



## ADVANCED PHYSICS CLUB

OCTOBER 25, 2020

### 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=ay2020](https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2020)

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

### TODAY'S MEETING

Today we begin discussing problems on kinematics of motion with constant velocity.

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. That is why we would ask to **submit the solutions to part 2 in writing prior to our next meeting by sending them to [apc@schoolnova.org](mailto:apc@schoolnova.org)**.

### HOMEWORK PART 1

1. 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?
2. Two long sticks intersect at an angle  $2\alpha$  and move in the same plane, each moving perpendicularly to itself with a velocity  $v$ . Find the velocity of their intersection point.
3. 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?
4. 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

- \*5. A bus is moving on a straight road with constant speed  $v$ . You have noticed the bus when it was at some point  $A$ . From what region around the road should you start running in order to catch the bus? You run with speed  $u < v$ .
- \*6. 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?
- \*7. Four turtles are initially located in the vertices of a square with side  $a$ . They start moving at the same time with constant speed  $v$ . Each turtle always moves in the direction towards its clockwise neighbor. Where and after what time will the turtles meet? What if there were three turtles in the vertices of an equilateral triangle?

### FOR THE NEXT MEETING

**IMPORTANT:** The next club's meeting is at 3:00pm, via Zoom, on Sunday, **November 1**.