11-14 Calculating Speed

The Main Points

- **Speed** measures how quickly something is moving.
- If something is not speeding up or slowing down (it has a steady speed) we say it has a **constant speed**.
- The speed in m/s (metres per second or metres *each* second) tells us how far the object moves each second. So a speed of 6m/s means that the object travels 6m every second.
- The speed in km/h (kilometres per hour or kilometres *each* hour) tells us how far would travel in a whole hour if we kept this speed up.
- **Typical speeds**
    - Walking speeds are about 1.5m/s which is about 6 km/h.
    - A jogger may run at 3m/s (12 km/h)
    - 30mph on the road is equivalent to 13m/s (50 km/h)
    - an express train might travel at 90 m/s (320 km/h)
    - an airliner might travel at 220 m/s (800 km/h)
- When doing calculations with objects at constant speed, we use the formula
    - **Distance travelled = Speed x Time**
    - In symbols s = v t where we use s for distance and v for speed.
- **Velocity** measures speed and direction
- For something with a changing speed during a journey
    - **Average speed** = Total distance / Total time

Teacher Quarter Briefing

- Introduction: ttps://youtu.be/tc2FbIt0Gws
- Practice: https://isaacphysics.org/gameboards#teach_quart_calcspeed
- Review: ttps://youtu.be/GjKS9bI5mBg
- If you want to go further: https://isaacphysics.org/pages/covid19_gcse_archive#08

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.

1. Here, after a discussion, the objects are put in increasing order of speed, but please do point out to your students the typical magnitudes of the speeds (1.5m/s as a walking speed is a particularly important figurer). It may also be worth pointing out that to convert a speed from m/s (used in classrooms) and km/h (used more in the real world), you multiply the number by about 4 (actually 3.6). If your students are more confident with miles per hour (mph), 1m/s is about 2mph, so 70mph is equivalent to about 35m/s (actually 31m/s).
2. In this question, students work out a distance from a speed and a time. The formula has not been introduced yet - the idea is for students to get used to speeds as the distance moved each second (or hour). So in 10s at 3m/s, you move 10x3 = 30m. In question 2d, the student must convert 10 minutes into 600 seconds.
3. In this question, students work out how much time it takes a car at 30m/s to cover certain distances. Please encourage students to do this by common sense. If the car covers 30m each second, then a journey of 90m will be covered in 90/30 = 3s.
4. Here the student works out the speed covered each second when a buggy takes 8s to cover 32m. Encourage them to do it by reasoning rather than a formula.

5. Here the student works out the speed covered in an hour by a train which takes 12min (which is 0.2h) to cover 30km. Encourage the student to think that 12min is ⅕ h, and therefore in a whole hour the train will travel 30km x 5 = 150km, so the speed is 150km/h.
6. In this question the student writes down and rearranges the word equation for speed, distance and time.
7. In this question, the student writes down and rearranges the equation using symbols. In science we use v for speed and s for distance (which is not what they do in maths). This looks forward to the day when they start calculating velocities.
8. This is a question allowing students to practise using the formulae.
9. Here the student is introduced to a motion in two parts - one part forward and one part backwards. They calculate the distance forward and the distance backward. They then need to take the difference to work out how far the object (a model train) is from its starting point. In later study this idea will be developed as the concept of **displacement**.
10. In this question, students use the formula Average Speed = Total Distance / Total Time. Please remind them that an average speed is not the averages of the speeds, but rather the equivalent steady speed which would cover the distance in the time.

Homework Question Notes

These questions have a very similar form to the questions in the class task, so students can refer back to their earlier answers to help

1. In this question, students choose vehicles from a list to go with the speeds already written in a table in m/s. They also add the speeds in km/h from a list. If students are not comfortable converting the units, they can fill in the table by simply putting the km/h speeds in the table in numerical order.
2. Students practise writing the word equations for Distance and Time. Online, they drag and drop the options into place.
3. Students practise writing the symbolic equations for Distance and Time. Online, they drag and drop the options into place.
4. This is a straightforward question applying the formulae - all distances are in m, and all times are in seconds. Part (e) involves a distance of 10cm, but the question reminds students that 1cm = 0.01m.
5. Here the student calculates how far an athlete at 9m/s runs in 2s and 30s. Ideally they do this by common sense and multiplication rather than the formula.
6. This question involves a coach at 100km/h, where the student works out the time taken to cover 600km (=6x100km, so 6hr) and 25km (=¼ x 100km, so quarter of an hour = 15 min).
7. Students calculate speeds distances times for new scenarios where the distances are in km and the times are in a variety of units.
8. This question is similar to q9 on the classwork sheet. This is a journey in two parts, and the student has to work out where the radio controlled car ends up. The car moves 5x4=20m forwards then 10x3=30m backwards, so it ends up 10m behind its starting point.
9. This is another two-part journey, where the total distance and average speed is calculated. The driver travels 140km/h x ⅓h = 47km then 100km/h x ⅔h = 67km making a total of 93km (to the nearest kilometre). This is in one hour, so the average speed is 93km/h.
10. In this question, the student applies their understanding of average speed to work out whether a motorcyclist will be ‘caught’ by average speed cameras on a fast road. Their speeding is detected despite the fact that they are below the speed limit while passing the cameras.

Extension questions from ‘Step Up to GCSE Physics’:
https://isaacphysics.org/gameboards#step_up_phys_6_b1