

USEFUL RESOURCES

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:

[https://schoolnova.org/nova/classinfo?class\\_id=adv\\_phy\\_club&sem\\_id=ay2021](https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2021)

The practical information about the club and contacts can be found on the same web page.

TODAY'S MEETING

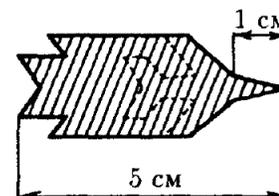
Today we finished the last homework on various topics. Now we switch to mechanics and begin with problems on kinematics - from simple to more complicated.

This time the homework is split in two parts: a simpler part 1 and a more complicated part 2. Solutions of part 1 will be discussed on the next meeting as usual. As for the solutions of part 2 we may not have time to discuss them all. We encourage you to discuss the problems in the Discord channel. Problems marked with a star are in general more difficult than the ones not marked.

HOMEWORK PART 1

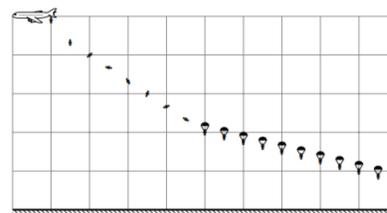
- Jack and John participate in a running competition. They are supposed to run 3 km. Jack got tired after running  $\frac{3}{4}$  of the distance and walked the rest of the distance sometimes stopping for rest. John only ran  $\frac{1}{4}$  of the distance and then walked without stopping. They finished at the same time. For how long did Jack stop in total? Both of them run with speed 12 km/h and walk with speed 6 km/h.

- The figure shows a "blurry photo" of a moving airplane. Length of the whole plane is 30 m and nose of the plane is 10 m. Knowing the camera exposure time 0.1 seconds find speed of the airplane. Shape of the airplane is shown by a dashed line.



- Athletes run one behind another as one line of length  $l$  with velocity  $v$ . Towards them runs the coach with velocity  $u < v$ . Each athlete upon coming up to the coach instantly turns around and starts running in the opposite direction with the same speed  $v$ . What will the length of the line of athletes be after they all turn around?

- An airplane full of skydivers flies horizontally with a constant speed. Skydivers jump out of the plane keeping the constant time interval after the previous skydiver. They very quickly reach constant (and same for all of them) terminal speed  $v$  and move with it until opening the parachute. After opening the parachute at some particular height their speed quickly becomes  $u$  (also the same for all of them). The arrangement of skydivers is shown on the figure. Assuming they move strictly vertically, find ratio of speeds  $\frac{v}{u}$ .



- \*5. A billiard table has length  $a$  and width  $b$ . A ball is launched from the middle of the side  $b$ . At what angle to side  $b$  should the ball be launched in order to return exactly to the initial point after several collisions?

- \*6. It's raining and the rain drops are falling down vertically with velocity  $u$ . On the ground a round ball (say, a soccer ball) is rolling horizontally with velocity  $v$ . How many times more rain drops will fall on this ball compared to the same one, lying still, during the same amount of time? Would the answer be different, if the ball wasn't round (say, a football)?

HOMEWORK PART 2

- \*7. A supersonic airplane is flying horizontally. Two microphones are located on the same vertical line, one below the other by distance  $l$ . They have detected arrival of the sound wave from the plane with a relative delay  $\Delta t$ . Speed of sound in the air is  $c$ . What is the speed of the plane?
- \*8. A group of Alaskan gold prospectors reach a wide straight river that flows with uniform speed  $v$ . What immediately catches all their eyes is a huge gold nugget lying on the further bank, directly across the river. The laws governing prospecting in Alaska state that the first person to reach any particular place has the right to establish a mine there; speed is of the essence!

Joe, one of the prospectors, has a canoe, which he can paddle in still water at the same speed  $u$  as he can hike along a river bank. What course of action should he take if  $u/v$  is (a) smaller than or (b) larger than a certain critical value? Assume that Joe first paddles across the river (in a straight line) and then, if necessary, hikes along the bank to reach the nugget.

FOR THE NEXT MEETING

**IMPORTANT:** The next club's meeting is at 4:00pm, via Zoom, on Sunday, **October 26**.