11-14 Velocity

Prerequisites:

There are no formal prerequisites, however we recommend that students should have already completed the **Distance-Time Graphs** or the **Calculating Speed** sheets before looking at velocity.

The Main Points

- **Speed** measures how fast you are going, but gives no indication of which way you are travelling.
    - ‘The cyclist moved at 20mph’ tells us a speed.
- If you know the speed and the direction of motion, you know the **velocity**.
    - ‘The pigeon flew down at 15m/s’ is a velocity as we have the direction as well as the speed.
    - Directions are sometimes given with East/West/Up/Down, but can also be relative to other landmarks like ‘further down the road’ or ‘towards the hill’. Even forwards/backwards counts as a direction.
    - In later work (such as in our ‘Step Up to GCSE’ material) we use positive and negative signs to give information about direction (so something moving to the right might have a velocity of +5m/s whereas something moving to the left could be -3m/s). In this sheet, however, the directions are always given with words.
- If something is **stationary**, then this tells us all we could want to know about the motion, so ‘stationary’ is a velocity even though there is no direction. (Because direction is meaningless in this case.)
- Directions need to be taken into account when thinking about the **change in velocity**. In the questions, this is exemplified by using number lines which go in two directions.
    - If you were going 6m/s forwards and then change and go at 2m/s backwards
    - …the change of speed is 6m/s - 2m/s = 4m/s.
    - …however the change of velocity is 8m/s backwards. This is because you
        - have a change of 6m/s backwards to cancel out the 6m/s of forward motion
        - and then have an extra change of 2m/s backwards,
        - making it 8m/s backwards in total.
- While it is not mentioned on this sheet, the reason for familiarising the students with the idea of velocity is so that they will be able to understand acceleration and its link with force better when the students do the **Acceleration** and **Force and Acceleration** sheets.
    - You need a **force** to change something’s **velocity**.
    - If the **velocity is changing, there is an acceleration** (even if the speed isn’t changing). This is because the direction is changing, and as we know from tyres and the way they grip a road, you do need a force if you wish to change direction (turn).

Teacher Quarter Briefing

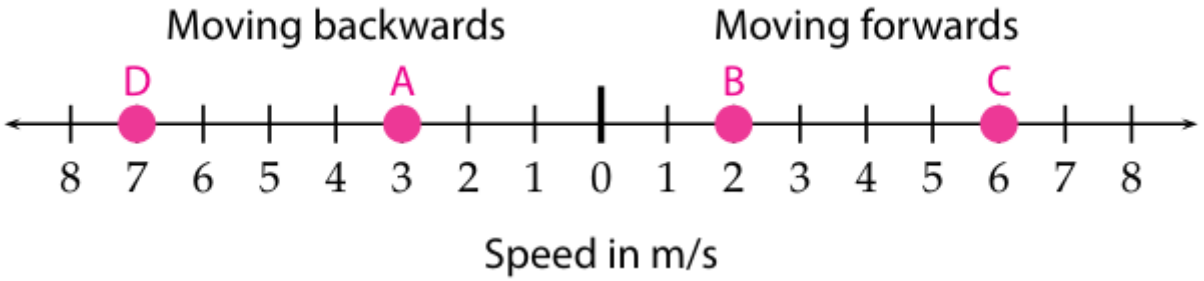
- Introduction: https://youtu.be/OhnTKy7YSIQ
- Practice: https://isaacphysics.org/gameboards#itsp_teach_velocity
- Review: https://youtu.be/Zbne3ilvmcw
- If you want to go deeper, please see https://isaacphysics.org/gameboards#step_up_phys_1_b1 which explores the ideas here in the context of displacement (position), or https://isaacphysics.org/gameboards#step_up_phys_4_b1 which looks at how we get velocity information from a distance-time graph.

Class Question Notes

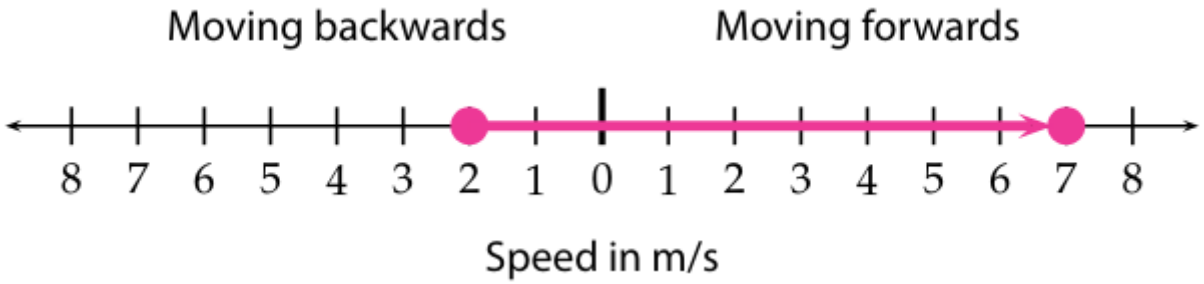
The worksheet can be printed either in full, or in cloze text form (where the red text is missing, and students can complete these blank spaces after class discussion). The online version of the notes requires the appropriate text to be dragged to the right place in the sentences.

Shallow learning gradient online assignment - q1,2,3,4,5,6,7
Steeper learning gradient online assignment - q1,2,4,6,7,8,9

1. Here the student is given information (such as 'The seagull flew west') and has to decide whether they have a speed, direction and/or velocity (they might have more than one).
2. This is the first question where students see a number line used to represent velocities. For each point on the line, they have to say what the speed, direction and velocity is. For example, for A the speed is 3m/s, the direction is 'backwards' and the velocity is '3m/s backwards'.



3. This question enables students to see that even if the speed stays the same, velocity can change (if the direction has changed).
4. This is the first question where students are shown the number line for velocity and shown a velocity change marked. Here the change is 9m/s forwards and students can see this by looking at the length of the arrow marking the change in velocity.



5. This question is very similar to Q4, but the student is not told the velocity change and has to work it out from the number line.
6. This question is similar to Q4 and Q5, but the student needs to mark the velocities on the number line.
7. Students work out velocity changes without a number line.
8. Students work out the velocity and speed change for a netball which was going at 6m/s upwards, but is now going downwards at 6m/s.
    a. the speed has not changed
    b. the direction has changed, so the velocity has changed. The velocity change here is 6m/s + 6m/s = 12 m/s. (If one book is 6cm above a desk, and another is 6cm below the desk, the books are 12cm apart.)
9. Students comment whether the velocity is changing as a satellite goes round the Earth at a steady speed on a circular course.

Homework Question Notes

These questions have identical form to the questions in the class task, so students can refer back to their earlier answers to help. Equally, you as teacher, may refer to the notes above which are equally relevant to the homework questions.

Shallow learning gradient online assignment - q1,2,3,4,5,6,7
Steeper learning gradient online assignment - q1,3,4,5,7,8,9,10