



## How far to the target?

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**Data dodania:**

19.06.2018

**Słowa kluczowe:**

rangefinder, peryskop

**DZIEDZINA:**

Physics, Constructing, Optics, Trigonometry

**Cel doświadczenia:**

Determine the distance to the observed object by determining the angle of observation of the object from two different places.

**Spis materiałów:**

1. two small mirrors with dimensions of approx. 5×5 cm
2. a tape measure (at least 3 m)
3. a protractor
4. cardboard or paperboard
5. cardboard or plastic tube (or rolled paper)
6. glue or double-sided tape
7. some string, colour ribbon or chalk

**Etapy realizacji:**

**I Construction of the periscope**

1. Build a vertical obstacle that will block the view (e.g. a sheet of cardboard placed vertically).
2. Place one of the mirrors in front of the obstacle and the other one next to the obstacle, so that it should be possible to observe the area behind in the first mirror.
3. Use cardboard or paperboard to make a periscope housing. Fix the mirrors using glue or double-sided tape.

**II Rangefinder housing**

1. Find a rather distant object to which you will be determining the distance.
2. Specify two points of observation of the object.
3. Connect the observation points by means of a length of string (tape) or by routing a line on the ground/floor – the observation base.
4. Determine the distance between the observation points.
5. If you do not have a tube, make one of paper.
6. Position yourself at one of the observation points. Observe the surrounding through the tube to find an object of interest.
7. Determine the angle of observation of the object relative to the base.

8. Repeat the observation and measurement of the angle for the other observation point.
9. Using trigonometric formulas, determine the distance to the object based on the measurement results.
10. Try to determine the distance to the observed object in another way.
11. Compare the results.
12. Does the position of the base relative to the observed object have any impact on the results?

**Pytania do doświadczenia:**

1. From what other optical elements can a periscope be constructed?
2. Is there only one mirror positioning that enables seeing what is behind the obstacle?
3. What does the accuracy of determination of the distance to the observed object depend on?
4. How is location of different objects determined in modern times?

**Opis zjawiska:**

**Ciekawostki:**

1. The periscope enables you to carry out observation without being seen yourself. This is a popular military device used for observations from bunkers, trenches or submarines. The prototype of periscope, called polemoscope, was designed by Johannes Hevelius, the Gdank-based astronomer, in 1637.
2. Man determines the distance to an object by 'analysing' the angles of the eyeballs. Due to the distance between the eyes being several centimetres, man can only use this method to determine distances to objects being no more than 50 m away. Location of farther objects is determined based on a comparison with other known objects being within the range of observation. If we have no such point it is impossible to determine the distance to remote objects.
3. Military rangefinders from the period of the Second World War had a spacing (observation base) of several metres. The traditional optical rangefinder consists of two periscopes combined with each other.