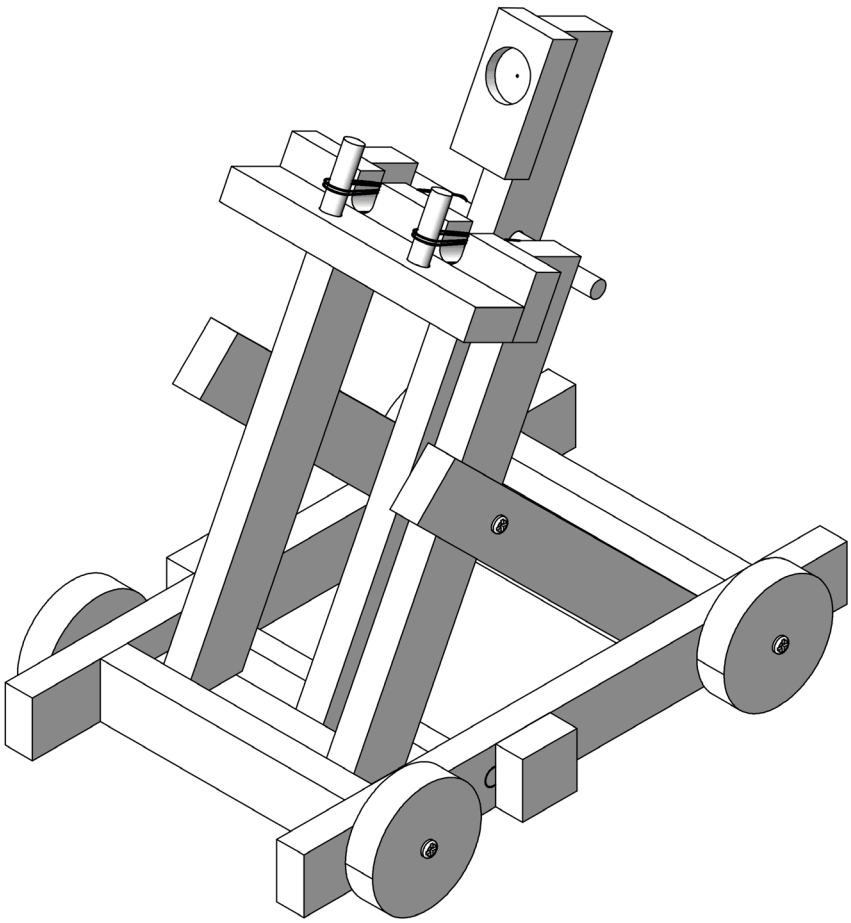
117.190

OPITEC PLUS-Line
Catapult



Teacher material

Possibilities for use in competency-based lessons

More suggestions for teaching

Assembly instructions

Student material

OPITEC

Options for use in the classroom

Competencies that can be gained when building and working with the catapult:

- naming parts of the catapult, using them and improving their function

- creating drawings (as a planning proposal or an illustration)

- investigating the law of the lever and putting it to use

- enhancing or changing the lever construction

- developing and building machines

Suggestions for the use of the materials in lessons:

1. Use the construction task to think about, sketch and test how the throwing range can be increased.

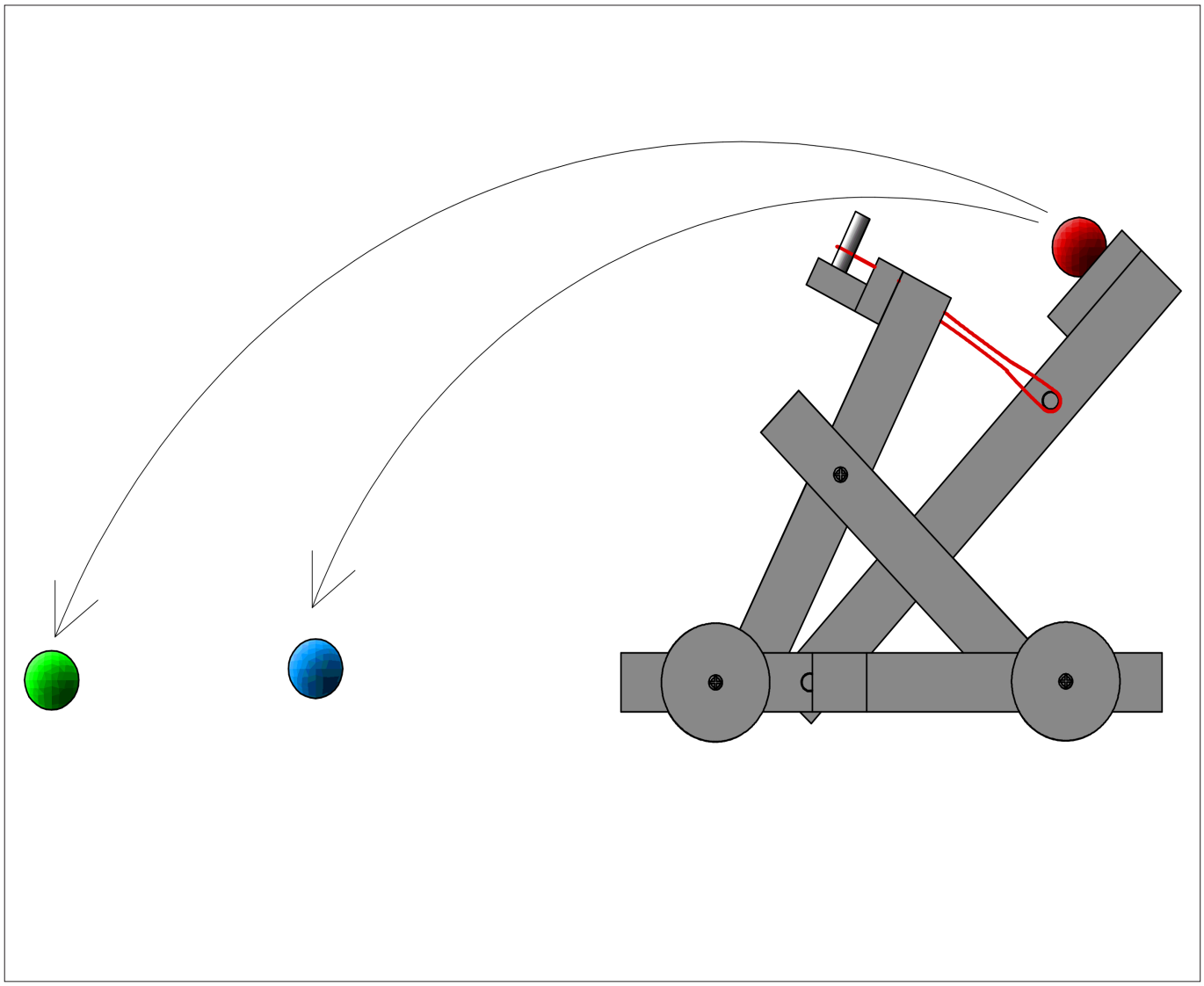
2. Use the instructions or your imagination to build the catapult (depending on existing knowledge, motoric ability and time available this can be done in groups, pairs or individually).

3. Write down the students' experiences, evaluate and test the construction within the group.

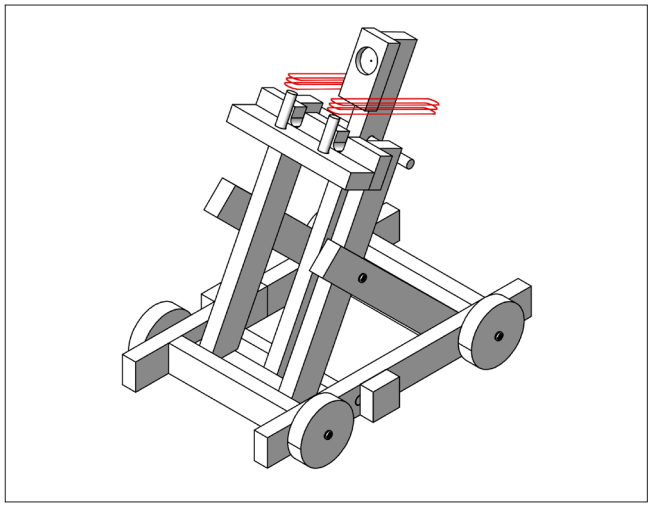
4. Create more work pieces utilising the laws of levers and simple mechanics (see also OPITEC model 114664 Savonius-wind generator, OPITEC model 103410 wind generator or models from the children's own experiences).

5. Finally test the created catapults in different competitions. This could be a "furthest throw" competition or a competition where targets have to be hit (e.g. a ball has to hit a waste paper basket).

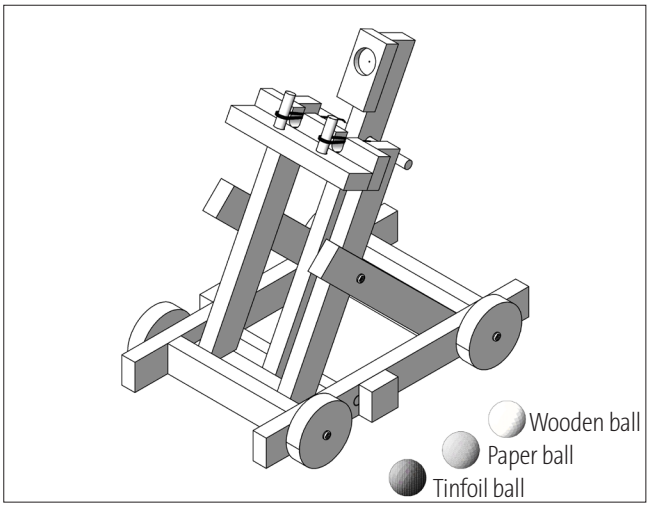
6. Extension: Write a non-fiction text possible in context of medieval history and find out more about the development of mechanical machines (e.g. Leonardo da Vinci).



To improve the throwing distance the following materials will be needed additionally: possibly a stronger elastic band or additional elastic bands. Paper and tinfoil to make small balls.

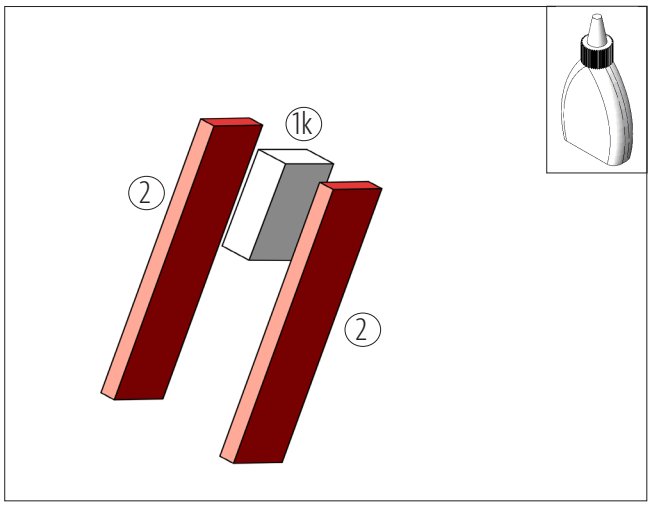


When attaching more elastic bands (or stronger elastic bands) the mechanical preload is higher and the throwing distance increases.

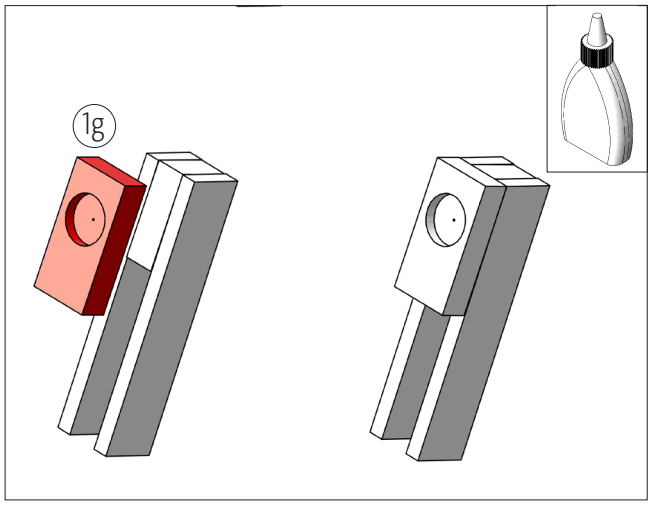


Create balls from different materials. Shape balls from paper and tinfoil. Because of weighing the most , the wooden ball will fly the furthest.

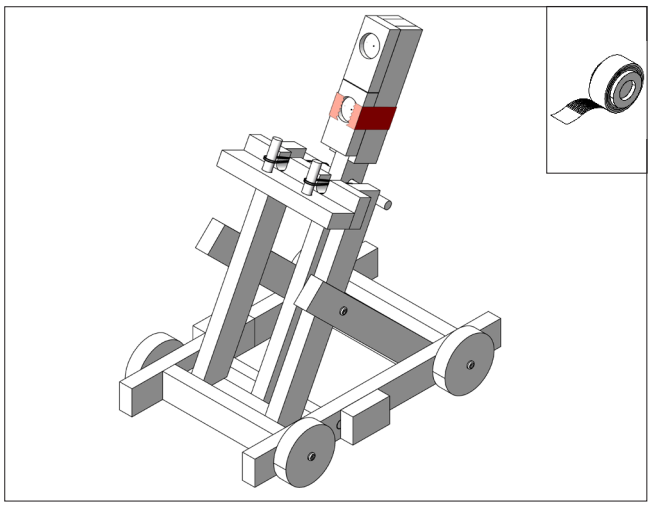
Instructions 117.190
OPITEC-Plus-Line Catapult
For whiz-kids: increasing the arm of the catapult



Glue the wooden bars (2) to part(1k) as shown.



Glue on the remaining part(1g). See illustration.



Affix the arm extension to the existing arm with sticky tape as shown.

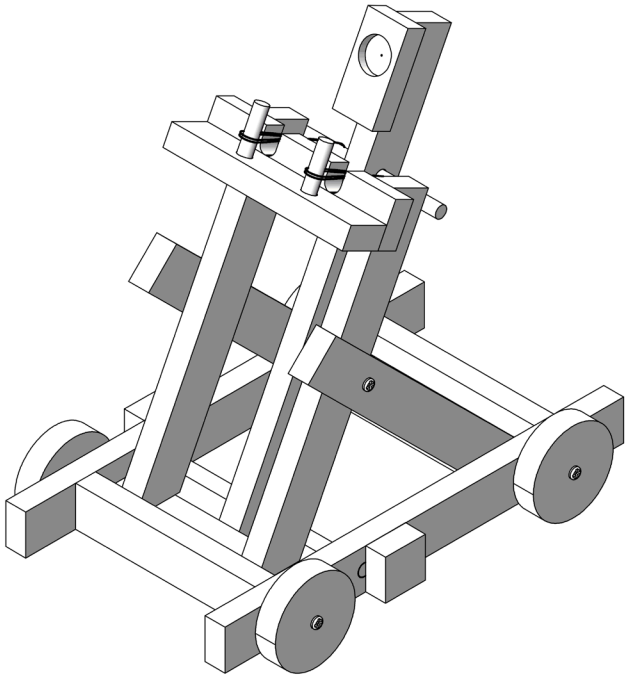
Testing with a longer lever will show the following result:
Although a longer lever increases the torque, the extension of the lever also increases the mass (weight). The balls don't fly as far as without the extension.

117.190

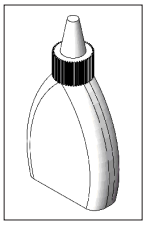
Instruction

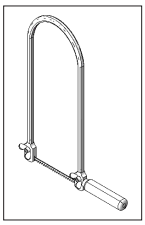
OPITEC PLUS-Line

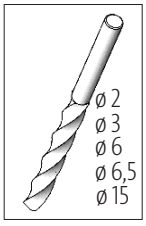
Catapult



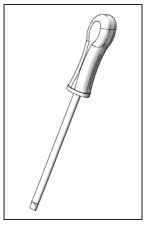
Tools needed:

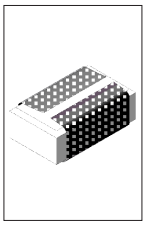

Wood glue

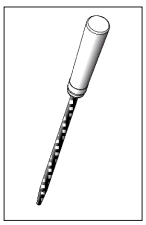

Jigsaw

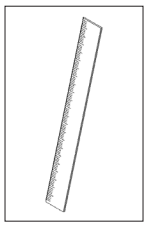


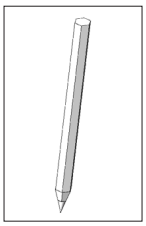
Hand drill

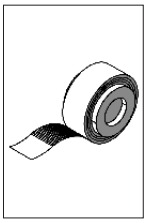

Screwdriver

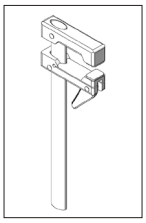

Sandpaper


Round file


Ruler


Pencil


Sticky tape


Clamp

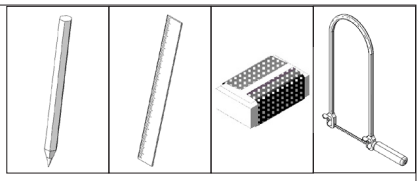
Please Note

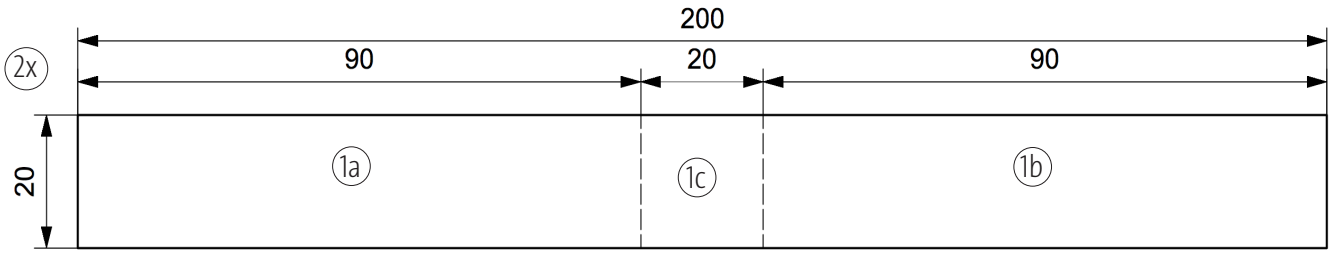
The OPITEC range of projects is not intended as play toys for young children. They are teaching aids for young people learning the skills of Craft, Design and Technology. These projects should only be undertaken and operated with the guidance of a fully qualified adult. The finished projects are not suitable to give to children under 3 years old. Some parts can be swallowed. Danger of suffocation!

Content	Quantity	Dimensions(mm)	Designation	Part no.
Wooden bars	10	200x20x10	Wooden bar	1
Wooden bar	1	200x20x5	Wooden bar	2
Round wooden bar	1	250x6	Round bar	3
Wooden wheels	4	ø 40	Wooden wheels	4
Metal screws	6	19x3	Screw	5
Wooden ball	1	ø 20	Wooden ball	6
Elastic band	6	ø 40	Elastic band	7

OPITEC

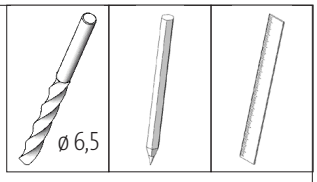
1

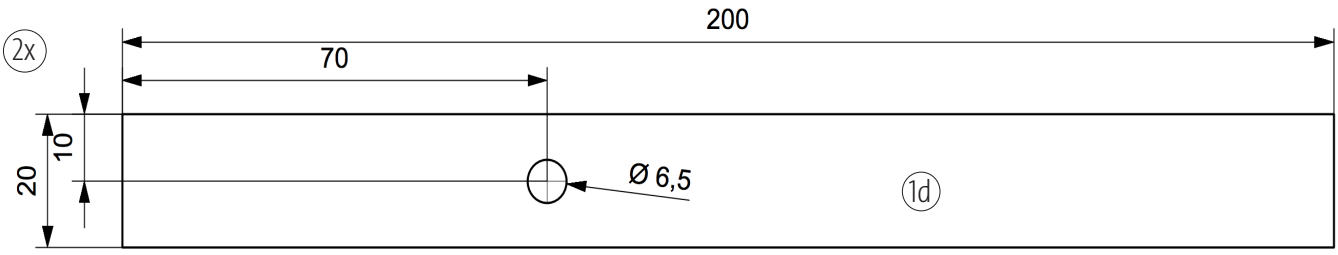




Take two wooden bars (1) and copy the templates (page 11). Cut off 2 90mm long pieces (1a+1b) from each wooden bar and clean up the edges with sandpaper. Put both parts (1c) aside for a later work step!

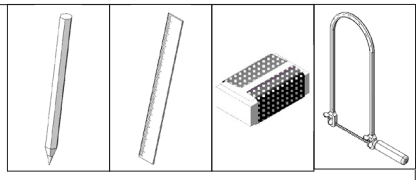
2

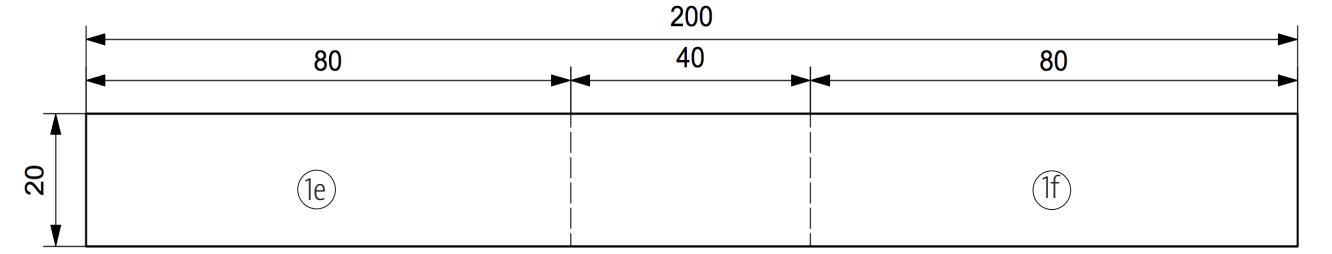




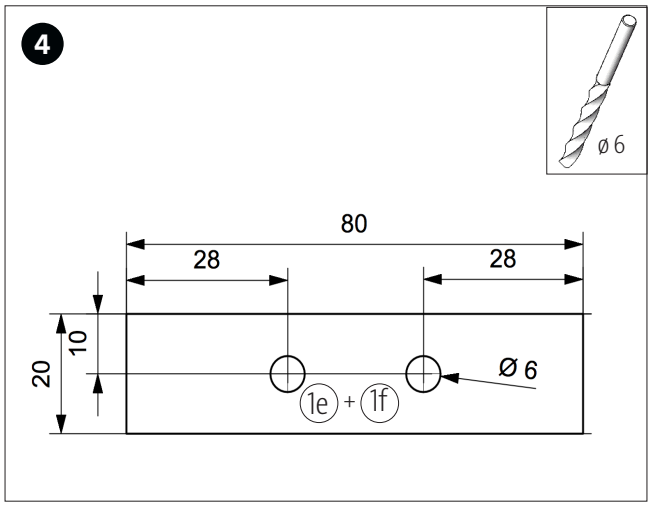
Measure 70mm on two other wooden bars (1d) and mark. Drill a ø 6,5mm hole at the markings.

3

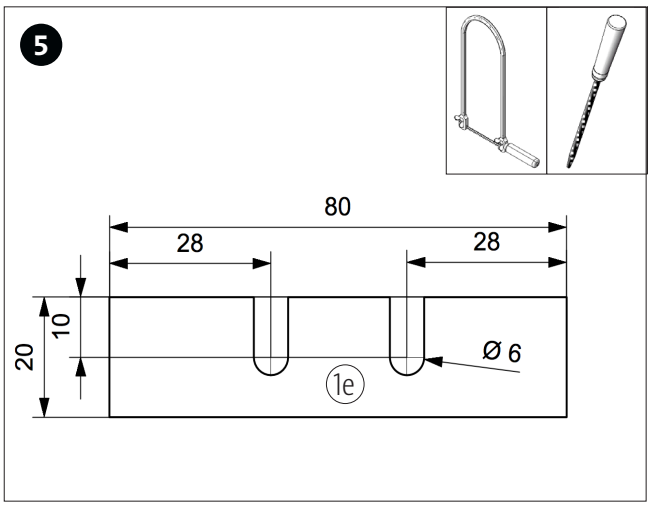




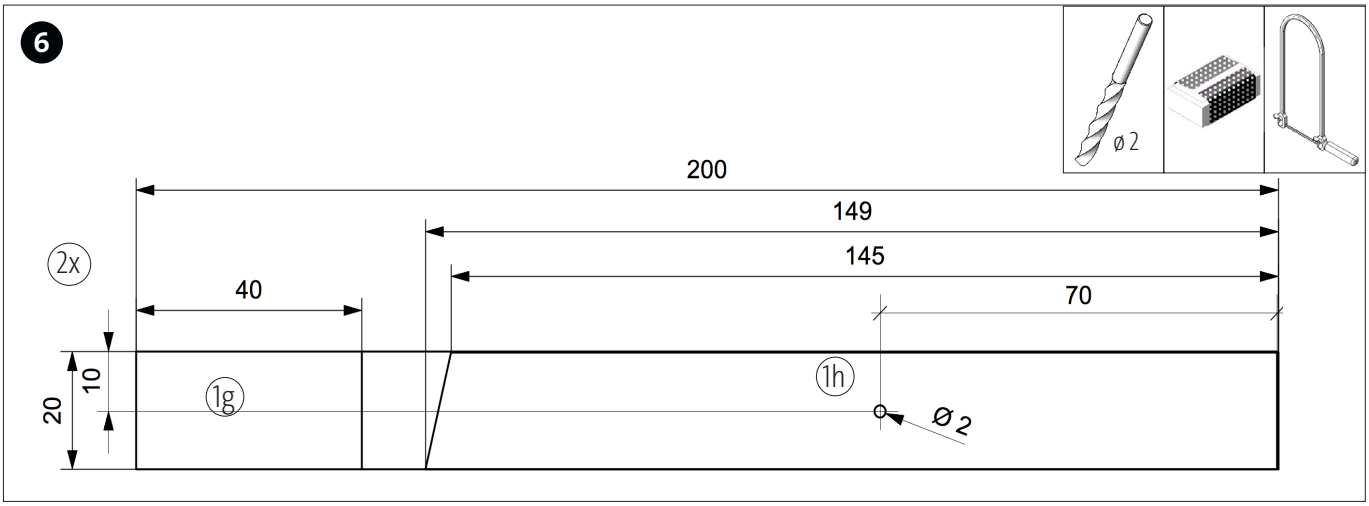
Take another wooden bar (1) and measure 80mm from both sides. Cut off and clean the saw edges.



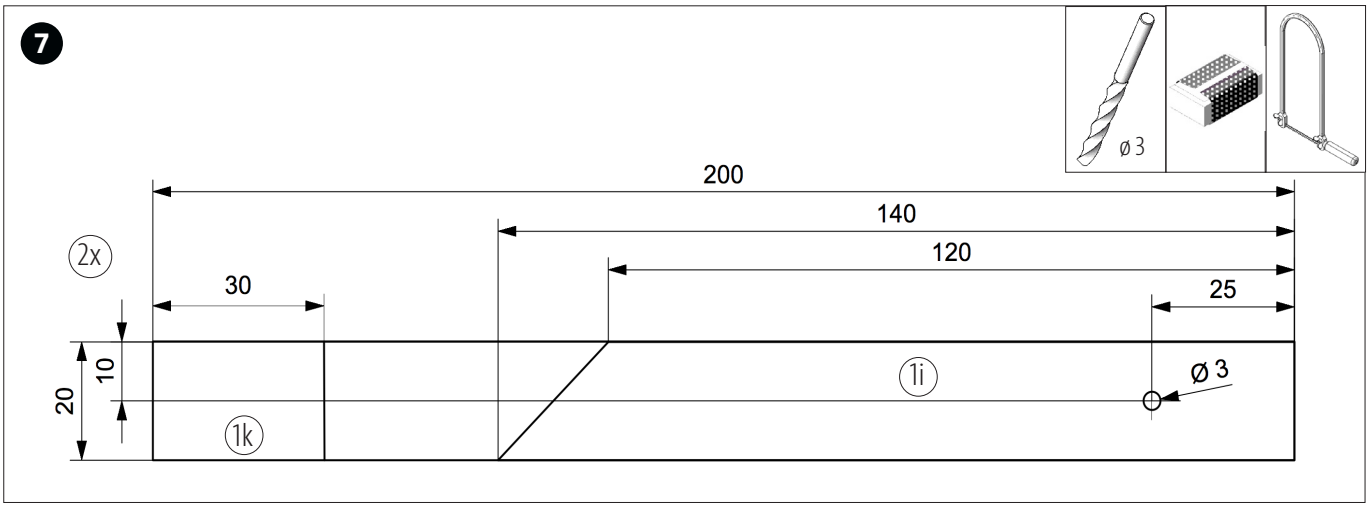
Measure the distance for the drill holes on parts 1e and 1f as shown or use the template (page 12) and drill ø 6mm holes.



Then use the jigsaw to saw to the drilled holes on the wooden bar (1e) as shown. File the edges with the round file if necessary.

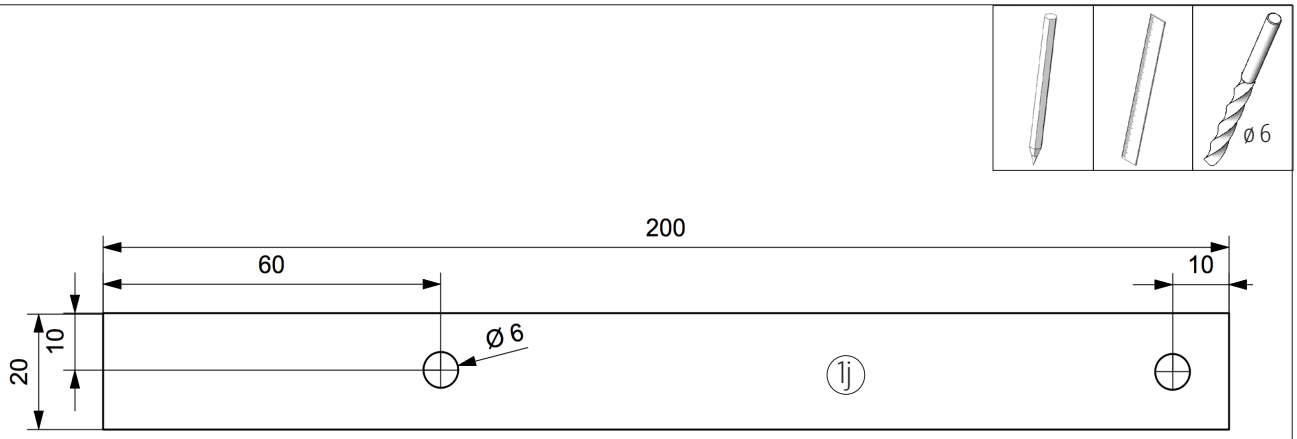


Measure and cut two more wooden bars according to the template. Clean up the sawn edges. Keep both parts 1j for later! Drill a ø 2mm hole.



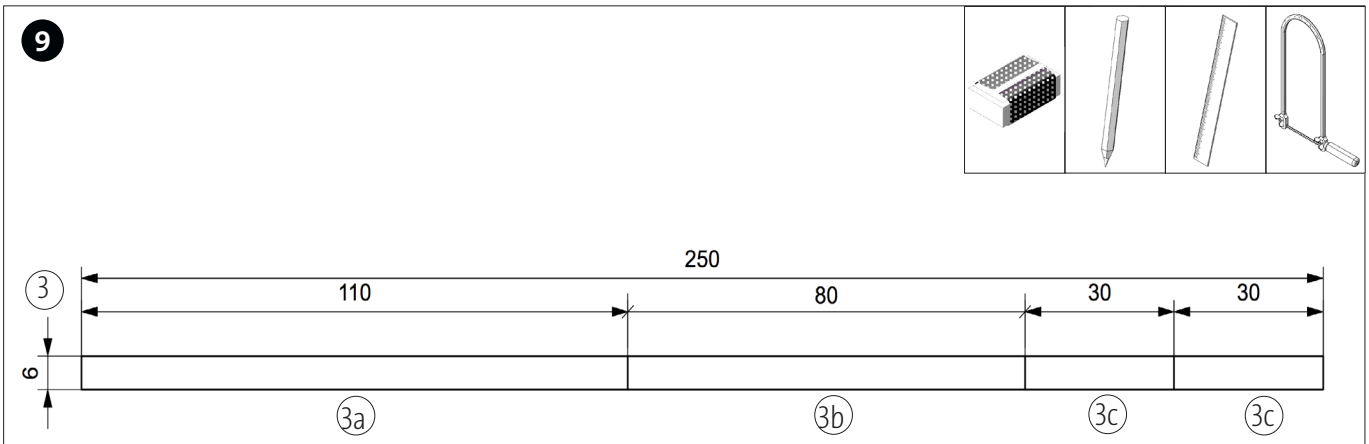
Take the next two wooden bars (1) and measure and cut as shown. Clean up the saw cuts. Drill the ø 3mm hole.

8



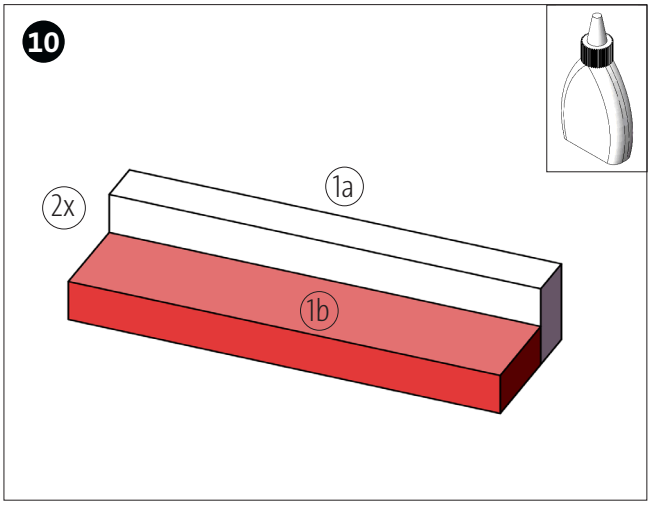
Mark the position of the drill hole on the last wooden bar (1) and drill a ø 6mm hole.

9



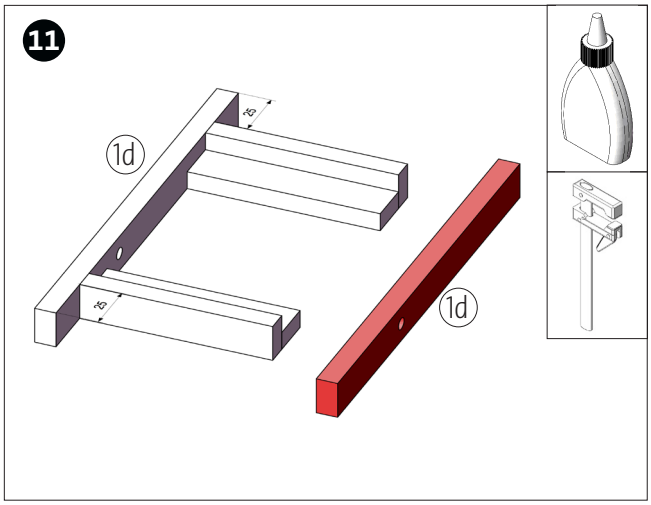
Mark the measurements on the round wooden bar (3) and cut to length with the jigsaw. Tidy up the saw cuts. Keep all cuttings.

10

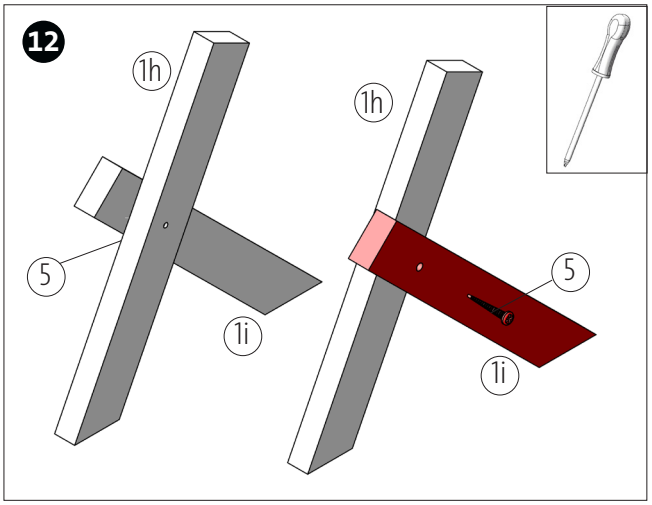


Glue part (1b) and part (1a) together as shown and let the glue dry.
Then glue together the other parts (1a+1b- see step 1) in the same way.

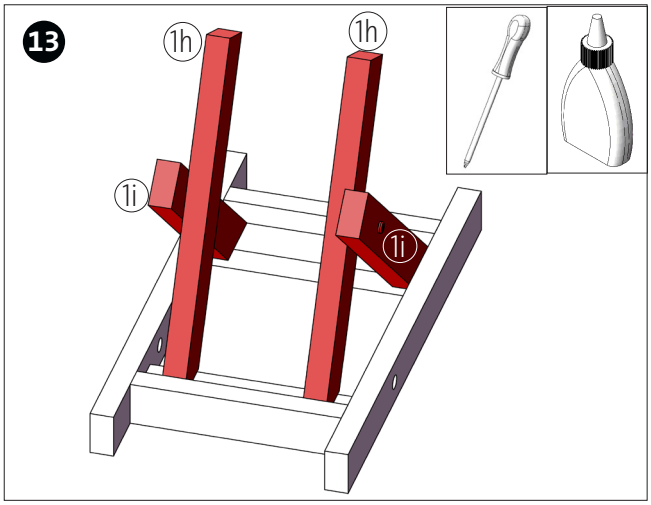
11



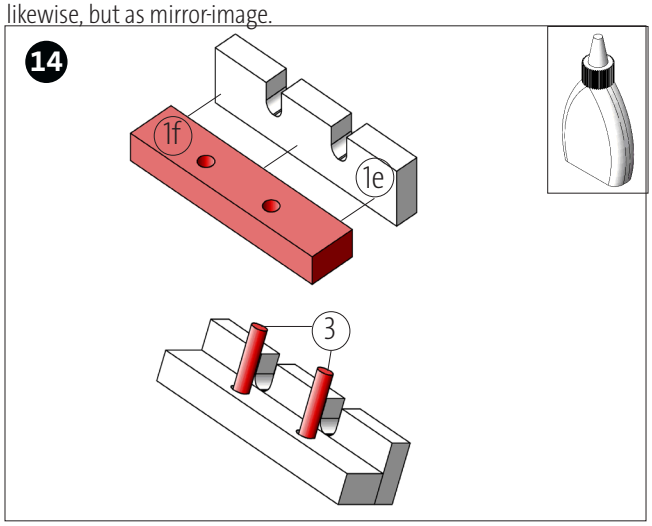
Glue both parts (1d) to the two completed parts (1a+1b) as shown, with an indent of 25mm on both sides. Hold together with a clamp and let the glue dry properly.



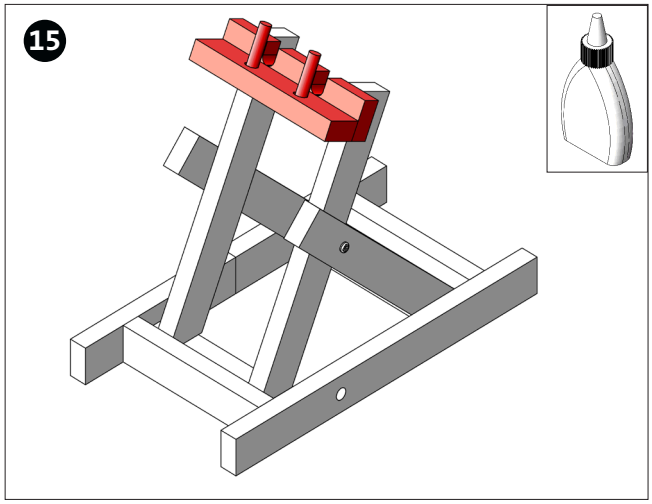
Connect the two side struts (1h+1i) with a screw (5) in such a way that they still stay flexible (see illustration). Connect the two bars (1h+1i) likewise, but as mirror-image.



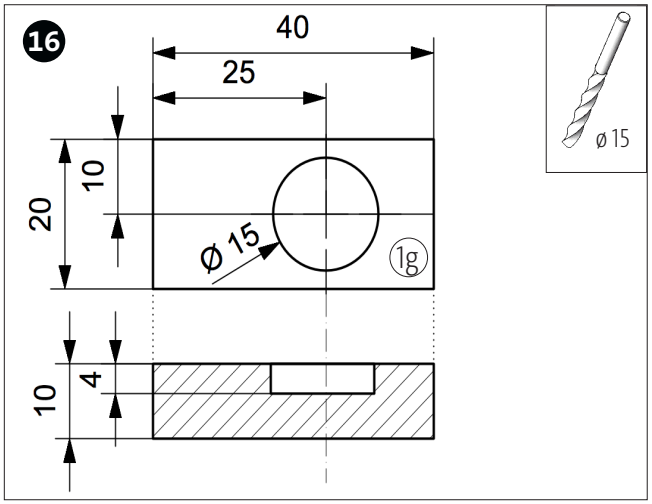
Glue the connected side struts into the frame. Let the glue dry properly and tighten the screws.



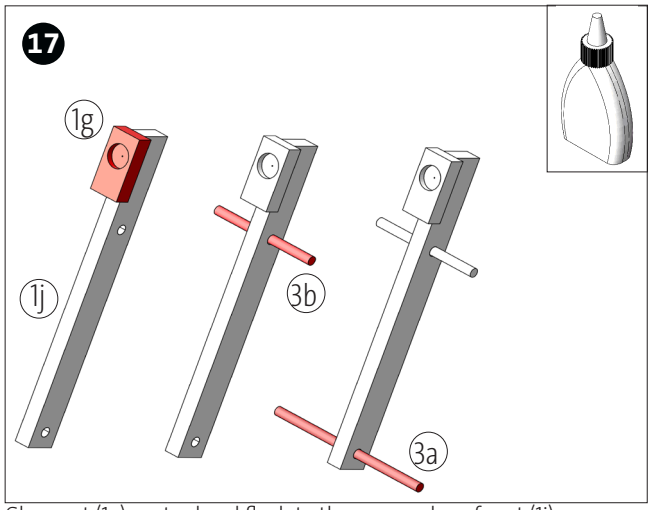
Glue part (1f) to part (1e) as shown. Let the glue dry properly. Glue the two 30mm lengths of round bar (3) into the drill holes in part (1f).



Glue the finished part centred and flush to the upper edge of parts (1i) as shown. Let the glue dry properly.

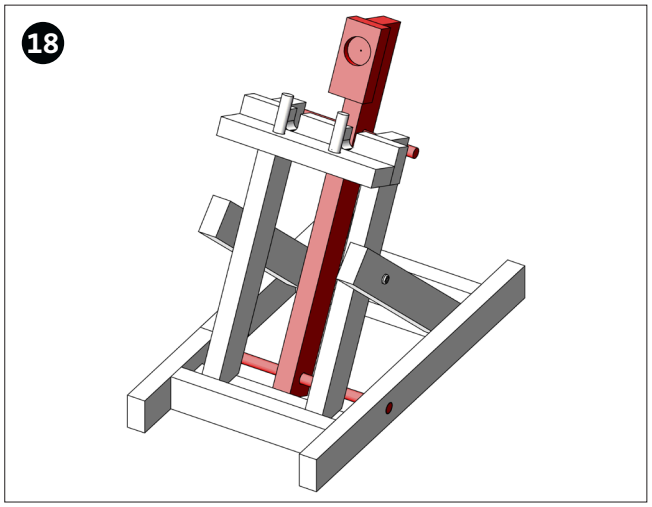


Measure and mark ø 15mm drill holes on both parts (1g) and drill them 4mm deep.



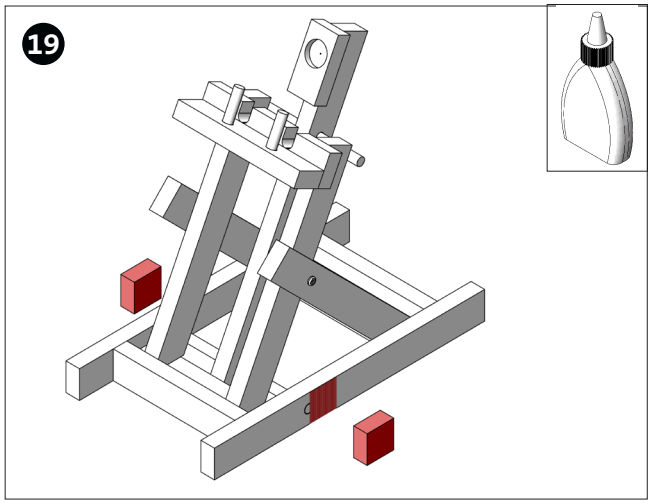
Glue part (1g) centred and flush to the upper edge of part (1j) as shown. Push the round wooden bar (3b) through the upper drill hole in part (1j), centre and glue in position. Push round wooden bar (3a) through the lower drill hole , centre and glue in position.

18



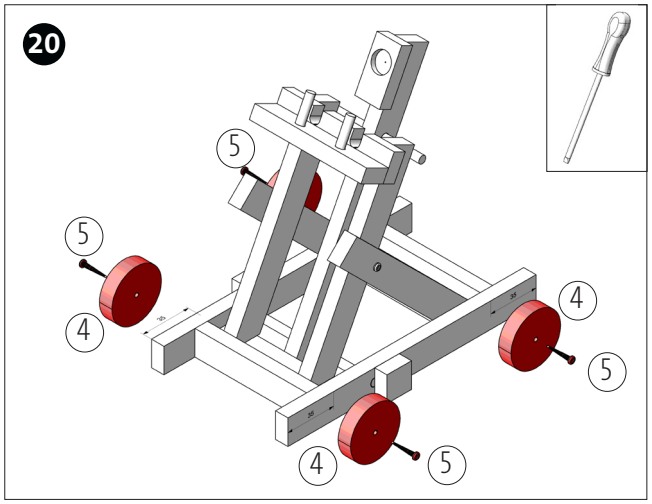
Place the round wooden bar (3a) from the arm into the drill holes of the two side panels (1b). Do not glue!

19



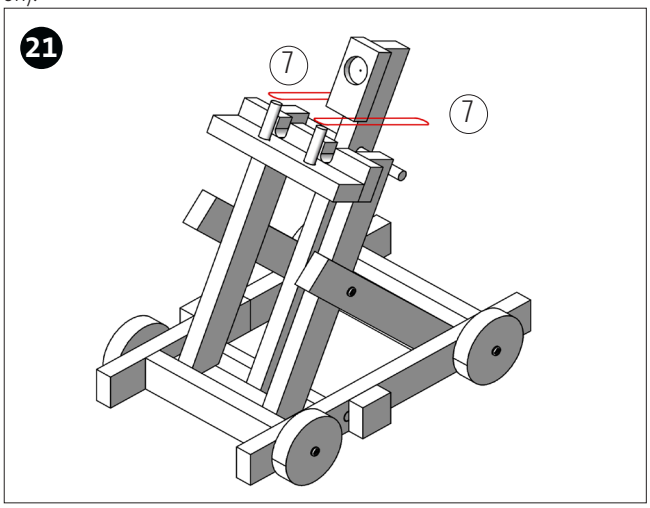
Glue both parts (1c; see step 1) to the sides of the structure in such a way, that the arm cannot move through the drill holes (see illustration).

20



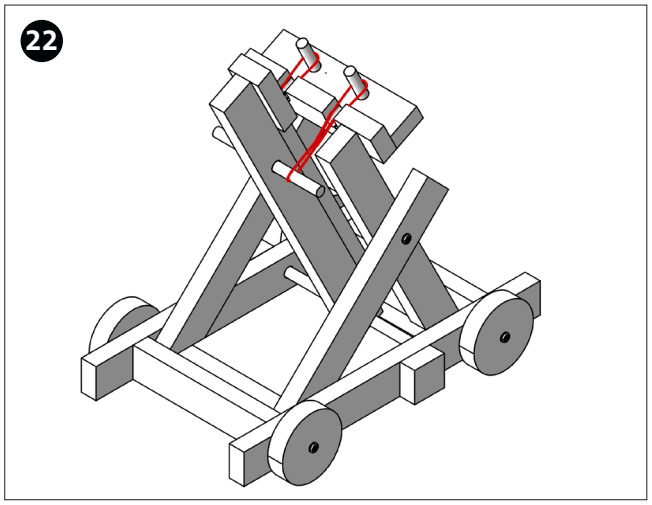
Measure and mark 35mm from both ends of every bar (1d). Then attach the four wooden wheels (4) as shown with one screw (5) each.

21



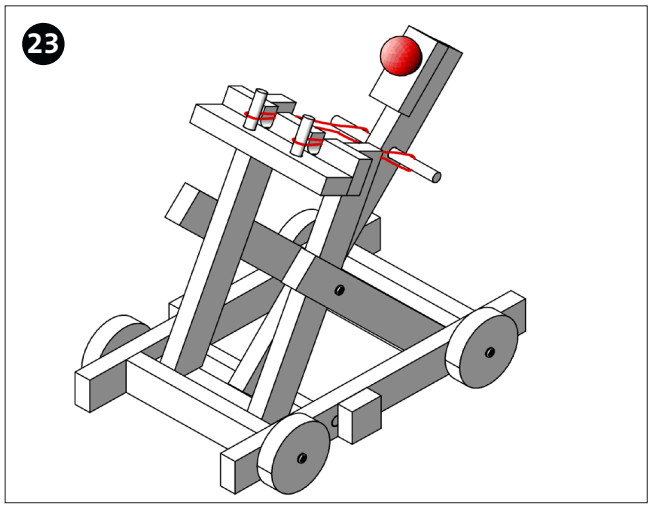
Attach an elastic band to each of the two round wooden bars (3).

22

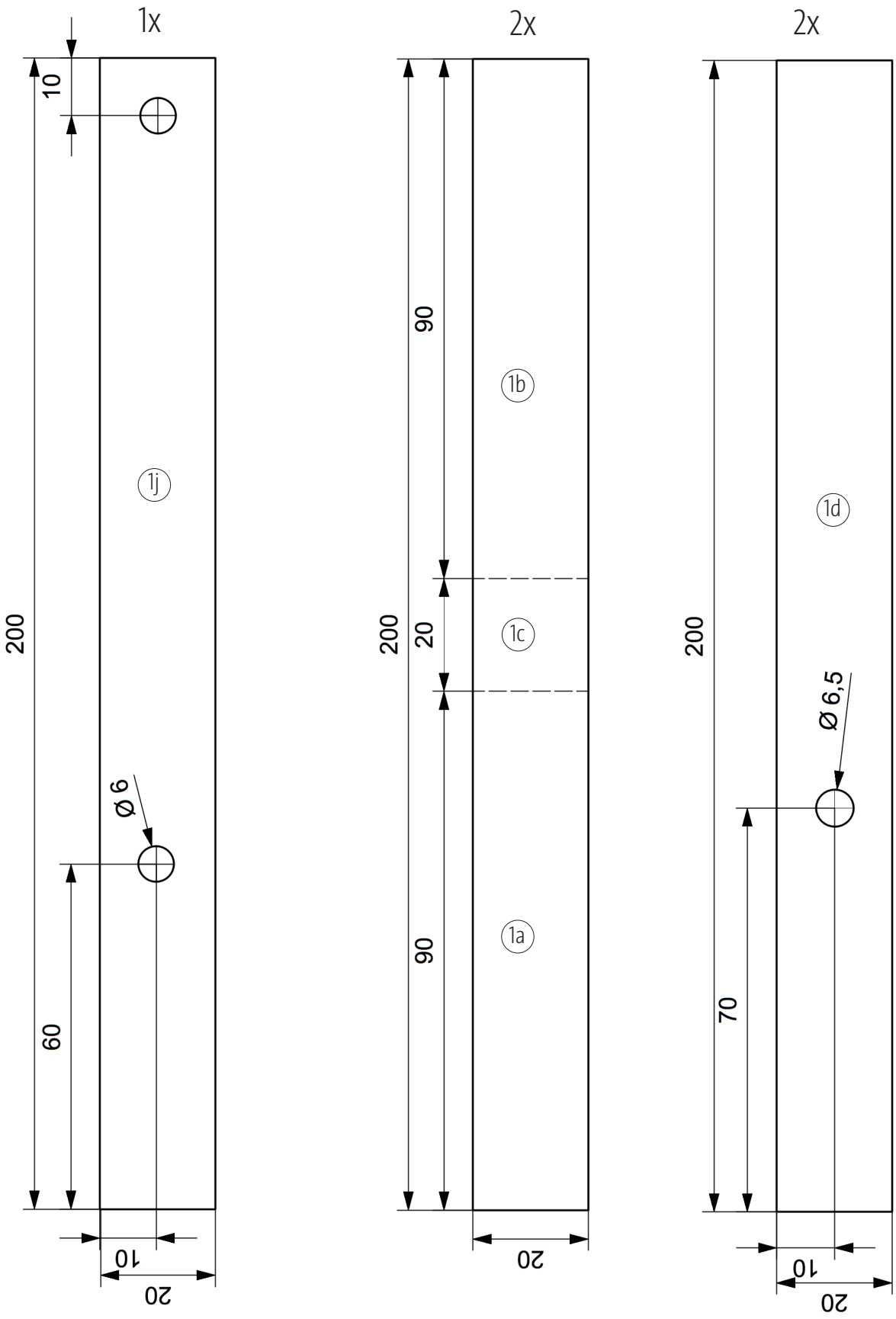


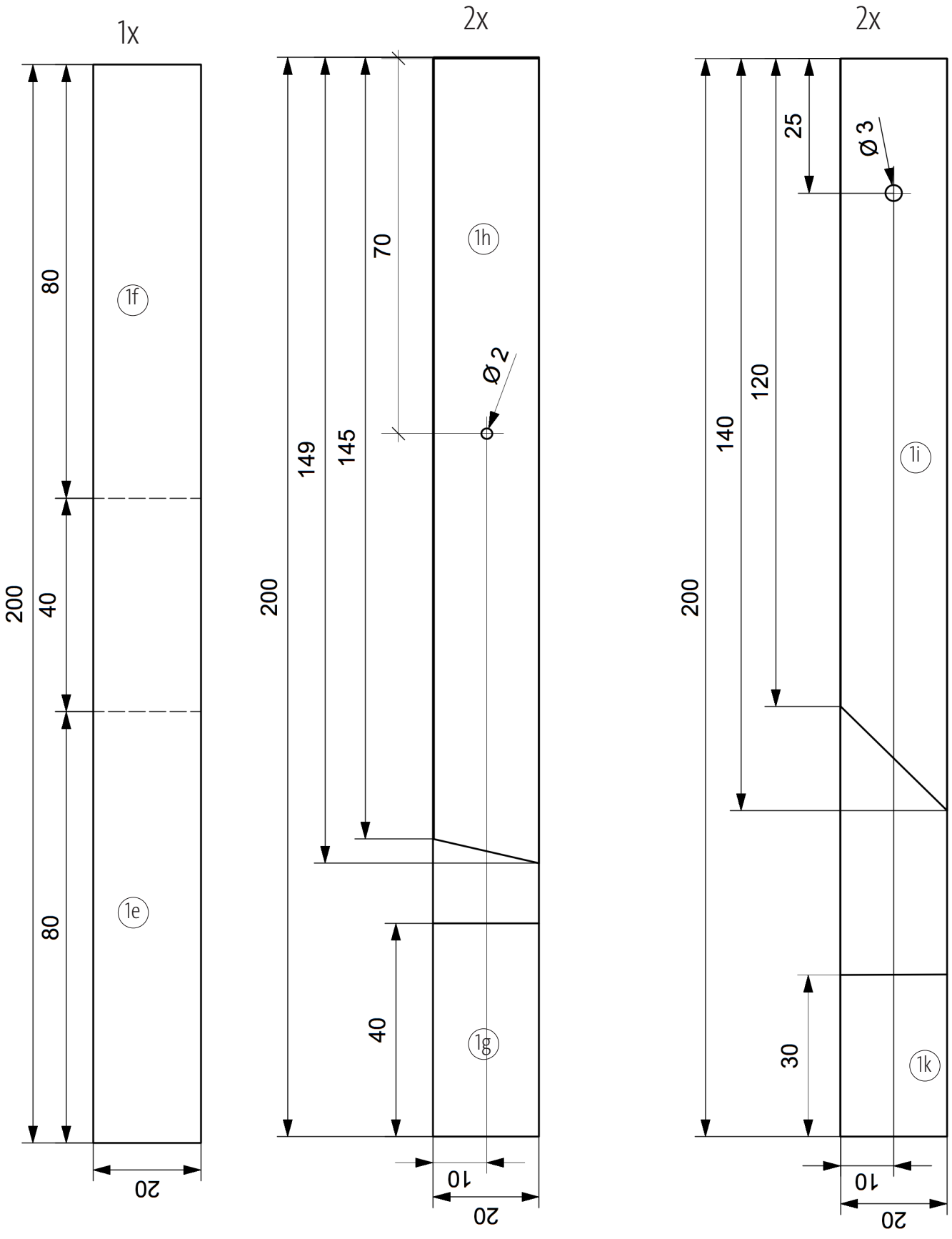
Attach the other ends of the elastic bands to the wooden bars (80mm). See illustration!

23

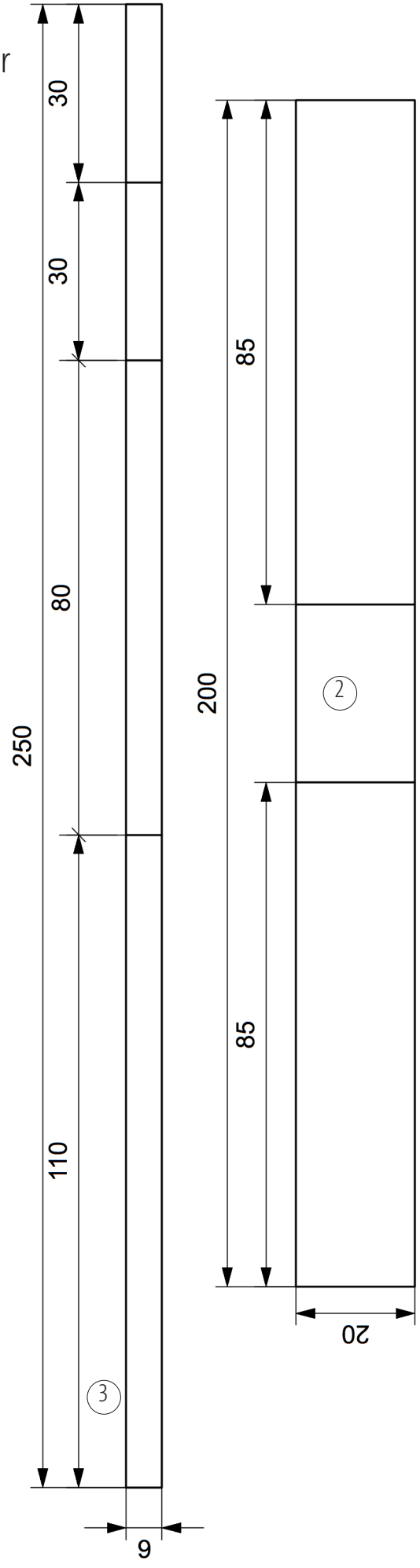


Hold the catapult down with one hand. Tense the arm with the other hand and insert the wooden ball (6).

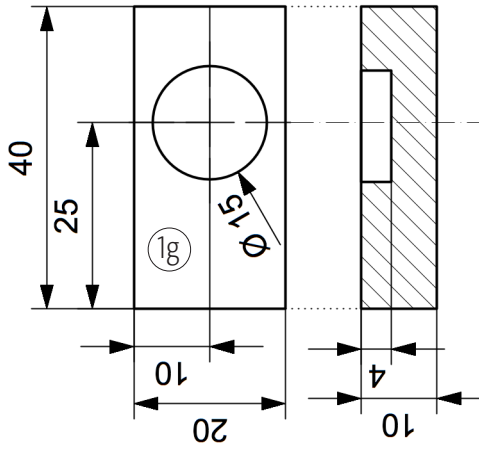

1x
10
1j
200
Ø 6
60
10
20
2x
90
1b
200
20
1c
90
1a
20
2x
1d
200
Ø 6,5
70
10
20

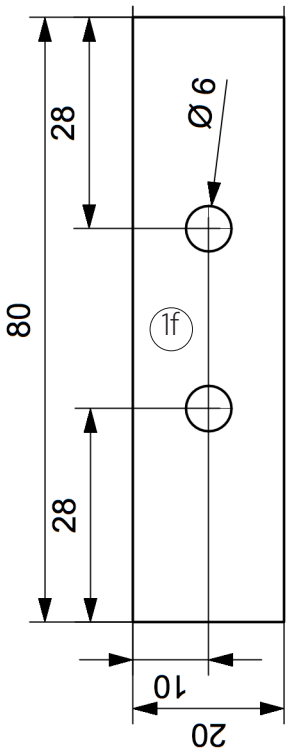

1x
2x
2x
200
80
40
80
1f
1e
20
200
149
145
70
Ø 2
1h
40
1g
10
20
200
140
120
25
Ø 3
1i
30
1k
10
20

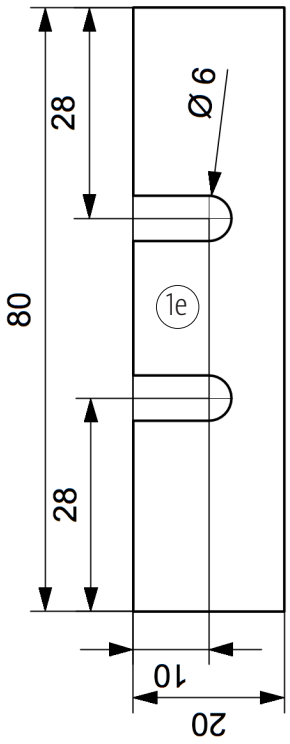
Round bar


30
30
80
110
250
6
9
85
85
200
20
2
3

2x


40
25
Ø 15
1g
10
20
4
10


80
28
28
Ø 6
1f
10
20


80
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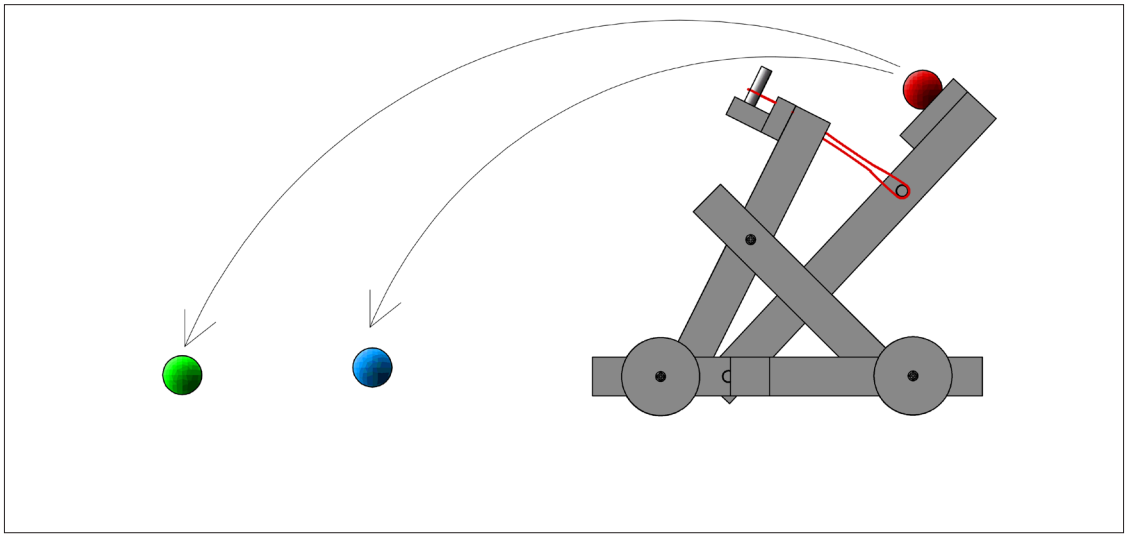
How can you increase the throwing capacity of your catapult?



1st Step: this is how it could work (2 options!):

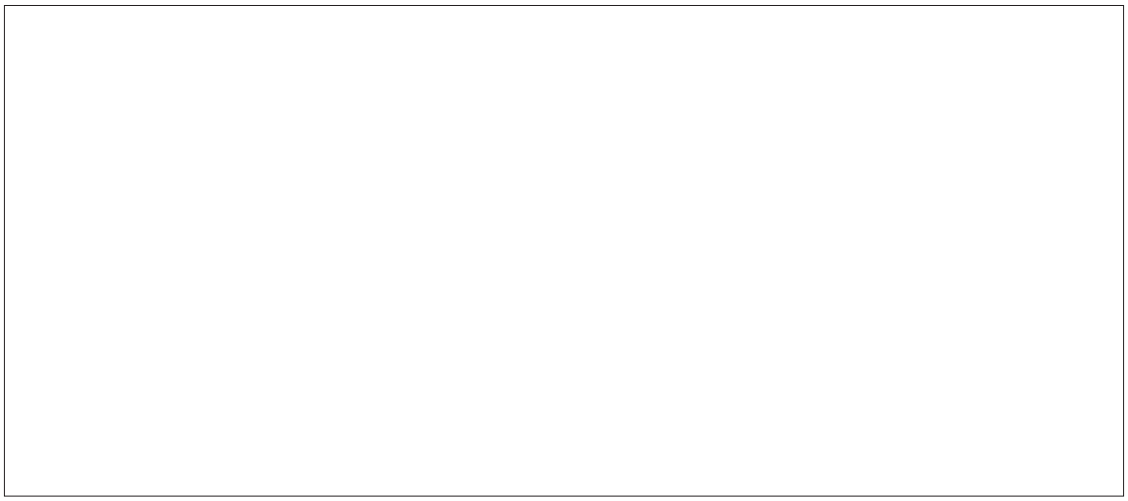
Here is space for your drawing:

I will need these materials and tools:

„Give reasons for your decision:“

1st Step: Setup Option 1

2nd Step: Setup Option 2



What can you observe?

Why is it that way?

The tension in the arm increases noticeably when more elastic bands or a stronger elastic band are used. Thus the distance of flight of the ball increases too.
Balls made of different materials have different weights. The lighter the object that is thrown, the shorter the distance.

For whiz-kids: do you achieve a longer distance when increasing the length of the catapult's arm?

3rd Step: How can you do this with the remaining pieces and bars?

This is how I am going to construct my extension:

Here is space for your drawing:

I will need these materials and tools:

Give reasons for your decision:

What can you observe?

Why is that so?

A longer lever means a bigger mass (weight). Therefore the balls don't fly that far anymore, although the torque has been increased.