

Exercises

Exercise 1

A rowdy student shoots paper balls at a speed of $v_0 = 10$ m/s from a height of 1.2 m using his blowgun. He aims at the top of the blackboard 3 m in front of him. The blackboard is hung 1 m above the floor and is 1.50 m high. Does he hit the blackboard?

Tip : $\frac{1}{\cos^2 \alpha} = 1 + \tan^2 \alpha$

Exercise 2 , 30 minutes **

A cannon is placed at the foot of a hill whose slope forms an angle φ with the horizontal. If the cannon is pointed at an angle α from the horizontal and the shell has an initial velocity v_0 , find the distance l measured *on the hill* at which it will fall.

Exercise 3 *Winter is coming*

A student in a physics class gets into a snowball fight with a friend. The friend manages to catch the snowballs and throw them back immediately.

The student knows that a snowball can be thrown at two different angles but with the same speed and still hit the same target. However, the flight times are different. So, to win the game, the student decides to throw two balls at different times, one on a higher trajectory than the other. The higher ball will create a diversion, and while the friend prepares to catch it, the second ball will arrive and both balls will strike simultaneously. If the friends are at a distance L from each other and they throw the balls at an initial velocity v_0 :

1. What are the firing angles?
2. How long should you wait before throwing the second ball?
3. Numerical application : $L = 25$ m and $v_0 = 20$ m/s.

Exercise 4 *David and Goliath*

This is an example of an exercise that requires (a little) modeling of the problem and breaking it down into elements. This approach is part of an engineer's daily routine.

A slingshot consists of a 30 cm long string that holds a stone and is spun quickly in a horizontal plane, then released abruptly. If the slingshot is used from a height of 1.8 meters and the aim is to hit a target on the ground 10 meters away, how fast must the slingshot be spun? How could you achieve a lower rotation speed (using the same slingshot)? What is the minimum rotation speed?