Forces and work
Force-transforming apparatus

Forces and paths at a block and tackle - Stand setup

D 1.2.3.5.a
Physics experiments
Secondary

Objects of the experiment

1. Investigating the relation between load and force
2. Investigating the relation between the load path and the force path

Setup
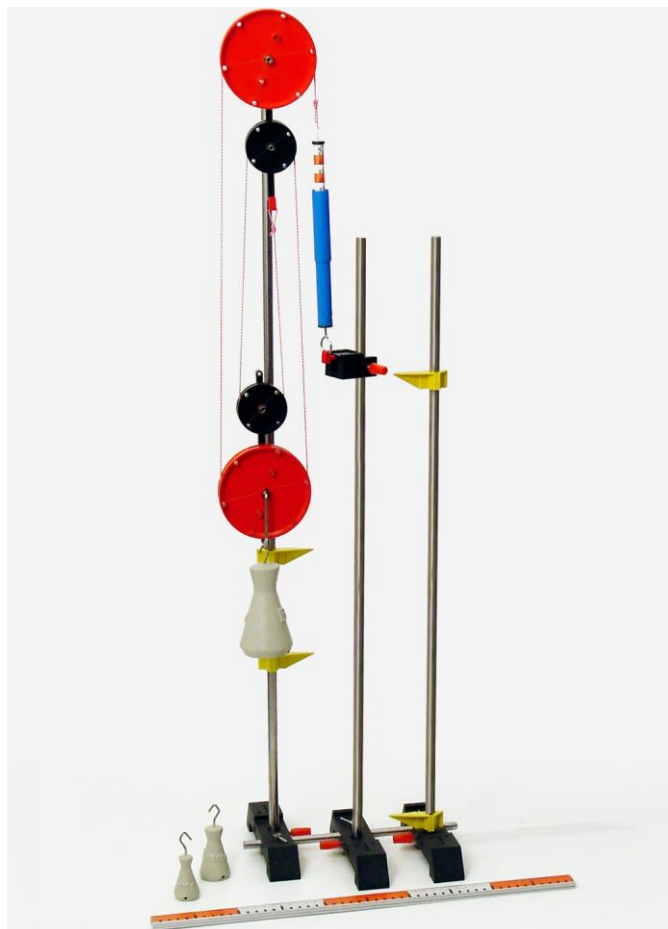
Apparatus

1 Pulley, 100 mm Ø, plug-in, pair, set of 2	340 921ET2
1 Pulley, 50 mm Ø, plug-in, pair, set of 2	340 911ET2
1 Pulley bridge, set of 2	340 930ET2
1 Load hooks, set of 2	340 87ET2
1 Support clip, for plugging in, set of 5	314 04ET5
1 Plug-in axles, set of 2	340 811ET2
1 Weight, 1 kg	315 39
1 Weight, 0.5 kg	315 38
1 Weight, 0.2 kg	683 11
1 Precision dynamometer, 5 N	314 161
1 Metal rule, 0.5 m	460 97
2 Pointer, pair	301 29
3 Stand bases MF	301 21
1 Stand tube 1000 mm, diam. 10 mm	608 052
2 Stand tubes 750 mm, diam. 10 mm	608 051
1 Stand rod, 50 cm, 10 mm diam.	301 27
2 Support blocks	301 25
1 Demonstration cord	309 50

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Carrying out the experiment

1. Relation between load and force:
- Using the dynamometer, measure the gravitational forces of the three weights one after another, and enter them into the table as load F_1.
- Then assemble the experimental setup as shown in the illustration.
- Make the zero adjustment at the unloaded dynamometer.
- Suspend the weight 1 kg.
- Read the force F_2 at the dynamometer.
- Then suspend the other two weights one after another and read the corresponding force F_2.

2. Relation between the load path and the force path:
- Set the load path s_1 with the pointers at the left stand rod to a fixed value of 12 cm.
- Align the load so that its lower edge is at the height of the lower pointer.
- Mark the position of the dynamometer with the upper pointer at the right stand rod.
- Loosen the screw at the support block and pull the dynamometer down until the load has passed the fixed load path.
- Fasten the screw at the support block.
- Mark the new position of the dynamometer at the right stand rod with the lower pointer.
- Measure the distance between the lower and the upper pointer at the right stand rod, and enter it into the table as force path s_2.
- Repeat the experiment with other load paths.

Measuring example

Body	* Load F_1 in N	*Force F_2 in N
weight 1 kg	10	2.5
weight 0,5 kg	5	1.25
weight 0,2 kg	2	0.5

*rounded values

Load path s_1 in cm	Force path s_2 in cm
12	48
8	32
4	16

Evaluation

1. At the loose pulley, the load is equally distributed to four cords. Therefore only a forth of the force is needed for lifting a load: $F_2 = \frac{1}{4} F_1$.

2. The force path is four times the load path: $s_2 = 4s_1$.

Remark: the measured values can be used to calculate the mechanical work performed at the block and tackle: $W = F_1 \cdot s_1 = F_2 \cdot s_2$