



[https://isaacscience.org/question\\_decks#ipts25\\_sat\\_2a\\_ks3](https://isaacscience.org/question_decks#ipts25_sat_2a_ks3)

# Using Isaac with 11-14

Nicki Humphry-Baker and Anton Machacek

This symposium  
is generously  
funded by



**making  
physics  
matter**

# Our Aims: Years 7 & 8



- Build skills and confidence in:
  - Numeracy
  - Creativity
  - Curiosity
  - Problem-solving
- Embed numeracy (mathematics) within the development of conceptual understanding
- Support teachers with reference materials to teach the lessons and tailored CPD.

# The Questions



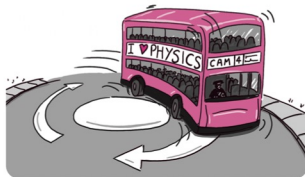
## Acceleration

**Velocity** is the **speed** and **direction** of something's motion.

**Acceleration** means that the **velocity** is **changing**.

An accelerating bus could be **speeding up**, **slowing down** or **turning**.

Slowing down is a special kind of acceleration called **deceleration**.



1 Is it accelerating? How did you decide?

(a) A snail starting to move.

(b) A cyclist riding East at 12 mph.



2 Is it accelerating? How did you decide?

(a) The Earth going round the Sun.

(b) A train slows to stop at a station.

3 An aeroplane begins to speed up down a runway. An airport worker measures the speed after each second. The speeds are in the table below.

Time (s)	0	1	2	3	4	5
Speed (m/s)	0	4	8	12	16	20

(a) Is the aeroplane accelerating? How can you tell?

(b) What do you think the speed is after 7 s?

(c) When will the speed be 36 m/s?

Brief summary at the start.

First 2-3 questions  
Testing the ideas. Not numeric

3+ questions  
Numeric questions requiring pattern matching or straightforward algebra

# The Questions



## Acceleration Practice

1 Is it accelerating? How did you decide?

(a) A cat running North at a steady speed. (c) A cyclist turning a corner.

(b) An aeroplane just after it lands.

(d) A cow standing in a field.

2 A train speeds up after passing a signal. The speeds are in the table below, but one is missing.

Time (s)	0	5	10	15	20
Speed (m/s)	5	11	17		29

(a) Is it accelerating? How can you tell?

(b) What is the missing speed?

(c) If it keeps accelerating like this, when will the speed be 65 m/s?

(d) What is the acceleration in  $\text{m/s}^2$ ?

3 A bus slows down as it approaches a bus stop.

Time (s)	0	1	2	3
Speed (m/s)	12	9		3

- Sections come with questions for in class and similar homework questions (labelled practice)

# The Questions



A rocket accelerates at  $20 \text{ m/s}^2$ .

(a) Complete the sentence: The velocity gets   $\text{m/s}$  greater every second.

(b) Work out the velocity change in five seconds using an equation.

$$\begin{array}{ccccccc} \text{velocity change (m/s)} & = & \text{acceleration (m/s}^2\text{)} & \times & \text{time (s)} \\ \hline \text{ } & = & 20 & \times & 5 \end{array}$$

(c) Work out the velocity change in 10 s using an equation.

$$\begin{array}{ccccccc} \text{velocity change (m/s)} & = & \text{acceleration (m/s}^2\text{)} & \times & \text{time (s)} \\ \hline \text{ } & = & 20 & \times & 10 \end{array}$$

(d) Work out the velocity change in 25 s.

Unit...

[Check my answer](#)

- Develop understanding of formulae through number patterns and scaffold a common-sense deduction rather than memorising formulae.
- Helps develop scientific thinking and intuition.

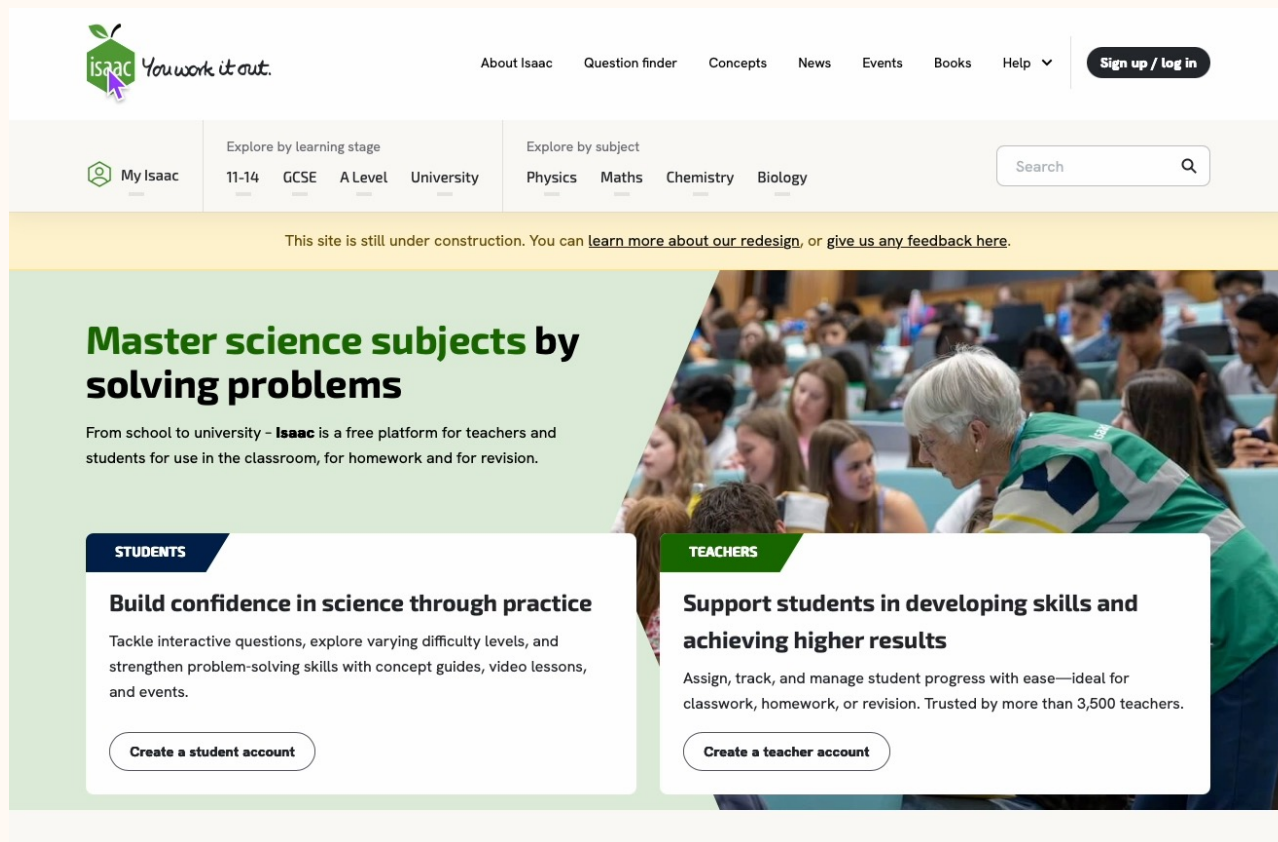
# The Questions



The screenshot shows the 'Step into Physics' web application. On the left is a navigation menu with categories like Overview, Forces, Weight, Density, Stretching, Pressure, Motion, Forces &amp; Motion, Energy, Electricity, and Experiments. The 'Forces' category is selected. The main content area is titled 'Forces' and contains three sections: 'Questions' with links to 'Forces Notes', 'Forces A', 'Forces B', 'Forces Practice A', and 'Forces Practice B'; and 'Resources' with links to 'Forces (full text PDF)', 'Forces Practice (full text PDF)', 'Forces (cloze text PDF)', and 'Forces Practice (cloze text PDF)'. There is also a small image of a rocket launch.

- Notes section appear as questions
- Questions are split into shallow and steeper progression
  - A is shallow
  - B is steeper

# How to Find the Resources



The screenshot shows the Isaac website homepage. At the top, there is a navigation bar with the Isaac logo and tagline "You work it out.", followed by links for "About Isaac", "Question finder", "Concepts", "News", "Events", "Books", and "Help". A "Sign up / log in" button is on the right. Below this is a secondary navigation bar with "My Isaac" and two main sections: "Explore by learning stage" (with links for 11-14, GCSE, A Level, and University) and "Explore by subject" (with links for Physics, Maths, Chemistry, and Biology). A search bar is located to the right of these links. A yellow banner below the navigation bar states: "This site is still under construction. You can [learn more about our redesign](#), or [give us any feedback here](#)." The main content area features a large green and white graphic with the text "Master science subjects by solving problems". Below this, a paragraph reads: "From school to university - **Isaac** is a free platform for teachers and students for use in the classroom, for homework and for revision." There are two prominent white boxes with green accents. The left box is for "STUDENTS" and is titled "Build confidence in science through practice". It describes the platform's features: "Tackle interactive questions, explore varying difficulty levels, and strengthen problem-solving skills with concept guides, video lessons, and events." It includes a "Create a student account" button. The right box is for "TEACHERS" and is titled "Support students in developing skills and achieving higher results". It describes the platform's features: "Assign, track, and manage student progress with ease—ideal for classwork, homework, or revision. Trusted by more than 3,500 teachers." It includes a "Create a teacher account" button. The background of the main content area shows a photograph of a teacher interacting with students in a classroom.

**isaac** You work it out.

About Isaac Question finder Concepts News Events Books Help ▾ Sign up / log in

My Isaac

Explore by learning stage

11-14 GCSE A Level University

Explore by subject

Physics Maths Chemistry Biology

Search

This site is still under construction. You can [learn more about our redesign](#), or [give us any feedback here](#).

## Master science subjects by solving problems

From school to university - **Isaac** is a free platform for teachers and students for use in the classroom, for homework and for revision.

### STUDENTS

#### Build confidence in science through practice

Tackle interactive questions, explore varying difficulty levels, and strengthen problem-solving skills with concept guides, video lessons, and events.

Create a student account

### TEACHERS

#### Support students in developing skills and achieving higher results

Assign, track, and manage student progress with ease—ideal for classwork, homework, or revision. Trusted by more than 3,500 teachers.

Create a teacher account

# How Teachers Use it



- Present on the screen and check questions together
  - Can model how to use the Isaac Science
- With Years 7 & 8, and Year 9, and GCSE
- Any students needing more practice with foundation ideas in physics

Students really enjoyed being able to write in the book.  
Teacher at KS3 Jamboree



# Teacher Resources

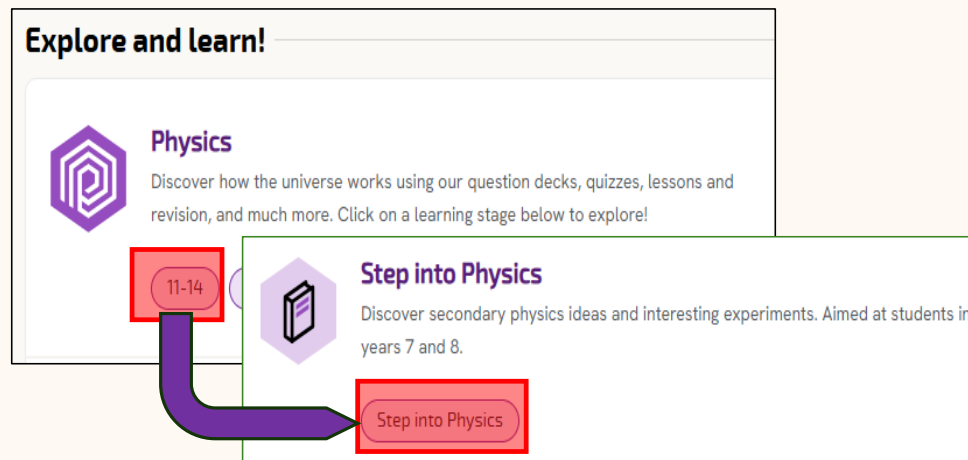


- Guidance notes
- Print outs with and without cloze text
- Teacher Quarters

# The Teacher Quarter



15 minute CPD session on the lesson, its concepts and how to handle student questions



Then choose topic, and scroll to bottom

If asked to  
organize a 45min  
CPD session for  
your department,  
ask your teachers  
to do 3!

# The Teacher Quarter



## Resources

<a href="#">Velocity (full text PDF)</a>	<a href="#">Velocity Practice (full text PDF)</a>
<a href="#">Velocity (cloze text PDF)</a>	<a href="#">Velocity Practice (cloze text PDF)</a>



## Teacher Quarter

The Teacher Quarters are 15-minute video-based CPD sessions giving you a quick introduction to the concepts and content of each lesson. These are primarily intended for teachers new to teaching physics. Here you will find:

- an introductory video
- a selection of questions to practise the idea
- a video which reviews those questions and how they might be tackled in class

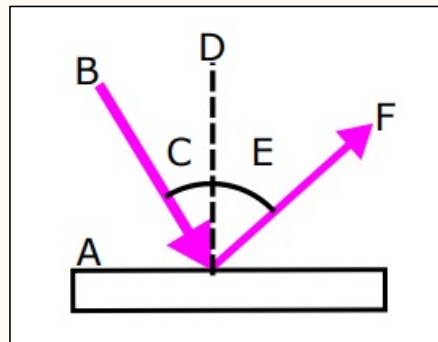
[Introductory video](#) ▾[Question selection](#) >[Question review video](#) >[Guidance notes](#) >

# Ongoing developments

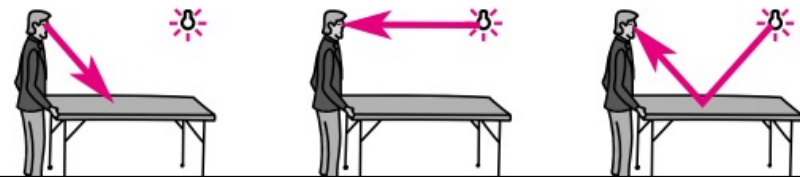


- Resource development for all physics KS3 concepts
- Particular focus on waves
- Draft class worksheets available for you to try as PDF

<https://tinyurl.com/itsp25wavesks3>



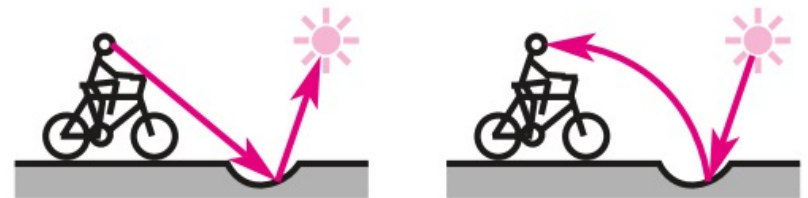
A person can see a table in a room with a light bulb. Which of the following diagrams is correct? The lines with arrows show the light travelling.



What is wrong with these diagrams showing a person looking at their phone?



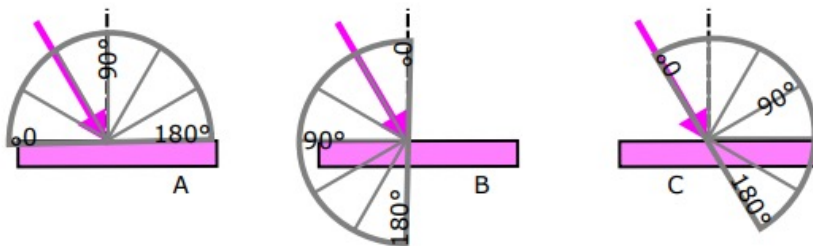
What is wrong with these diagrams showing a cyclist looking at a hole in the road?



# More waves

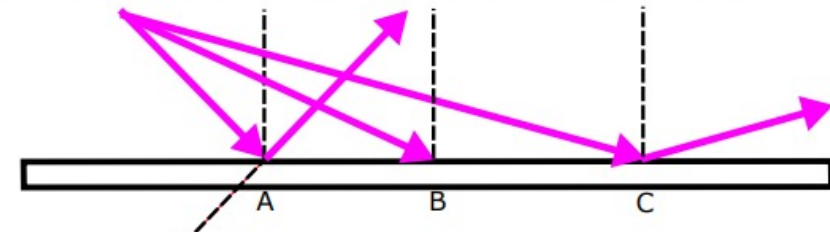


The diagrams below show three attempts to measure an angle of incidence.

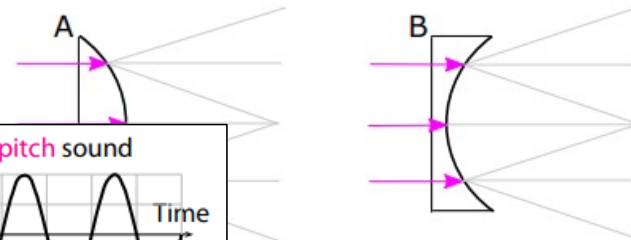


- From which of these protractors could we read off the correct angle?
- State the angle of incidence of the ray.
- What do we line the centre of the protractor up with?

The diagram below shows three rays from the same point striking a mirror.



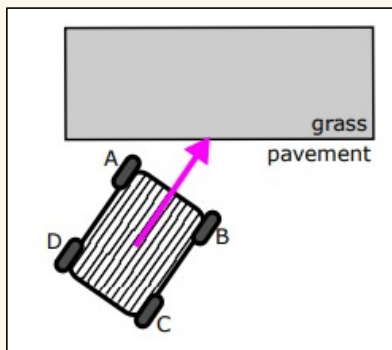
The diagrams below show rays passing into pieces of glass with a curved surface.



...aces where light reaches the curved surface.  
how light leaves the glass. Each refracted ray follows  
will need to choose which one to use.

. A **convex** lens is thicker in the middle than at the  
s? Write A or B.

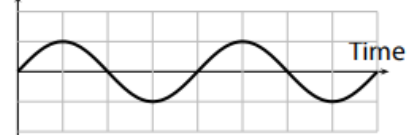
ex lens causes a parallel beam of light to



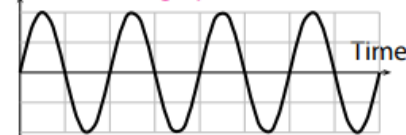
Loud, low pitch sound



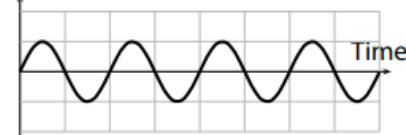
Quiet, low pitch sound



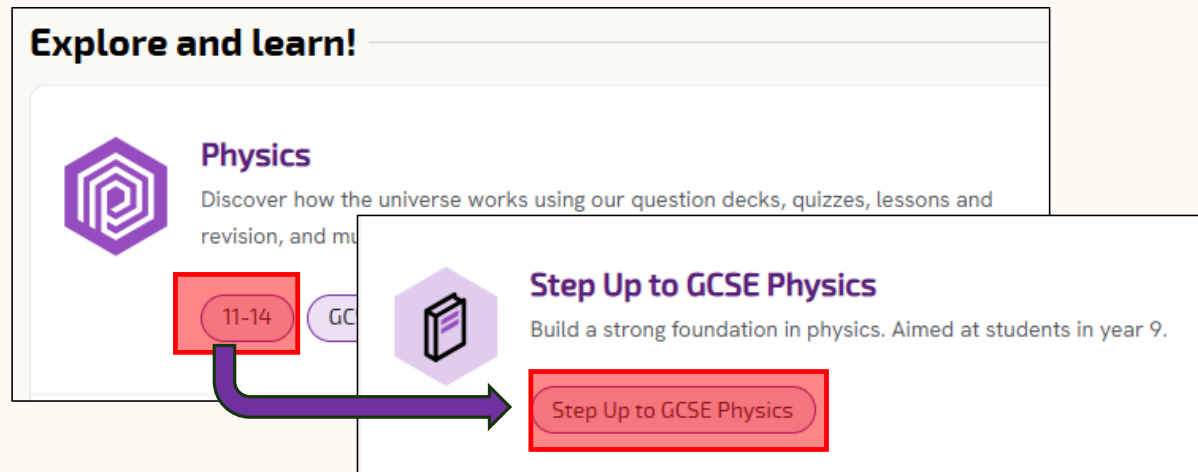
Loud, high pitch sound



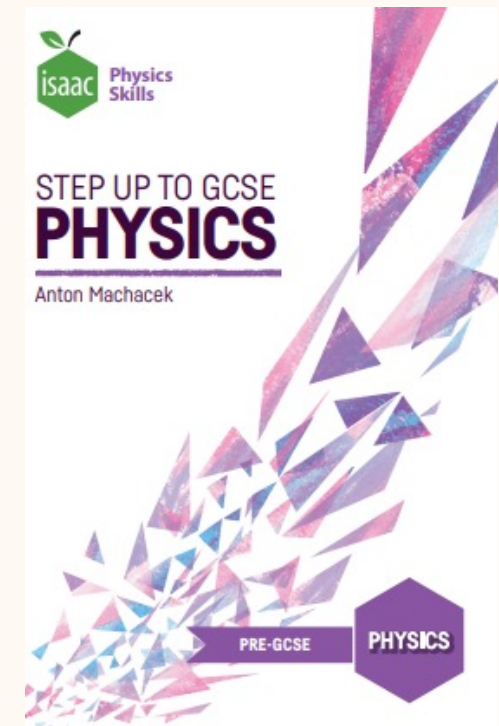
Quiet, high pitch sound



# The next stage – we step up!



- Gives quantitative detail to KS3 previous coverage
- Designed for flexible usage
- Can be used by Y10/Y11 students gaining confidence
- Can be used by Y7/Y8 students for extension learning
- Teacher CPD: The principal resource for 'further learning' from the Step into Physics Teacher Quarters



# Scope

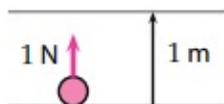


- **Mechanics:** displacement, units and conversion, s-t and v-t graphs and how to read them, velocity, acceleration, weight, resultant force, force & acceleration, momentum and impulse
- **Electricity:** Current and voltage in circuits, energy & voltage, charge & current, large & small numbers, resistance, power, sharing voltage
- **Energy:** Work, gravitational potential energy, power, energy flow, energy & temperature, balancing & moments
- **Materials & Forces:** Density, floating, friction, springs, pressure
- **Extra resources:** summary questions, challenge, secret key

**You choose!**

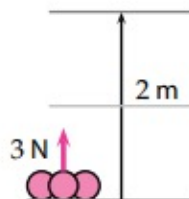


# Examples



A small apple weighs 1 N. We lift it 1 m.  
This needs 1 J of energy.

Three small apples weigh 3 N.  
Lifting them 1 m would need 3 J of energy.  
Lifting them 2 m, requires 6 J of energy.



The **energy given** to an object in this way is called the **work done on it**:  
Work (J) = Force applied (N) × Displacement change (m),  $\Delta E = F \Delta s$

The equation can be re-arranged (see page 9) to give

$$F = \frac{\Delta E}{\Delta s}$$

$$\Delta E = F \Delta s$$

$$\Delta s = \frac{\Delta E}{F}$$

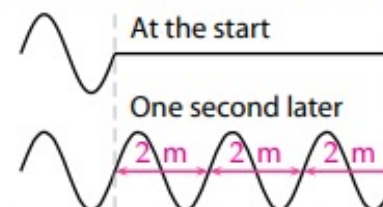
**Example 1** – Calculate the energy given to a cart by its engine, which pulls it 25 m East with a force of 35 N in that direction.

If we use + to mean 'East' then  $F = +35$  N, and  $\Delta s = +25$  m, so  
 $\Delta E = F \Delta s = 35 \text{ N} \times 25 \text{ m} = +875 \text{ J}$  so 875 J is given to the cart.

24.1 Calculate the work done on a sack which is dragged 13 m across the floor with a 45 N force.

24.2 Calculate the distance it will take for a 20 N force to do 600 J of work

If we know the **wavelength** and **frequency** of a wave, we can work out its **speed**. The diagram shows the front of a wave going forward for one second.



Frequency is 3 Hz, wavelength is 2 m.  
In one second, 3 new waves are made.  
Length of new wave is  $3 \times 2 \text{ m} = 6 \text{ m}$ .  
The wave's front moves 6 m each second.  
The wave's speed is 6 m/s.

The formula for wave speed is

Speed (m/s) = Frequency (Hz) × Wavelength (m), or  $v = f \lambda$ .

This equation can be re-arranged using the methods on page 9 to give

$$f = \frac{v}{\lambda}$$

$$v = f \lambda$$

$$\lambda = \frac{v}{f}$$

**Example** – A wave's speed is 20 m/s and its wavelength is 0.40 m. What is its frequency?

We re-arrange  $v = f \lambda$  by dividing both sides by  $\lambda$  to give

$$f = \frac{v}{\lambda} = \frac{20 \text{ m/s}}{0.4 \text{ m}} = 50 \text{ Hz.}$$



# Enabling and Challenge material



- Enabling
  - Positive and negative numbers (various contexts)
  - Unit conversion (proportionality)
  - Re-arranging equations
  - Large and small numbers (prefixes and standard form)
  - Repeated practice, graduated questions
  - $\Delta$  notation (or is that challenge?)
- Challenge
  - Displacement from a v-t graph
  - Momentum and impulse
  - Potential division
  - Balancing as energy conservation
  - Flotation, Friction, Internal energy, Dimensional analysis

# Resources – Teacher guide



- Pedagogical approach
- Scheme of Learning Framework

- 3 - Displacement-time graphs. Support for this is given in
  - 1 - Displacement (representing position as a number)
- 4 - Velocity (introduced graphically)
- 6 - Calculating velocities. Support for this is given in
  - 2 - Converting units
  - 5- Rearranging equations
- 7 - Velocity-time graphs
- 8 - Acceleration. Extension for this is given in
  - 9 - Calculating accelerations
- 11 - Weight and Resultant Force
- 12 - Force and Acceleration

- Specific Section Guidance

## Section 9 - Calculating Acceleration

More challenging questions: 5,6,7,8

Questions on the ['quick' homework board](#): 1,2,3,6,8

In this section, students practise using the formula  $\text{Acceleration} = \text{Velocity change} / \text{Time taken}$ . Please do not expect students to find q6-8 easy if they have not been taught how to convert units (section 2 can be used as a resource for this). If you do not want to worry about converting units, then just use q1-5.

Q9.3 This is about the time taken to stop. The acceleration given is negative because the vehicle is slowing from high speed forward motion. The acceleration of  $-4.5\text{m/s}^2$  means that it loses  $4.5\text{m/s}$  of speed each second. So in  $3.5\text{s}$ , it can lose  $3.5 \times 4.5 = 15.75\text{m/s}$ , which is therefore the top speed. If you went any faster, you would not be able to stop in  $3.5\text{s}$ .

Q9.5a Change in speed = change in velocity = acceleration  $\times$  time =  $30 \times (5 \times 60) \text{ m/s}$  - remember that the acceleration has to be in  $\text{m/s}^2$  (so  $3g = 30\text{m/s}^2$ ) and the time has to be in seconds.

# Features – Quick Boards



- A board with a few questions suitable for a short homework

16 Energy, Charge and Potential

17 Potential in Circuits

18 Charge and Current

19 Large and Small Numbers

20 Current in Circuits

### Questions

9

**17. Potential in circuits**  
Charge & Current

5

**17. Potential in circuits Quick Board**  
Charge & Current

### 17. Potential in circuits Quick Board

Notes

**Potential in Circuits 2**  
Step Up to GCSE Physics 17.2  
Physics | Electricity | Charge & Current

**Potential in Circuits 3**  
Step Up to GCSE Physics 17.3  
Physics | Electricity | Charge & Current

**Potential in Circuits 4**  
Step Up to GCSE Physics 17.4  
Physics | Electricity | Charge & Current

**Potential in Circuits 5**  
Step Up to GCSE Physics 17.5  
Physics | Electricity | Charge & Current

**Potential in Circuits 8**  
Step Up to GCSE Physics 17.8  
Physics | Electricity | Charge & Current

# Features – Summative Assessment



- Calculation practice

Use  $\Delta s = v \Delta t$  to work out how far a 3.5 m/s runner will run in 15 s.

Value

Unit

- Review questions after each chapter (full & quick)
- Online summative test in matching format and style

## Energy, Charge, Current and Voltage

Help

All stages ▾

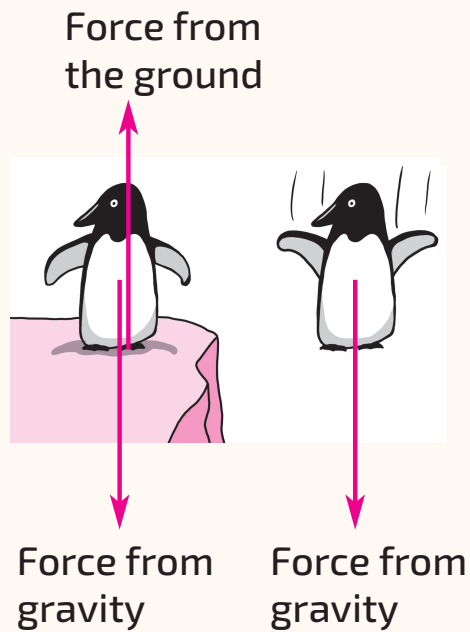
Show instructions

How much energy is gained by 72 C on passing a 5 V battery?

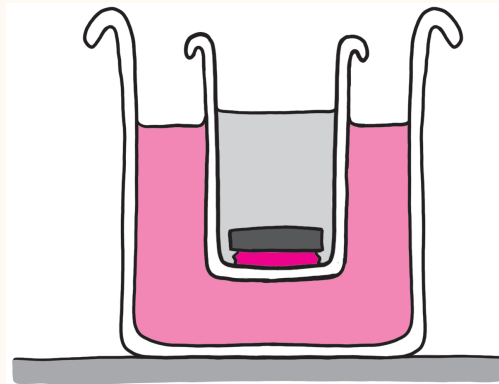
Value

Unit

# 11 - 14 Experiments



Falling penguin



Floating cups



Stretching sweets

# 11 - 14 Experiments



- Support scientific investigation.
- Uses standard lab equipment or can be done using images.
- Setup video for teachers and technicians
- Supports students through their analysis of the data either online or on paper

## Aims & Objectives of the practical

**Aim:** to find out whether an object that is dropped, on Earth, falls to the ground at constant speed or whether it accelerates.

### Objectives:

- Take time and distance readings from a pre-recorded video of a falling object and put them in a table.
- Use our table to plot a graph of the distance travelled against time.
- Look at the shape of the graph to answer our question: is the object accelerating?

Part A  
Background >

Part B  
List of equipment >

Part C  
The experiment >

Part D  
Experimental data & results >

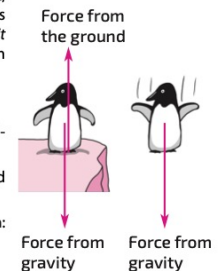
Part E

## Is this object falling at constant speed or accelerating?

In this experiment we are going to drop an object, from rest, on Earth. We all expect it to fall to the ground, but does our object fall through the same distance each second (*it moves at constant speed*) or does the distance travelled in each second change (*it accelerates*)?

We will:

- Take time and distance readings from a video of a falling object and put them in a table.
- Use our table to plot a graph of the distance travelled against time.
- Look at the shape of the graph to answer our question: is the object accelerating?



## Equipment

- A laptop, tablet or smartphone to watch the video
- Graph paper (in this worksheet)
- Pens, pencil
- Ruler

# Features – Experiments



[Books >](#)

**Book**

Overview

Forces >

Motion >

Forces & Motion >

Energy >

Electricity >

Experiments >

## Step into Physics

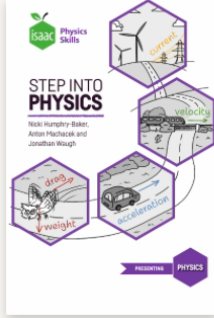
By Nicki Humphry-Baker, Anton Machacek and Jonathan Waugh

**About this interactive online book**

All of the content in the book is available online for **free**. Use the menu to find the review notes and sets of questions for practice in each topic.

Each topic has **5 question decks**, designed to help you learn step by step:

- The **Notes** deck helps you get started with the topic using drag-and-drop paragraphs.
- The **A** decks give you a gentle set of questions to build your confidence.
- The **B** decks progress a bit more steeply, helping you to stretch your thinking further.



**Step into Physics** will help you understand the ideas of secondary school physics and help you build confidence in using those ideas. This will give you a good foundation for your future studies in science.

Authors' summary ▾

Printed books >

**Step into Physics** will help students understand the ideas of secondary school physics and help them build confidence in using those ideas. This will give students a good foundation for their future studies in science.

# Have a Go



Have a go at some of the 11-14 questions on this deck:

[https://isaacscience.org/question\\_decks#ipts25\\_sat\\_2a\\_ks3](https://isaacscience.org/question_decks#ipts25_sat_2a_ks3)

