

## Ferry Motion

### Speed and Acceleration across the Solent!

#### Student Introduction

- ▶ In this activity you will compare the speeds of the two Red Funnel ferry services and consider how common variables affect service delivery.



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### REVISION TIME!

The **speed** of an object depends upon the **distance** moved and the **time** taken.

To calculate speed you use the formula:

$$\text{speed (m/s)} = \text{distance (m)} \div \text{time (s)}$$

or, more usefully when considering long distances and timescales:

$$\text{speed (km/h)} = \text{distance (km)} \div \text{time (h)}$$

As the ferry moves out of the harbour its speed will increase. It will accelerate. Acceleration is the rate at which you change speed.

To calculate acceleration, you use the formula:

$$\text{acceleration (m/s}^2\text{)} = \text{change in velocity (m/s)} \div \text{time taken for the change (s)}$$

## TASK

## 1

## Practice Calculations

Let's practise some simple speed calculations!

Complete each of the following problems:

Q1.

- ▶ The distance travelled by the vehicle ferry from Southampton to East Cowes is **18.5km**
- ▶ The average time for this crossing is **1 hour**
- ▶ What is the **average speed** of the ferry?

Show your working out. Don't forget to include the units of measurement.



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ANSWER:

Q2.

- ▶ The Red Jet travels **18.3km** from Southampton to Cowes in **0.5 hours**
- ▶ What is the average speed of the ferry?

Show your working out. Don't forget to include the units of measurement.



ANSWER:

Q3. Fill in the missing word:

The Red Jet passenger ferry crossing is \_\_\_\_\_ times as fast as the Red Funnel vehicle ferry crossing.

## TASK 2

### Introducing Variables

Running a ferry service to timetable is a tricky business!

Consider the following variables and complete the calculations.

Q4.

- ▶ High winds and shipping can affect the speed of the Red Funnel vehicle ferry
- ▶ During Cowes Week there are often hundreds of yachts in the Solent which can slow down the crossing
- ▶ Sometimes the crossing can take as long as **1.2 hours**



▶ Calculate the average speed of the ferry when this

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ANSWER:

Q5.

- ▶ If the wind is favourable, the ferry can increase its average speed to **22 km/h**
- ▶ **Calculate the time taken** for this ferry crossing

Show your working out. Don't forget to include the units of measurement.



ANSWER:

TASK  
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## Considering Acceleration

Ferries don't move at a constant speed, so let's consider acceleration too!

Complete the following problems:

Q6.

- ▶ As the vehicle ferry leaves the terminal it accelerates until it reaches a velocity of **5 m/s**
- ▶ It takes **180 seconds** to reach this velocity
- ▶ Calculate the **acceleration** of this ferry



Show your working out. Don't forget to include the units of measurement. NB: the formula you need is on the front page!

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ANSWER:

Q7.

- ▶ The Red Jet takes **120 seconds** to reach a velocity of **10 m/s**
- ▶ Calculate the acceleration of the Red Jet

Show your working out. Don't forget to include the units of measurement.

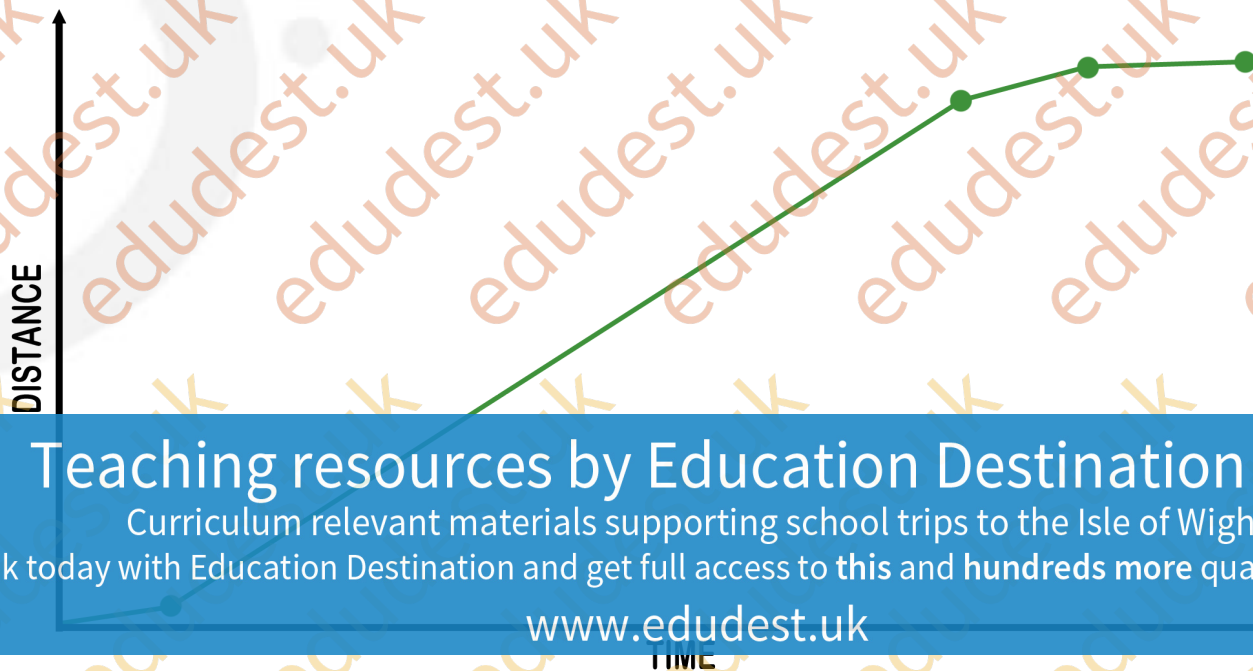


ANSWER:

## Distance-Time Graphs

### TASK 4

The whole journey of a ferry crossing can be represented on a distance-time graph.  
Look at the graph and follow the instructions



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On the graph above, mark the sections with numbers to represent the following in the correct order:

1. Ferry slows down due to speed restrictions in Cowes Harbour
2. Ferry accelerates away from departure terminal at Southampton
3. Ferry decelerates into arrival terminal at East Cowes
4. Travelling at a constant speed

In the space below, draw your own distance-time graph for a Red Jet journey - remember it accelerates and decelerates faster, and travels at a faster constant speed.

TASK  
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## Velocity-Time Graphs

An alternative way of representing the journey is on a velocity-time graph.  
Look at the graph and follow the instructions.



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On the graph above, mark the sections with numbers to represent the following in the correct order:

1. Ferry slows down due to speed restrictions in Cowes Harbour (2 segments)
2. Ferry accelerates away from departure terminal at Southampton
3. Ferry decelerates into arrival terminal at East Cowes (2 segments)
4. Travelling at a constant speed

In the space below, draw your own velocity-time graph for a Red Jet journey - remember it accelerates and decelerates faster, travels at a faster constant speed and on arrival at East Cowes it turns around before it docks.

