Acceleration Problems

Answer the following questions:

1. State the equation used to calculate acceleration.

$$Acceleration = \frac{Change\ in\ velocity}{Time}$$

2. State the SI unit for acceleration.
   Metres per second squared (m/s^2)
3. Explain why acceleration is a vector quantity.
   Acceleration is the rate of change of velocity and velocity is speed in a given direction, so acceleration must also have a direction.
4. Compare the meaning of a horizontal line on a distance-time graph and a velocity-time graph.
   On a distance-time graph a horizontal line represents a stationary object whereas on a velocity-time graph a horizontal line represents an object with constant velocity.
5. Name the quantity that can be determined from the gradient of a velocity-time graph.
   Acceleration

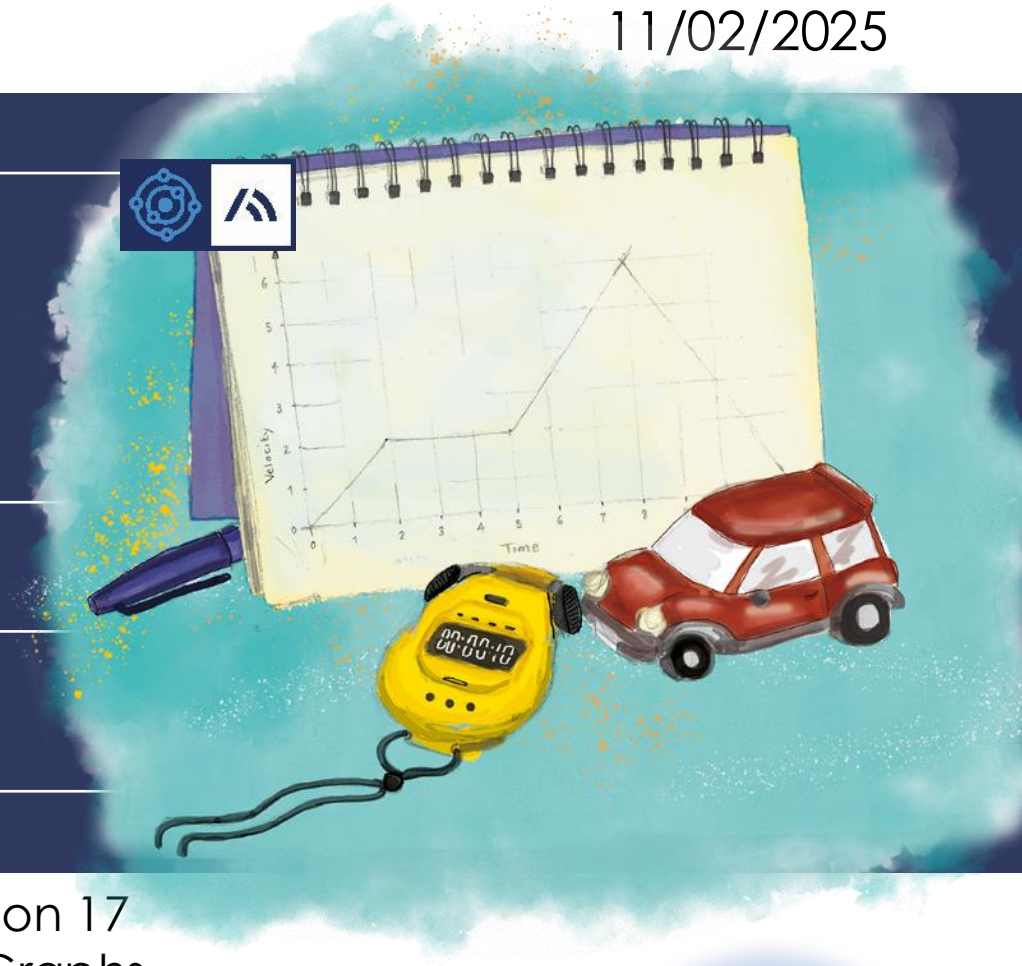
Do Now

11/02/2025

Acceleration Problems

P3.1.11

Science Mastery

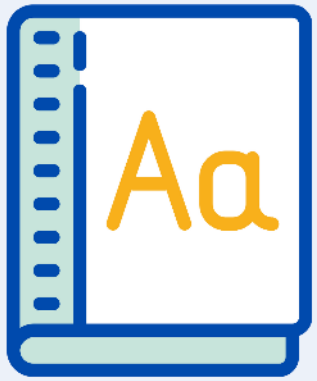


P3.1.1 Prior Knowledge Review
P3.1.2 Scalars and Vectors
P3.1.3 Resultant Vectors
P3.1.4 Resolving Vectors
P3.1.5 Newton's Third Law
P3.1.6 Newton's First Law
P3.1.7 Acceleration
P3.1.8 Acceleration Investigation
Maths in Science Lesson 17
P3.1.9 Velocity-Time Graphs
P3.1.10 Velocity-Time Graphs 2
➢ **P3.1.11 Acceleration Problems**

Following this lesson, students will be able to:

- Describe the motion of an object using a velocity-time graph
- Use a velocity-time graph to draw conclusions about the forces acting on an object

Key Words:



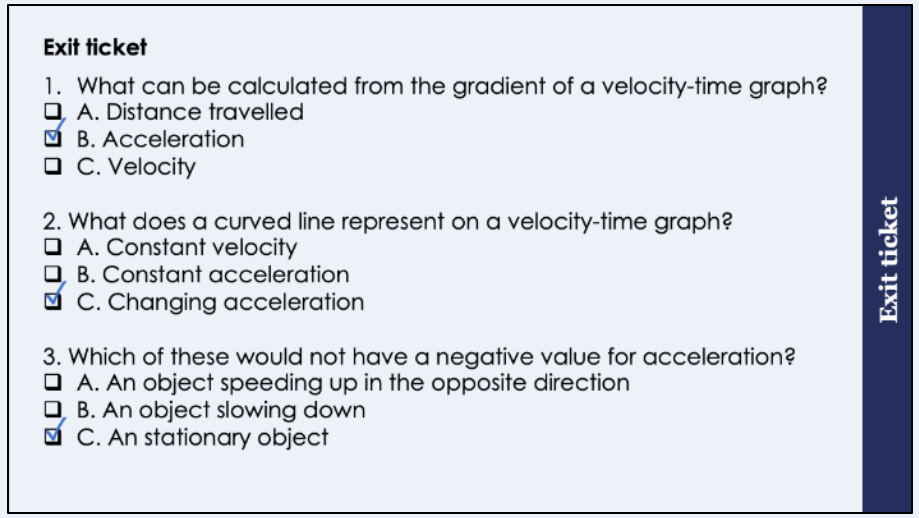
force	balanced	unbalanced
velocity	acceleration	vertical

Lesson Objectives

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Fix-it

Why do all cars have a top speed?

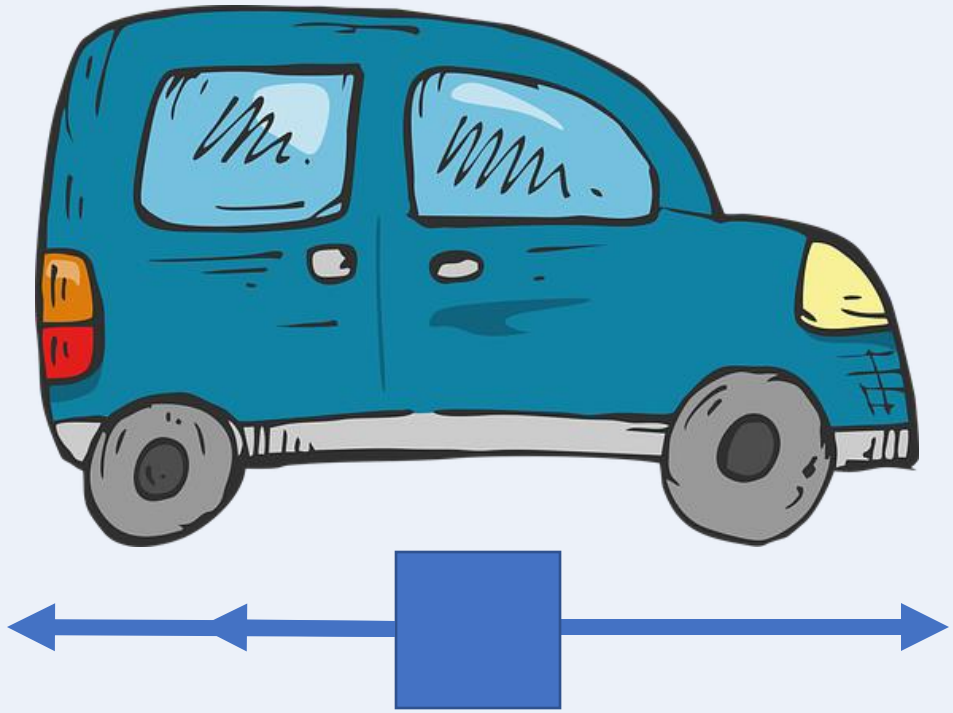
What is a top speed?

Which of these cars would have a greater top speed?

What would affect the top speed of these cars?

Talk Task

Terminal Velocity



Resultant force = non-zero

Resultant force = non-zero

Resultant force = zero

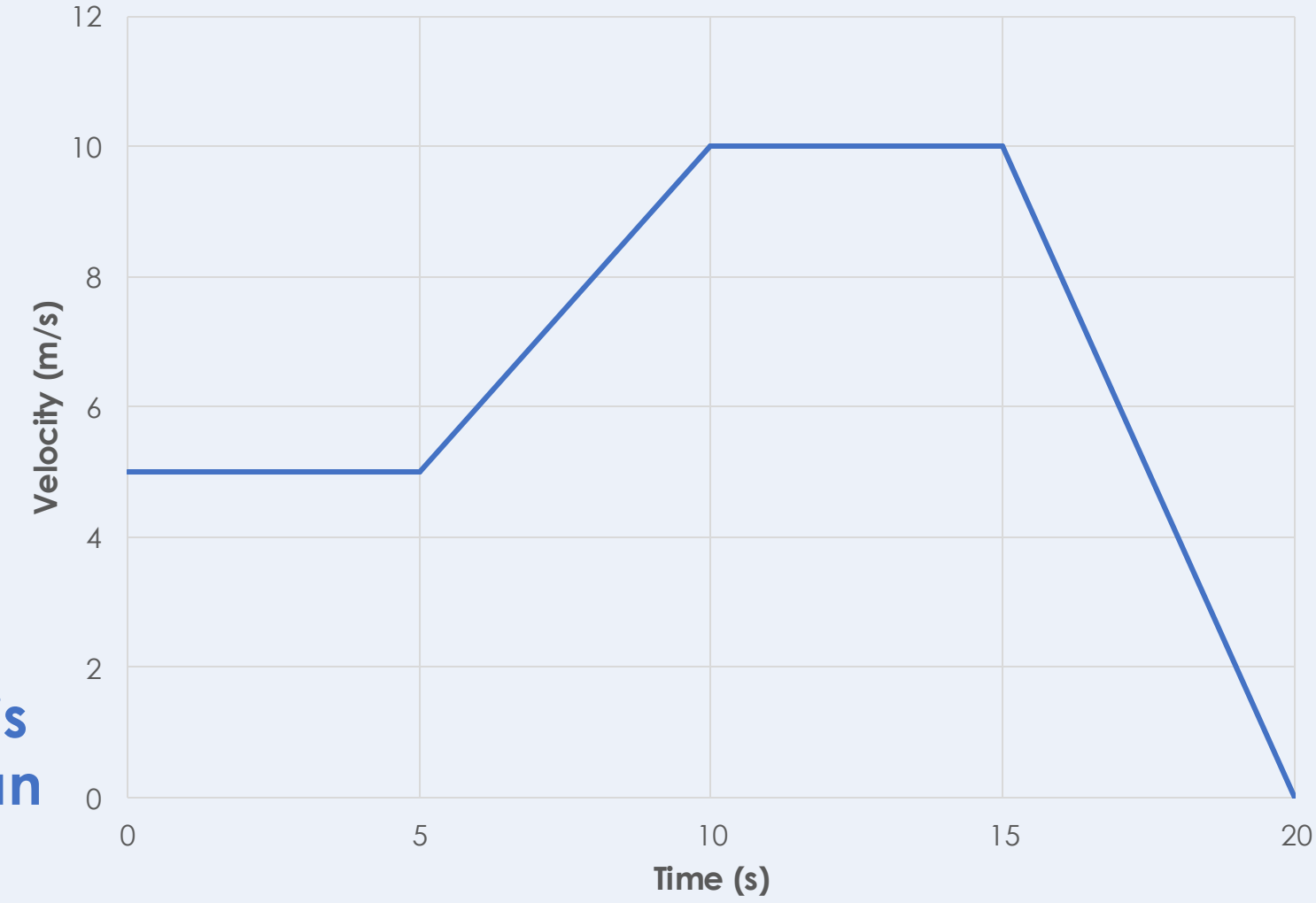
I: Velocity-Time Graphs and Forces

Describe the motion of this object between 0 and 5 seconds.

The object is travelling at a constant speed.

Explain what this shows about the forces acting on the object.

The forces must be balanced/resultant force is 0 because the motion of an object will not change unless acted upon by an unbalanced force.



Apply

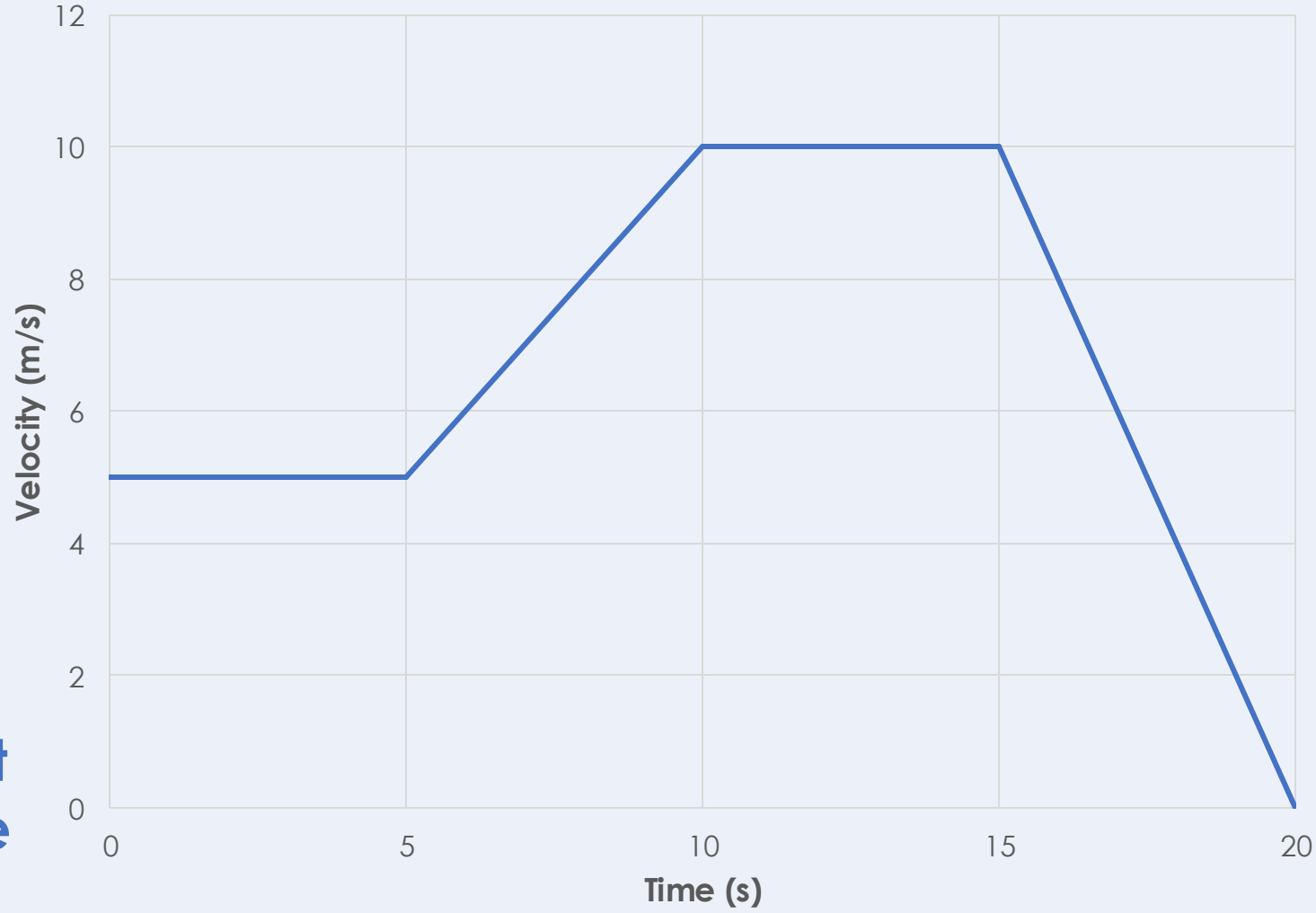
We: Velocity-Time Graphs and Forces

Describe the motion of this object between 5 and 10 seconds.

The object is accelerating.

Explain what this shows about the forces acting on the object.

The forces are not balanced/there is a resultant force (forwards) because the motion of an object only changes if it is acted upon by an unbalanced force.



Apply

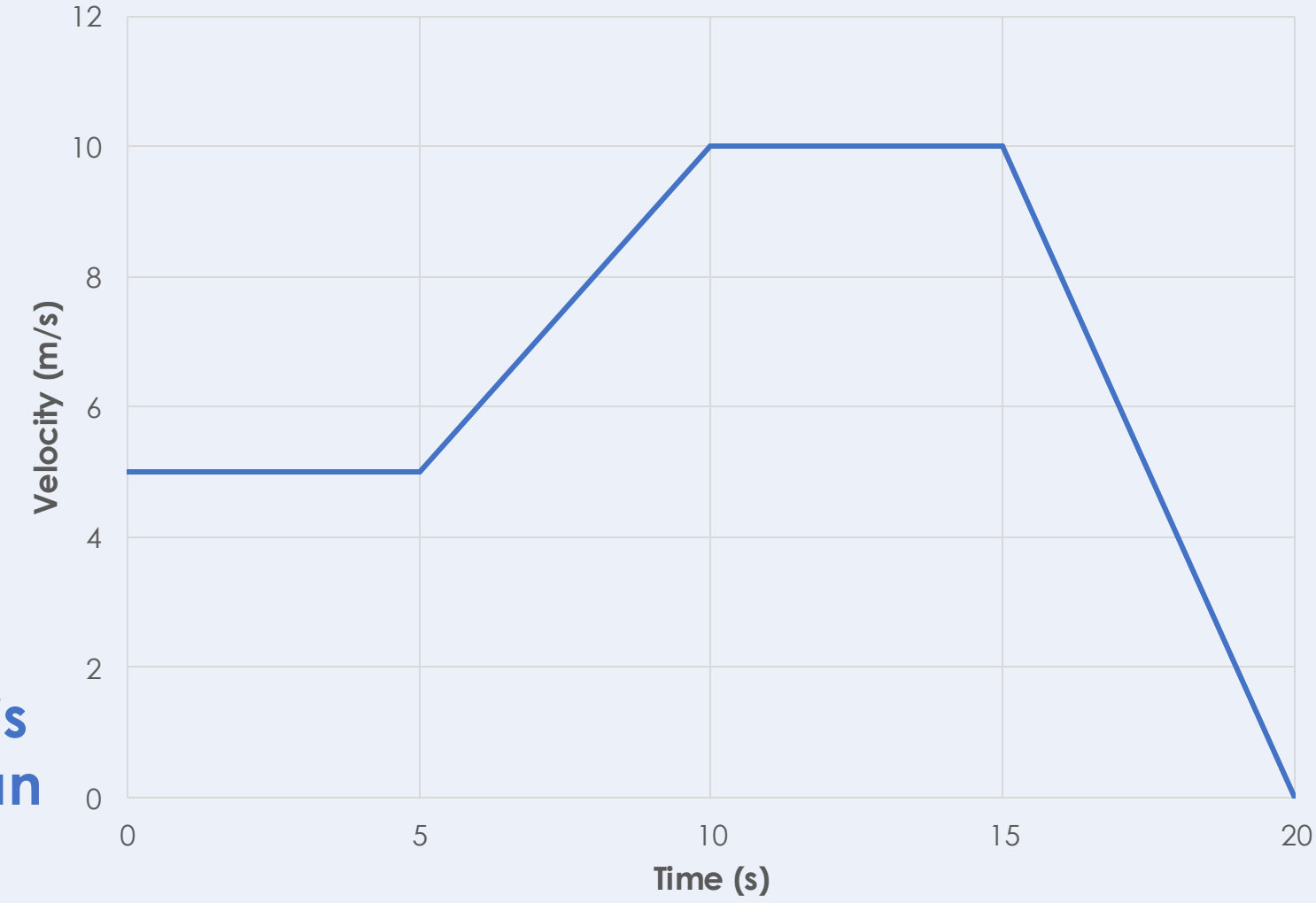
You: Velocity-Time Graphs and Forces

Describe the motion of this object between 10 and 15 seconds.

The object is travelling at a constant speed.

Explain what this shows about the forces acting on the object.

The forces must be balanced/resultant force is 0 because the motion of an object will not change unless acted upon by an unbalanced force.



Apply

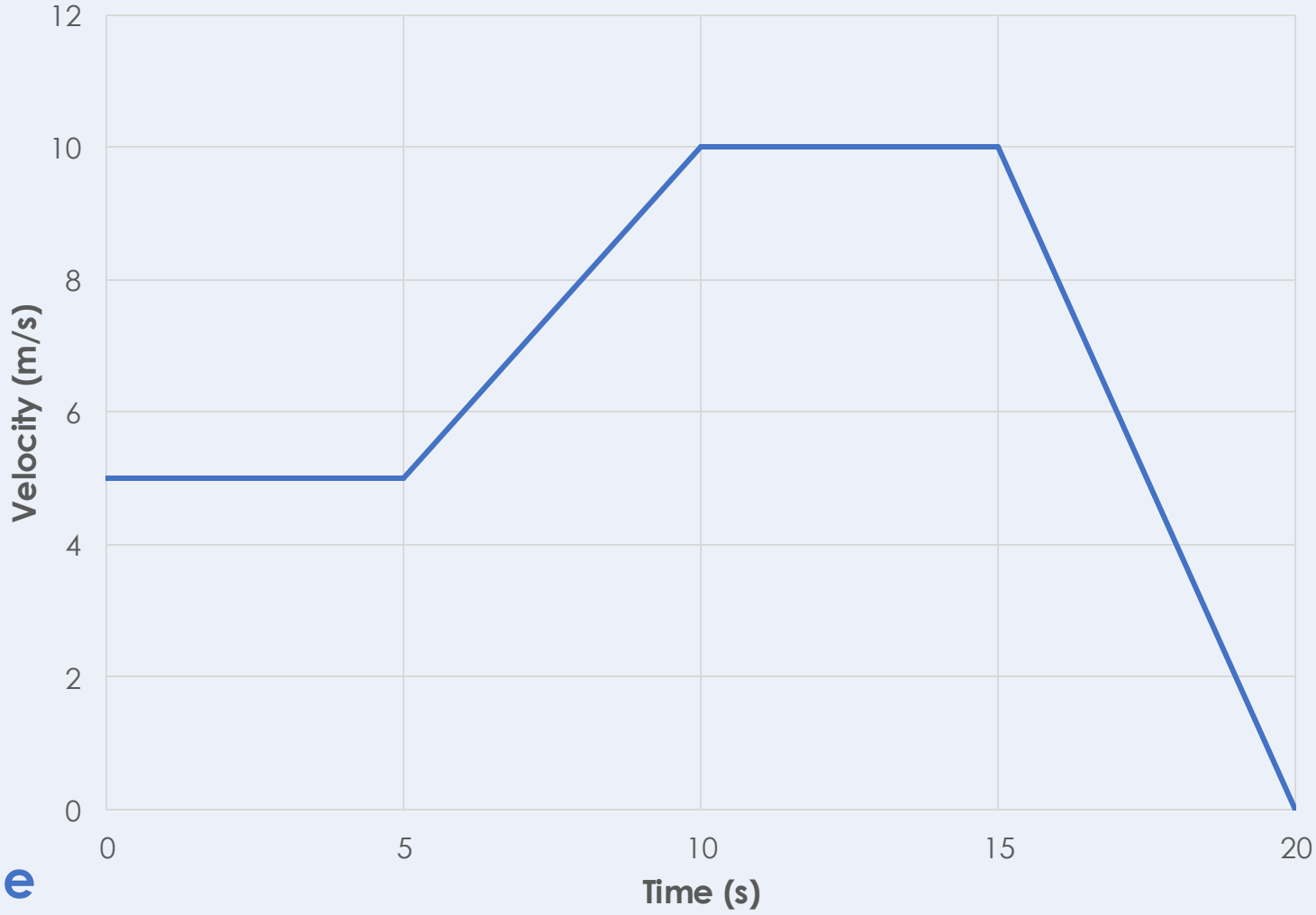
You: Velocity-Time Graphs and Forces

Describe the motion of this object between 15 and 20 seconds.

The object is decelerating.

Explain what this shows about the forces acting on the object.

The forces are not balanced/there is a resultant force (acting in the opposite direction to motion) because the motion of an object only changes if it is acted upon by an unbalanced force.



Apply

Acceleration

Acceleration can occur **vertically** as well as **horizontally**.

Newton's First Law states that an object's motion will not change unless acted upon by an unbalanced force.

This also applies to objects travelling up and down.

The same rules apply with velocity-time graphs when describing vertical motion.

Determine if the following statements are true or false:

1. Newton's First Law states that an object's motion will not change unless acted upon by balanced forces **False**

2. The resultant force acting on a stationary object must be zero **True**

3. The only force acting on an object that is falling is gravity **False**

4. A negative velocity shows that an object is travelling in the opposite direction **True**

Check for understanding

Accelerating Upwards

Why does a space rocket need a lot of force to lift off?

What is Newton's First Law?

What forces are acting on the rocket before lift-off?

What forces are acting on the rocket at lift-off?

What can be said about the size of these forces for the rocket to be able to lift off?

In which direction would the resultant force be acting?

Which direction would the rocket accelerate in?

Talk Task

Drill

1. What is Newton's first law?
2. Describe the forces acting on a stationary car.
3. When a car accelerates, what happens to the forces?
4. What happens to air resistance as a car accelerates?
5. Which direction would air resistance act on a car moving forwards?
6. What are the forces acting on a stationary rocket?
7. If a rocket initially accelerates upwards what does this tell you about thrust and weight?
8. If a rocket runs out of fuel, what will happen to the thrust force?
9. If a rocket is moving upwards and the weight is greater than thrust force, then what happens to the rocket?
10. What is the force that attracts objects with mass towards the centre of earth?

Check for understanding

Drill answers

1. Newton's first law states that an object in motion will not change unless there is an unbalanced force acting on it.
2. The resultant forces on a stationary car are 0N as they are equal and opposite.
3. When a car accelerates the forward force (thrust force from the engine) is greater than the backward force(friction and air resistance).
4. Air resistance increases as a car accelerates.
5. Air resistance would act backwards when a car moves forward.
6. Stationary rocket has weight and reaction force.
7. Thrust is greater than weight when a rocket initially accelerates upwards.
8. Thrust is removed when a rocket runs out of fuel.
9. The rocket will still move upwards but will then start to slow down, and then start to fall down, as the weight is greater than thrust.
10. Gravitational force.

Check for understanding

Answer the questions below.

1. Which scenario would have a non-zero resultant force?

- ☐ A. An object travelling at constant velocity
- ☐ B. A stationary object
- ☑ C. An object decelerating

2. At what point would a rocket have a velocity of 0?

- ☐ A. Just before it hits the ground
- ☑ B. At its highest point
- ☐ C. Just after it takes off

3. Which would show an object decelerating on a velocity-time graph?

- ☑ A. A negative gradient
- ☐ B. A positive gradient
- ☐ C. A horizontal line at 0 on the y axis

Exit ticket

Feedback

Lesson P3.1.11	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!