

2.14 Reactive forces for a loaded beam

Task

What is the effect of a load on the loading pressure of a beam?

Load a horizontally suspended beam with an additional weight, which you move progressively from right to left. Read the corresponding loading pressures F_1 and F_2 .



Use the space below for your own notes.

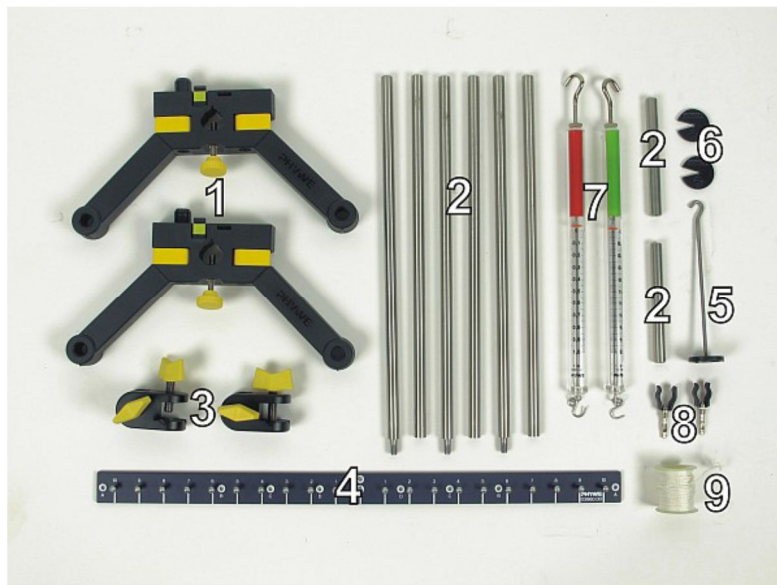
Material

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 with hole, stainless steel, 100 mm	02036-01	2
2	Support rod, split in 2 rods, $l = 600$ mm	02035-00	3

3	Bosshead	02043-00	2
4	Lever	03960-00	1
5	Weight holder for slotted weights, 10 g	02204-00	1
6	Slotted weight, black coloured, 10 g	02205-01	2
7	Spring balance, transparent, 1 N	03065-02	1
7	Spring balance, transparent, 2 N	03065-03	1
8	Spring balance holder for transparent Spring balances	03065-20	2
9	Fish line, in reel, $d = 0.7$ mm, 20 m	02089-00	30 cm
Additional Material			
	Scissors		1

Material required for the experiment



Setup

First screw the splitted support rods together (Fig. 1). Connect the two halves of the support base with the 60 cm support rod and tighten the locking levers (Fig. 2). Set the two 60 cm support rods into the support base halves, tighten them with the locking screws (Fig. 3).



Fig. 1



Fig. 2

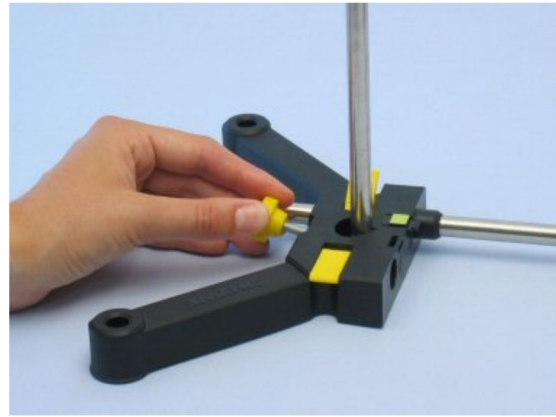


Fig. 3

Insert the spring balance holders into the short rods (Fig. 4). Fix the bosshead at the 60 cm support rod and clamp the short support rod in the bosshead. Clamp the two spring balances into place and adjust them to zero by using the adjustment screw (Fig. 5).

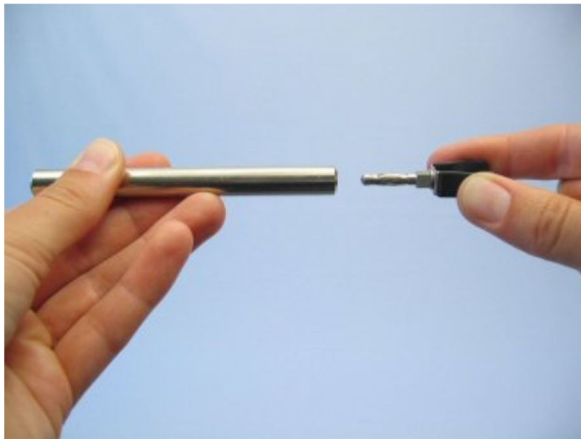


Fig. 4



Fig. 5

Action

Attach two loops (thread length of each = 10 cm) in the two outer holes on the beam (Fig. 6).

Hang the beam on the spring balances with the loops and adjust the heights of the spring balances so that the beam is horizontal (Fig. 7).

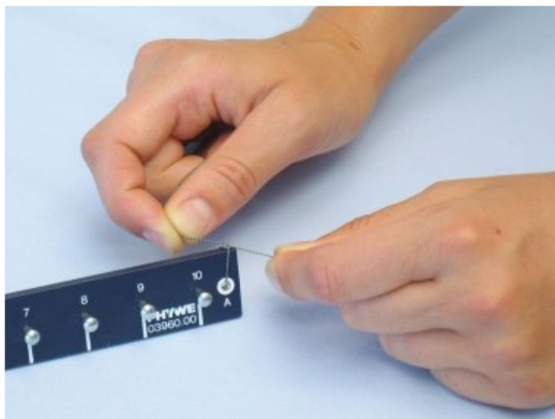


Fig. 6



Fig. 7

- Read the forces F_1 and F_2 without additional load and note the measured values in Table 1 on the Results page.
- Hang the weight holder with two 10 g mass pieces ($m = 30$ g) on the right 9 mark.
- Read the forces F_1 and F_2 and note them in Table 1, too.

- Hang the mass successively on the 7, 5, 3, 1 marks beginning at the right and continue further to the left on the 1, 3, 5, 7, 9 marks.
- Record the respective values for F_1 and F_2 in Table 1.

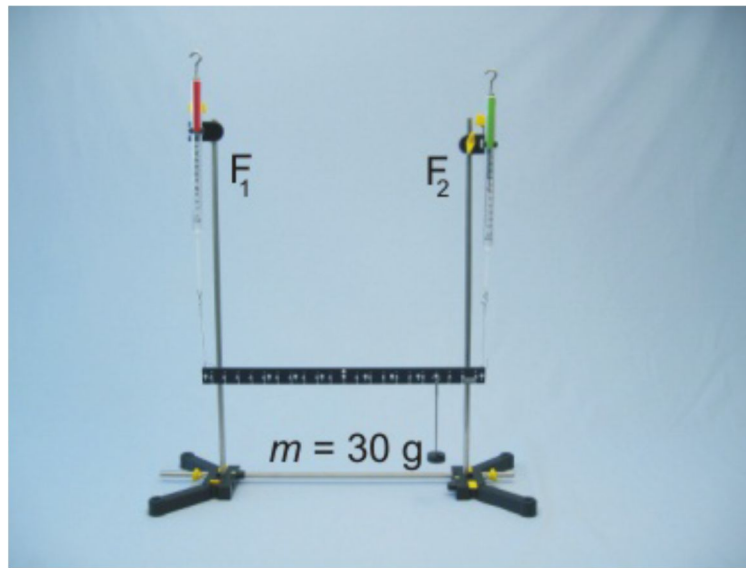


Fig. 8

Determine the beam's weight (force) F_b and record its value above Table 1 on the Results page.

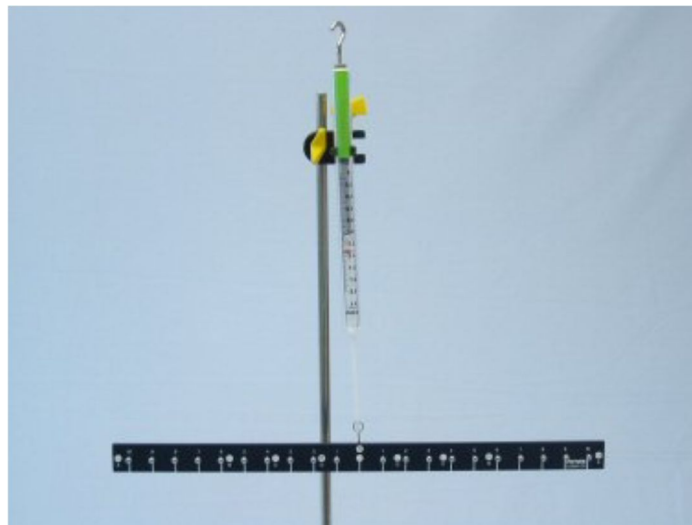


Fig. 9



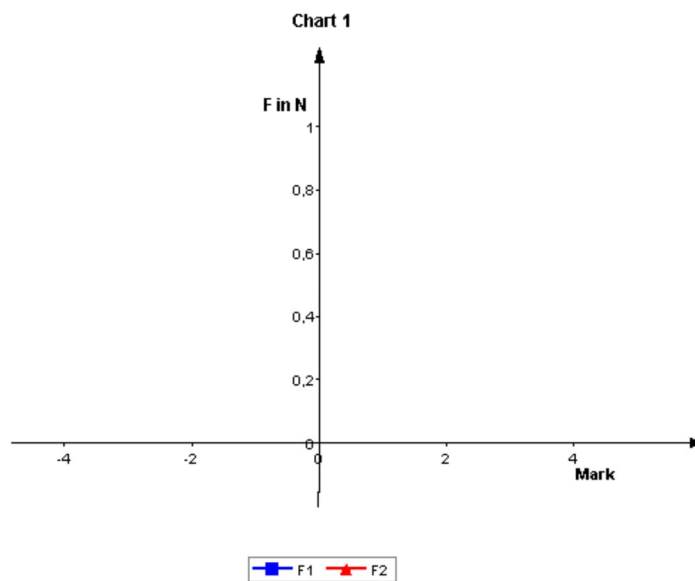
Results

Weight (force) of the beam: $F_b =$ N

Weight (force) of the mass m : $F_g =$ N

Table 1

Mark No.	F_1 in N	F_2 in N	F_{tot} in N
Force without mass, F_0			
9 _{ri}			
7 _{ri}			
5 _{ri}			
3 _{ri}			
1 _{ri}			
1 _{ri}			
3 _{ri}			
5 _{ri}			
7 _{ri}			
9 _{ri}			





Evaluation

Question 1:

Using the measured values calculate the sum of the loading pressures, $F_{\text{tot.}} = F_1 + F_2$ and complete Table 1 on the Results page.

Question 2:

Compare $F_{\text{tot.}}$ with the weight (forces) F_B and F_g . What is the result of your comparison?

Question 3:

How can you explain the correlation between the determined loading pressures and the point of impact of the mass? What is the role of the beam's center of gravity in this correlation? Watch the chart on the Results page. The chart is the graph of the measured values of F_1 and F_2 as a function over the position of the mass.

Question 4:

Complete the following statements:

When the mass m is moved from the right to the left,

the force F_2 becomes and the force F_1

Question 5:

How would the force F_{10} (without load) be changed by an additional load which was applied directly to the right suspension point of the beam?

**Question 6:**

Where do the lines for F_1 and F_2 intersect?

At the mark number , or in of the beam.

Question 7a:

What is the significance of this intersection point?

Question 7b:

Is there a difference in the effect of a mass on the forces F_1 and F_2 when the mass is applied to the left or the right of this intersection?

Question 7c:

How do the forces act at the intersection?

Question 8:

How would an increase in the load (mass m) affect the curve of F_1 in the chart on the Results page in a repetition of the series of measurements?

Question 9:

What would the effect on F_2 be?

