Acceleration

Answer the following questions:

1. State Newton's First Law.
   An object's motion will not change unless acted upon by an unbalanced force.
2. State Newton's Third Law.
   Every action has an equal and opposite reaction. If object A exerts a force on object B, B exerts an equal and opposite force on A.
3. Define velocity.
   Velocity is the speed of an object in a given direction.
4. Describe what happens to a stationary object if it is acted upon by an unbalanced force.
   The object will accelerate in the direction of the resultant force.
5. Describe the possible motion of an object with balanced forces acting on it.
   The object would be stationary or travelling at a constant speed in the same direction.

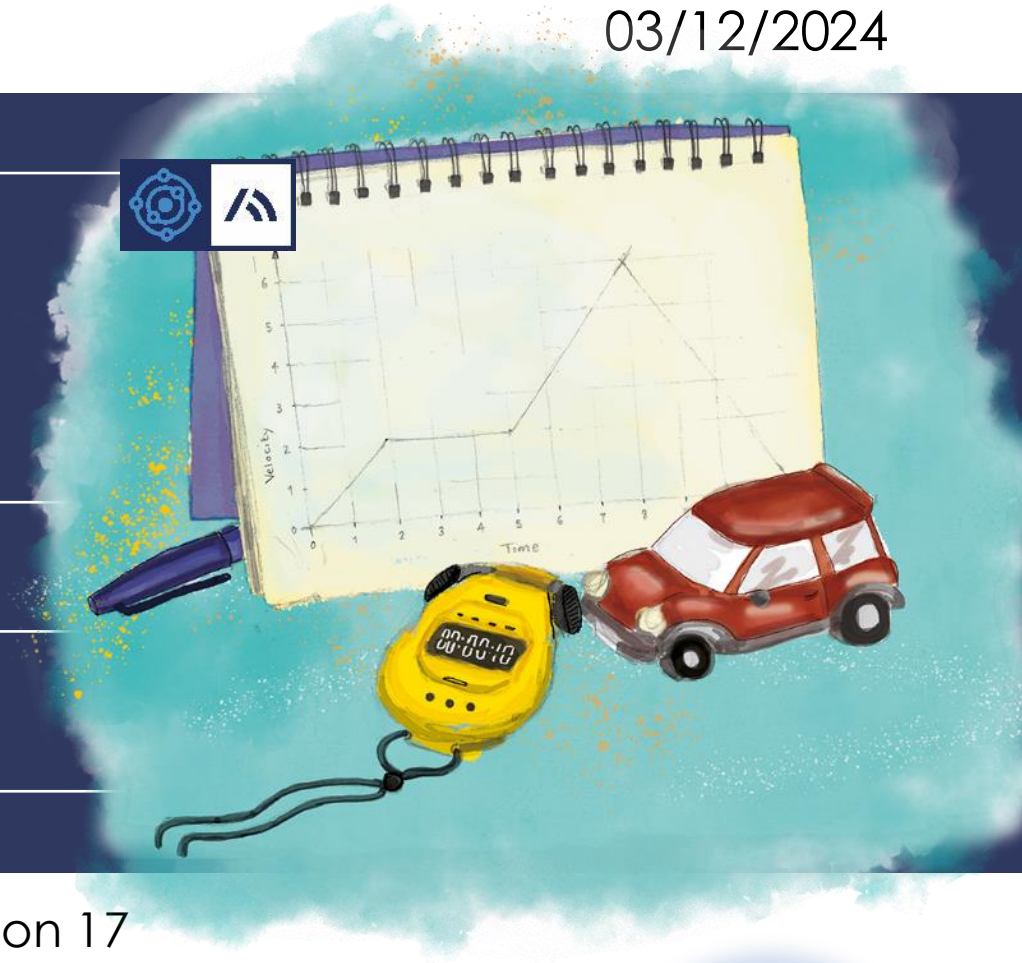
Do Now

03/12/2024

Acceleration

P3.1.7

Science Mastery



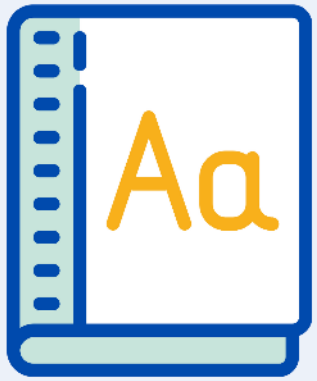
P3.1.1 Prior Knowledge Review
P3.1.2 Scalars and Vectors
P3.1.3 Resultant Vectors
P3.1.4 Resolving Vectors
P3.1.5 Newton's Third Law
P3.1.6 Newton's First Law
➢ **P3.1.7 Acceleration**
P3.1.8 Acceleration Investigation
Maths in Science Lesson 17
P3.1.9 Velocity-Time Graphs
P3.1.10 Velocity-Time Graphs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

Lesson Objectives

Following this lesson, students will be able to:

- Define acceleration
- Calculate acceleration using the equation $a = \frac{\Delta v}{t}$
- Explain the difference between velocity and acceleration

Key Words:



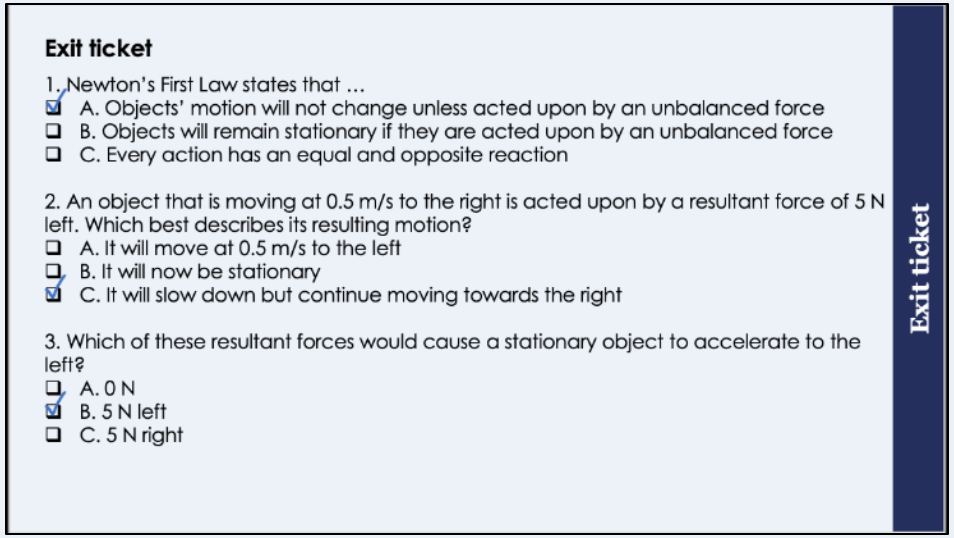
acceleration **deceleration** **velocity**

initial **final**

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

Vocabulary

Acceleration

'In an age of acceleration, nothing can be more exhilarating than going slow. And in an age of distraction, nothing is so luxurious as paying attention. '

Pico Iyer

General Definition

An increase in speed or rate.

From the Latin *accelerare* meaning 'hasten'.

Scientific Definition

The rate of change of velocity.

Synonyms

Speed up
Quicken

General Examples

The acceleration of technology has already been a big feature of the 21st century.

Scientific Examples

The car had a negative acceleration as it slowed down at traffic lights.

Acceleration

Acceleration is the **rate** of **change** of **velocity**.

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

This could be an object **speeding up**, **slowing down** or **changing direction.**

Change in velocity is the final velocity minus the initial velocity.

The SI unit for acceleration is metres per second squared (**m/s^2**).

$$a = \frac{m/s}{s}$$

As acceleration is the rate of change of velocity, it is also a **vector** quantity.

I: Calculating Acceleration

Worked example:

Calculate the acceleration of a car that goes from rest to 10 m/s forwards in 5 seconds.

Acceleration = $\frac{\text{change in velocity}}{\text{time}}$

$a = \frac{10\ \text{m/s} - 0\ \text{m/s}}{5\ \text{s}}$

$a = 2\ \text{m/s}^2$ forwards

$$a = \frac{\Delta v}{t}$$

Acceleration

Acceleration can refer to speeding up, slowing down or changing direction.

A negative acceleration (an object slowing down) can be called **deceleration.**

An object travelling in a **circle** is accelerating because it is constantly **changing direction**.

Objects near the surface of the Earth experience **acceleration due to gravity** of 9.8 m/s^2.

As objects speed up, air resistance increases.

We: Calculating Acceleration

Worked example:

Calculate the acceleration of a sprinter that crosses the finish line and slows down to a stop from 10 m/s in 2 seconds.

$$a = \frac{\Delta v}{t}$$

Acceleration = $\frac{\text{change in velocity}}{\text{time}}$

$a = \frac{0\ m/s - 10\ m/s}{2\ s}$

$a = -5\ m/s^2$

You: Calculating Acceleration

Worked example:

Calculate the acceleration of a cyclist that speeds up from 6 m/s to 10 m/s over 5 seconds.

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

$$a = \frac{10 \text{ m/s} - 6 \text{ m/s}}{5 \text{ s}}$$

$$a = 0.8 \text{ m/s}^2$$

Determine if the following statements are true or false:

1. Acceleration is an increase in velocity **False**
2. An object moving in a circle is accelerating **True**
3. The SI unit for acceleration is m/s **False**
4. Acceleration can be calculated by dividing the change in velocity by time **True**
5. If an object starts at rest its final velocity is 0 m/s **False**
6. An object that is accelerating must have balanced forces acting upon it **False**
7. As an object speeds up, the air resistance acting on it increases **True**

Check for understanding

Which statements do you agree with?

I think the Moon is not accelerating because it is moving at a steady speed

I think that the Moon is accelerating because it is always getting faster

I think that the Moon is accelerating because it is constantly changing direction

I think that the Moon is not accelerating because it always travels in the same direction

Talk Task

Drill

1. What is velocity?
2. What are the SI units for velocity?
3. What is acceleration?
4. What does the symbol Δ mean?
5. What are the SI units for acceleration?
6. What is the equation used to calculate acceleration?
7. When an object is decelerating what is it doing?
8. When calculating deceleration, it must always be a…... number.
9. What is the value for acceleration due to gravity? Give units.
10. As an object speeds up what happens to its air resistance?
11. An object at rest has a velocity of...?

Check for understanding

Drill answers

1. Velocity is the rate of change of distance.
2. The SI units for velocity are m/s.
3. Acceleration is the rate of change of velocity. Can be referred to as speeding up or slowing down.
4. The delta, Δ symbol denotes 'change in'.
5. The SI units for acceleration are m/s^2.
6. $Acceleration = \frac{Change\ in\ velocity}{Time}$ or $a = \frac{\Delta v}{t}$ is the equation for acceleration.
7. A decelerating object is slowing down.
8. When calculating deceleration, it must always be a <u>negative</u> number.
9. The value for acceleration due to gravity is $9.8 m/s^2$.
10. As an object speeds up, its air resistance increases.
11. An object at rest has a velocity of 0 m/s.

Check for understanding

Compare: *to outline the similarities and/or differences between things*

Example question:

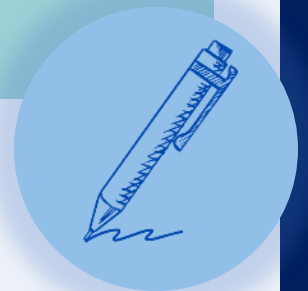
Compare the **forces** acting on an object that is **accelerating** and an object that is travelling at **constant velocity.**

Model answer:

- Both objects can have forces acting on them in opposite directions
- An object that is accelerating must have an **unbalanced force** acting on it, whereas an object that is travelling at constant velocity must have **balanced forces** acting on it
- Balanced forces are **equal** in **magnitude** and **opposite** in **direction**, whereas unbalanced forces may be **opposite** in **direction** but **not equal** in **magnitude**

To 'compare', your answer should:

- Give **similarities.**
- Write **paired statements** that **show differences relating to the same feature**.
- Use the term '**whereas**' to link your statements.



Writing like a scientist

Answer the questions below.

1. Acceleration is …

- [x] A. The rate of change of velocity
- [ ] B. When an object gets faster
- [ ] C. An increase in velocity

2. Which of these is an example of acceleration?

- [x] A. A car coming to a stop at traffic lights
- [ ] B. A car driving over the speed limit at 20 m/s
- [ ] C. Two trains passing each other at different speeds

3. What is the acceleration of a sprinter going from rest to 10 m/s in 2 seconds?

- [ ] A. 5 m/s
- [x] B. 5 m/s^2
- [ ] C. - 5 m/s^2

Exit ticket

Feedback

Lesson P3.1.7	
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!