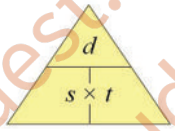
Motion, Distance, Time & Force

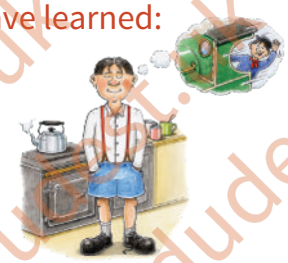
STUDENT INTRODUCTION

- Forces are in action everywhere at the Isle of Wight Steam Railway. The locomotive steam engine, the wheels and rails, the water tower, the signal-box…
- This activity enables you to apply formulae to the railway environment, working out the average speed based on distance and time

You will apply the formula you have learned:

Speed = distance ÷ time





You will need:

- To know the length of the track between the two points you are measuring
- Something to measure the time, i.e. stop-watch or smartphone app

Finding the average speed

- You will need to find out how long the track is between any two stations on your given journey
- You will then need to time how long the journey takes and use the calculation of **distance ÷ time** to work out the **average speed** of the train

Task

- On the graph paper provided (on page 3) draw a graph with ***time*** on the x axis and ***distance*** on the y axis
- Plot your journey or journeys - if you make two journeys, record both (on your graph in different colours) to form an average later

Questions

1. The train starts off slowly then the speed increases. It slows down as it gets into the station. How can this be shown on your graph?

2. If the train has to stop for an emergency for 5 minutes, how would you show this on your graph?

3. If you made a return journey can you work out the average speed of the two journeys?

4. What was the average speed in both kilometres per hour and miles per hour? (mph x 1.609344 = kph)

Forces

- If there are no forces having an effect on an object that is moving, it will carry on moving at the same speed. On Earth it is almost impossible to find something unaffected by forces.
- Moving objects usually have air resistance or friction acting upon them.
- If the train is moving at a steady speed, air resistance and friction are trying to slow it down. The forward force from its engine is the same size as the total force from air resistance and friction.
- Balanced forces cannot make something start or stop moving or change its speed.

At school, you will have studied force diagrams. These show how the size and direction of a force is represented by arrows that show:

- the size of the force (the longer the arrow, the bigger the force)
- the direction in which the force acts

- In the case of the train, if the forces are unbalanced it will change speed.
- If the forward force from the engine of the train is bigger than the forces of friction and air resistance, then the train will accelerate.
- The acceleration depends on the size of the force and on the mass of the object. If the same force is applied, a smaller mass will accelerate faster than a bigger mass.

Questions

5. In the diagram above, what is happening to the movement of the train?

6. Are there any other forces acting on the train?
(add these using force arrows to the diagram ab

Questions continued on page 3...

Hopefully you've identified the forces acting upon the train

Questions (continued)

7. Are these forces balanced or unbalanced? Explain your answer.

8. If the [illegible] forces are [illegible]

9. What effect would increasing or decreasing the number of carriages have on the amount of force needed to start the train moving?