

USEFUL RESOURCES

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

https://schoolnova.org/classinfo?class_id=2252&sem_id=74

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

TODAY'S MEETING

Today we welcomed all the participants into the club, discussed the normal form of operation and then solved a few nice estimate problems.

The first homework has few more estimate problems and problems on kinematics of uniform motion. Please solve the problems at home! During the club meeting we will only have time to discuss the solutions that you already have. You can also think in advance which problem(s) you may want to present at the meeting.

Problems are listed in no particular order. Problems marked with a star are somewhat more challenging. If you feel like you need some clarification about the formulation of any problem, you are always welcome to email apc@schoolnova.org

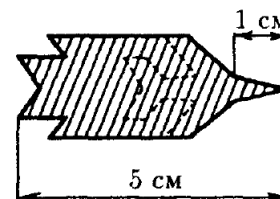
HOMEWORK

1. An important skill for any physicist is to quickly estimate some quantity without a detailed calculation. In this set of problems you are asked for an *estimate* which means that it is totally fine to be wrong by a factor of ~ 10 . You can google some background information as needed, but try to use your intuition and common sense first. Don't be afraid to make guesses in some of the intermediate steps, especially if you are unsure how to proceed. For inspiration and more problems of this kind google *Fermi estimate problems*.

- (a) Recent satellite measurements show that the North American continent is slowly drifting at a rate of about 1 cm per year. Assuming the continent is roughly 50 km thick, estimate the kinetic energy the continental US has due to this motion. How does this energy compare to the kinetic energy of a person walking?

- (b) Estimate the mass of a black hole the size of a pebble.

2. 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.



3. A particle covers the first half of a given distance at a constant speed v_0 . The remaining half of the distance is traveled such that the particle moves at speed v_1 for the first half of the remaining time, and at speed v_2 for the second half of that time. Determine the average speed of the particle over the entire journey.
4. Athletes form a line of length l and run together with speed v in the direction along this line. A coach runs towards them with speed $u < v$. Upon meeting the coach each athlete instantly turns around and starts running in the opposite direction with the same speed v . What will be the length of the line of athletes after they all turn around?
- *5. A billiard table has length a and width b . A ball is launched from the middle of the side b at some angle α to that side. Find all α such that after several collisions the ball returns exactly to the initial point?

FOR THE NEXT MEETING

IMPORTANT: The next club's meeting is at 3pm, via Zoom, on Sunday, **September 28**.