$, and add the values to Table 1.

Questions 2 and 3:

Using the values of the tables 2 and 3, calculate the weight (force) F_g and the lifting work W; then divide these values by the measured times: $P = W / t$.
Record the resulting values in tables 2 and 3.

Question 4:

Compare the values for the lifting work in all three cases.
Are the values different for the same load?

Can you give reasons for this?

Question 5:

For which part of the experiment have you done the most work: for 2. or 3.? Give the impression you got from the experiment.

Question 6:

Compare your assumption with the values for *P* in the tables. Does your assumption agree with the results?

Question 7:

Rewrite the formula $P = W / t$ in terms of *m*, *g*, *h* and *t*.

Question 8:

Power is denoted by *P*. State how power is defined.

Question 9:

Does the power for the same amount of work decrease when the time in which it is conducted decreases?