2.7 Forces aligned in the same and opposite directions

Task

When can forces be added?

First you will investigate the effect of two forces acting in the same direction on a mass piece; then the effect of two forces acting in opposite directions on it will be studied. From the comparison of the two measured forces with the given weight (force) you should deduce the relationship among the three forces.

Use the space below for your own notes.

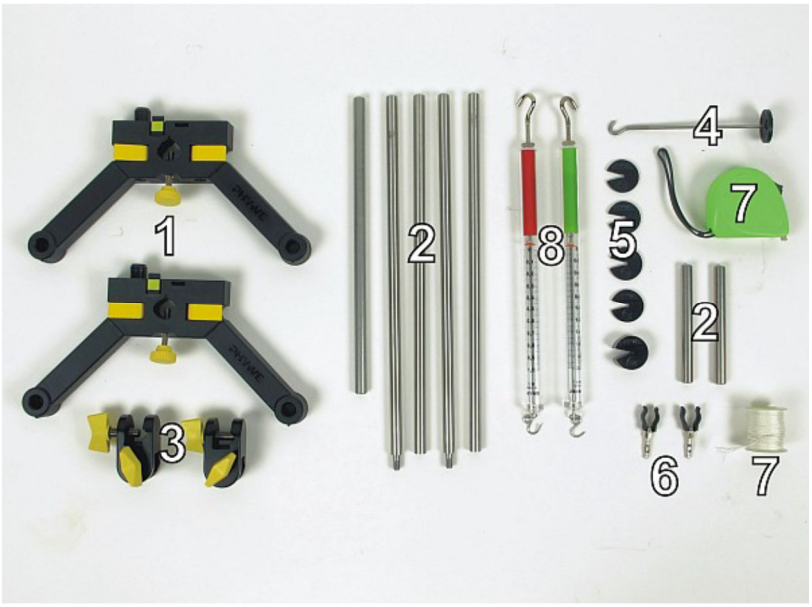
Material

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, 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	2

3	Bosshead	02043-00	2
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	1
6	Spring balance holder for transparent Spring balances	03065-20	2
7	Fish line, in reel, *d* = 0.7 mm, 20 m	02089-00	30 cm
7	Measuring tape, *l* = 2 m	09936-00	1
8	Spring balance, transparent, 1 N	03065-02	1
8	Spring balance, transparent, 2 N	03065-03	1
Additional Material			
	Scissors 1		

Material required for the experiment



Setup, part 1

Cut two short pieces of fish line (one about 10 cm long and the other about 20 cm) from the spool. Tie small loops in each end of both pieces (Fig. 1). Connect the two halves of the support base with the 25 cm support rod and tighten the locking levers (Fig. 2).

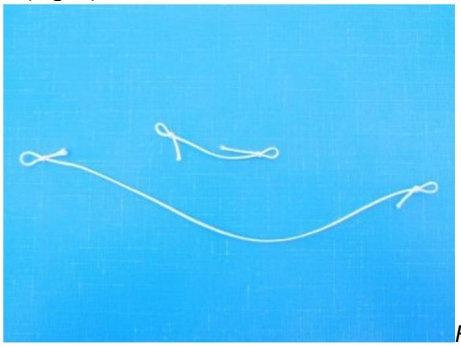


Fig. 1

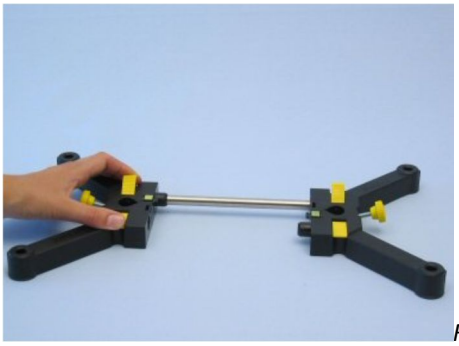


Fig. 2

Screw the four splitted support rods together (Fig.3) to get two long ones. Set these two 60 cm support rods into the support base halves, tighten them with the locking screws (Fig. 4). Insert the spring balance holders into the short rods (Fig. 5).

Fig. 3

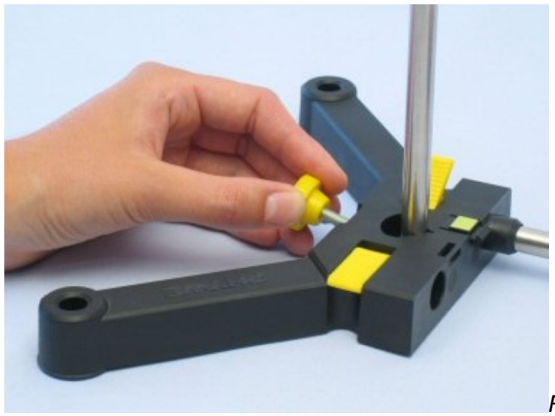


Fig. 4

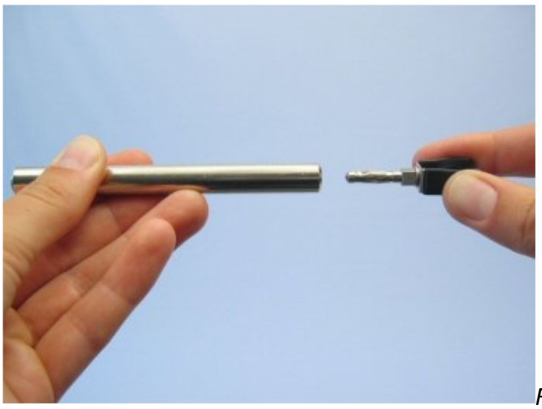


Fig. 5

Fix the bosshead at the 60 cm support rod, and clamp the short support rod in the bosshead (Fig. 6). Clamp the two spring balances into place and adjust them to zero by using the screw (Fig. 7).

Fig. 6

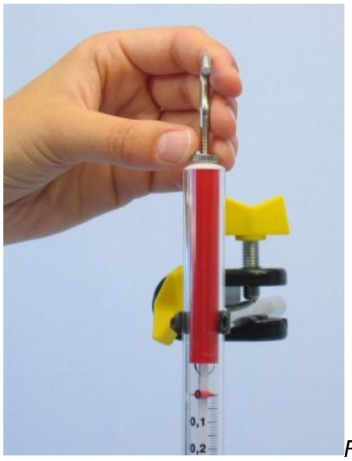


Fig. 7

Hang the fish lines on the hooked end of the spring balances, the short piece of fish line should be attached to the 1 N spring balance (Fig. 8).

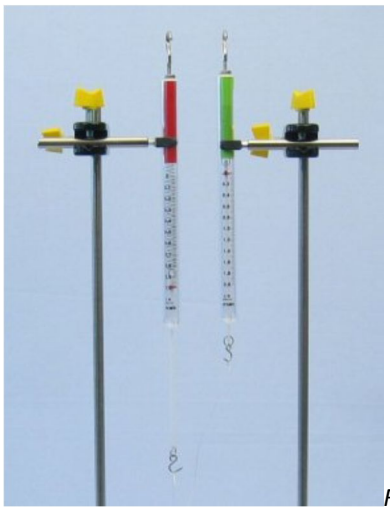


Fig. 8

Setup, part 2

Connect the two halves of the support base with the 25 cm support rod and tighten the locking lever on the left half (Fig. 9). Set one of the 60 cm support rods into the support base, tighten them with the locking screws (Fig. 10).


Fig. 9

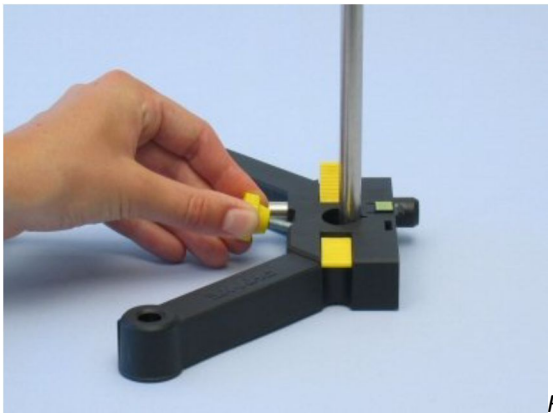


Fig. 10

Fix the spring balance 1 N with the bosshead, the short support rod and the spring balance holder. Adjust the spring balance if it is necessary (Fig. 11).

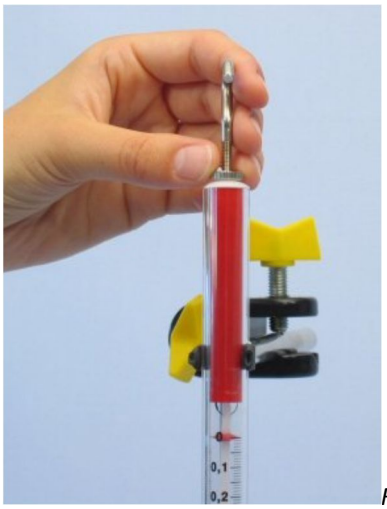


Fig. 11

Action, part 1

- Hang the weight holder on the lower loops of the two pieces of fish line and place mass pieces on it until the total mass is *m* = 100 g. The longer piece attached to the 2 N spring balance must not be taut (Fig. 12).

- For hanging the slotted weight up the weight holder, you should slip the slotted weight over the top end of the weight holder (Fig. 13).

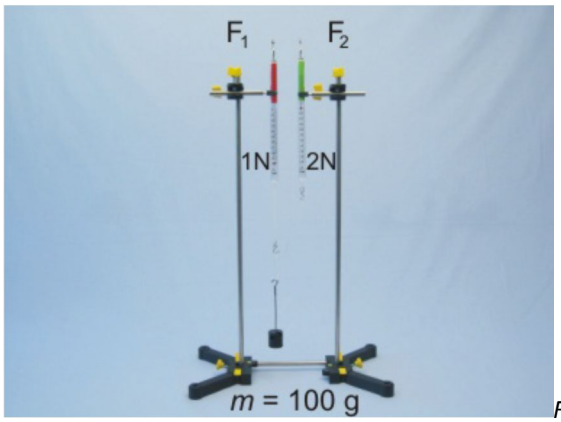


Fig. 12

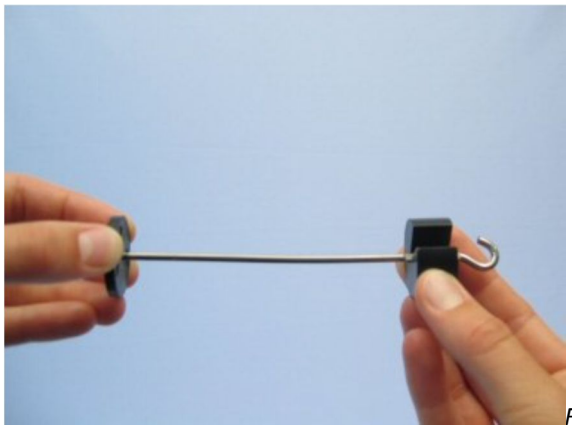


Fig. 13

- Read the indicators of both spring balances. Record the values in Table 1 on the Results page.
- Lower the 1 N spring balance by moving the bosshead downward until the longer piece of line becomes taut. Read both forces and record them in Table 1.
- Move the 2 N spring balance in its holder progressively higher and read both spring balances in each position (Fig. 14).
- Enter the values in Table 1.

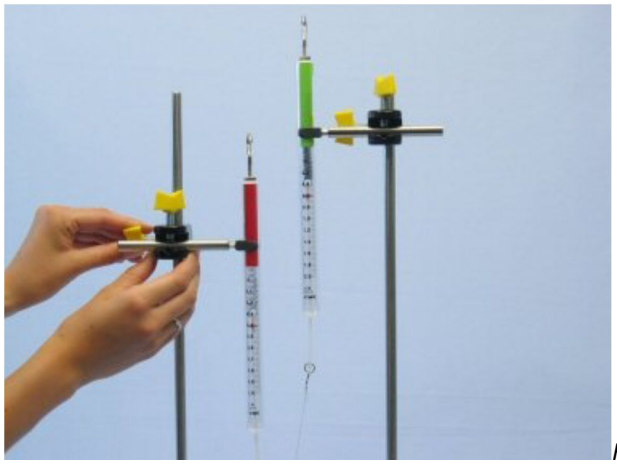


Fig. 14

Action, part 2

Hang the weight holder on the 1 N spring balance and place a 10 g mass piece ($m_{tot.}$ = 20 g) on the holder (Fig. 15). Note the reading in Table 2.


Fig. 15

- Hang the 2 N spring balance upside down on the hook of the other spring balance and pull it downward several times with different forces (Fig. 16).
- Determine the value of F_2 for every value of F_1 and record the measured values in the Table 2.

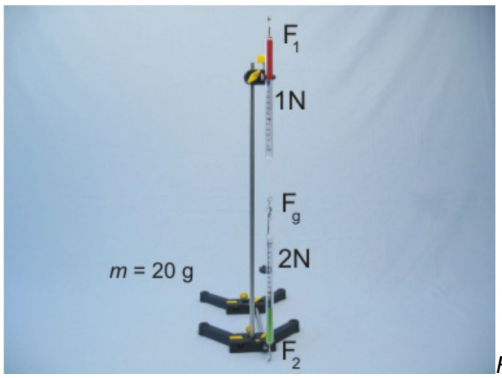


Fig. 16

Results, part 1

Table 1

m = 100 g

F_1 in N	F_2 in N	F_g in N
		1
		1
		1
		1
		1
		1
		1

Results, part 2

Table 2

m = 20 g

F_1 in N	F_2 in N	F_g in N
		0.2
		0.2
		0.2
		0.2
		0.2

Evaluation, part 1

Question 1:

What relationship do you see among the three forces F_1, F_2 and F_g?

Evaluation, part 2

Question 1:

What relationship do you see among the three forces F_1, F_2 and F_g?

Question 2:

How large would the difference (F_2 - F_1) be if no mass were hanging on the 1 N spring balance?