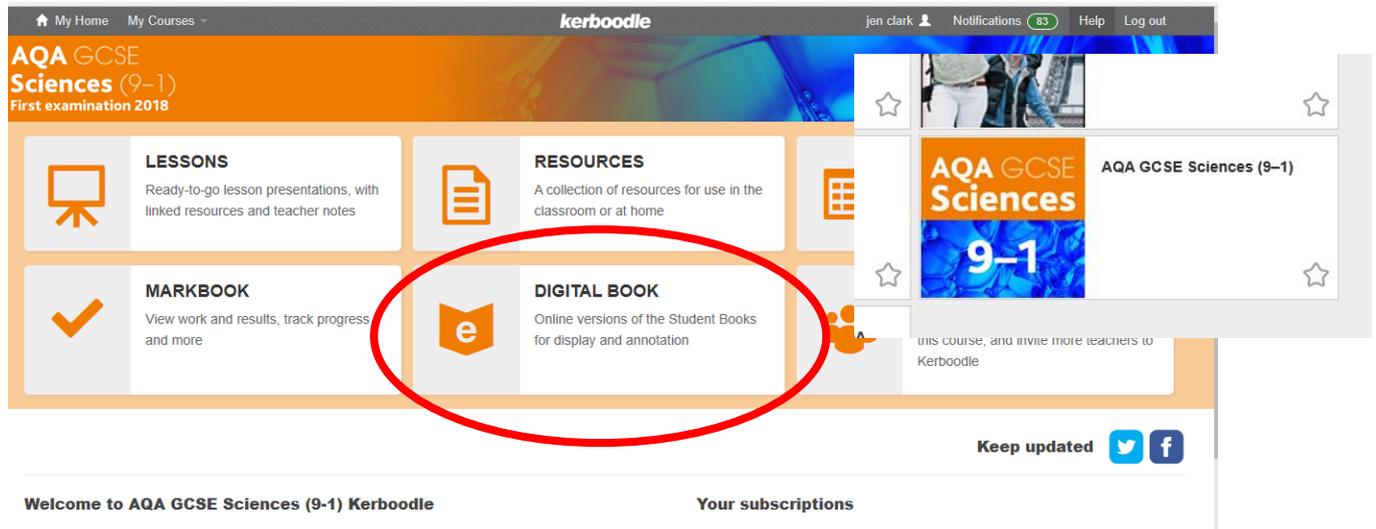


## Resultant forces assignment

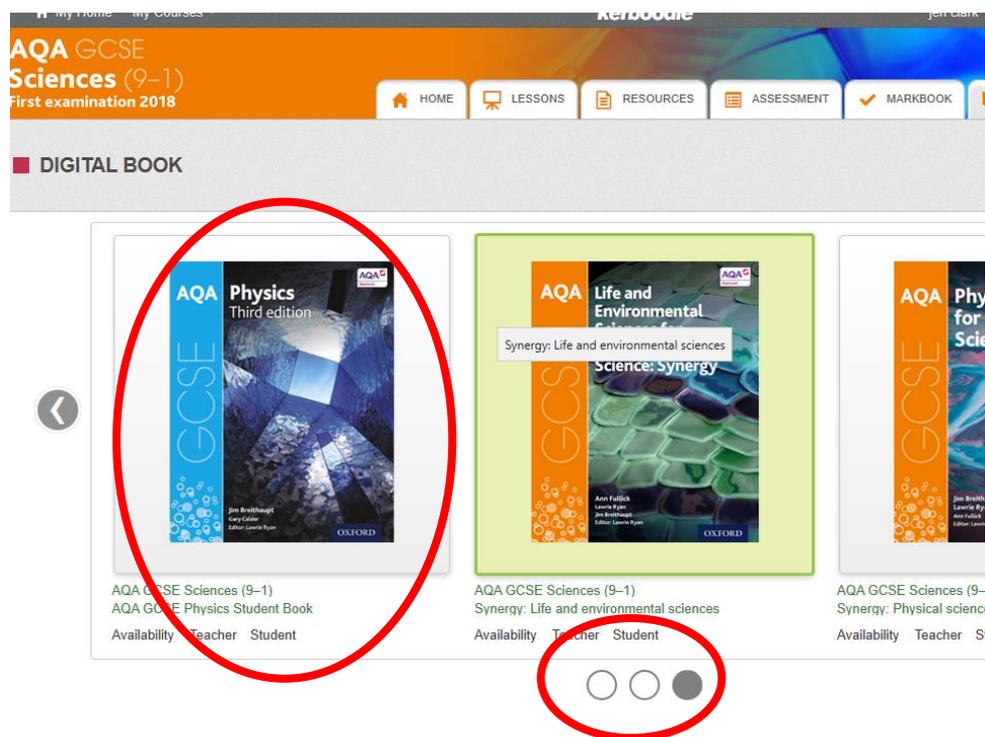
So you are logged into kerboodle and have navigated to the 9-1 science homepage.



The screenshot shows the kerboodle homepage for AQA GCSE Sciences (9-1). The navigation bar includes 'My Home', 'My Courses', 'kerboodle', 'jen clark', 'Notifications 83', 'Help', and 'Log out'. The main content area features several tiles: 'LESSONS' (Ready-to-go lesson presentations, with linked resources and teacher notes), 'RESOURCES' (A collection of resources for use in the classroom or at home), 'MARKBOOK' (View work and results, track progress and more), and 'DIGITAL BOOK' (Online versions of the Student Books for display and annotation). The 'DIGITAL BOOK' tile is circled in red. To the right, there is a 'Keep updated' button with social media icons for Twitter and Facebook. Below the main content area, there are sections for 'Welcome to AQA GCSE Sciences (9-1) Kerboodle' and 'Your subscriptions'.

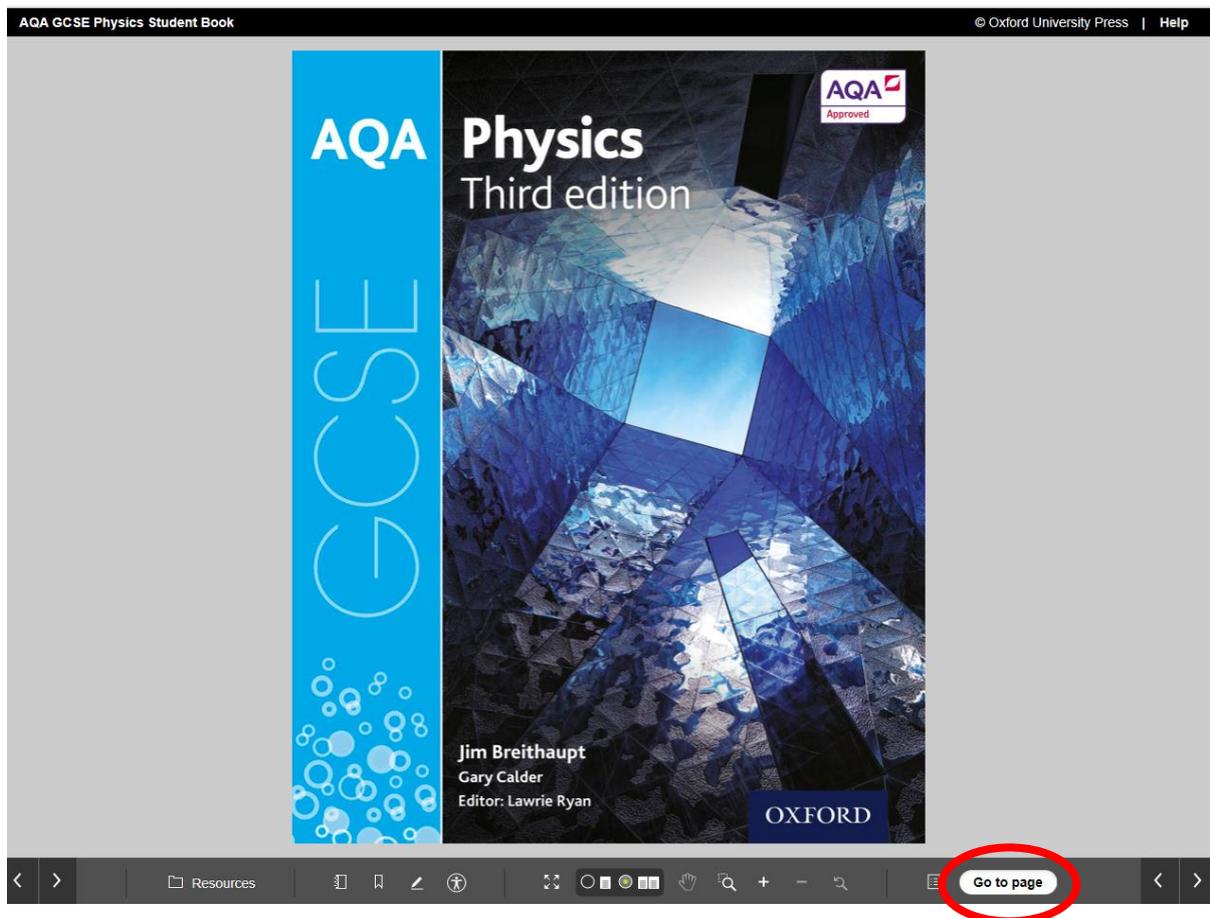
2. Click on the tile that says 'DIGITAL BOOK'. It will take you to all of the different science books that you can choose from.

3. The one you want is Physics. Use the grey circles at the bottom of the page to navigate through all of the textbook on offer.



The screenshot shows the 'DIGITAL BOOK' page on kerboodle. The navigation bar includes 'HOME', 'LESSONS', 'RESOURCES', 'ASSESSMENT', and 'MARKBOOK'. The main content area displays three book covers: 'AQA GCSE Physics Third edition' (circled in red), 'AQA GCSE Synergy: Life and environmental sciences', and 'AQA GCSE Synergy: Physical sciences'. Below the book covers, there are three grey circles for navigation, with the first circle (corresponding to the Physics book) circled in red. The text below the covers indicates 'Availability Teacher Student' for each book.

4. Click on the physics book and a new tab will appear that will look like this.....



5. Look at the bottom of the screen (red circle) if you enter one-page number e.g. 180 into this box it will take you that that page. You need p118-119. If you type this in and press enter on your keyboard it will take you to the right page.

**AQA GCSE Physics Student Book** © Oxford University Press | Help

## P8.3 Resultant forces

**Learning objectives**  
**After this topic, you should know:**

- what a resultant force is
- what happens if the resultant force on an object is:
  - zero
  - greater than zero
- how to calculate the resultant force when an object is acted on by two forces acting along the same line
- what a free-body diagram is.

**Wherever you are right now, at least two forces are acting on you.** These are the gravitational force on you and a force supporting you. Most objects around you are acted on by more than one force. You can work out the effect of the forces on an object by replacing them with a single force, the **resultant force**. This is a single force that has the same effect as all the forces acting on the object. If the resultant force is zero, we say that the forces acting on the object are balanced.

**Balanced forces**  
**Newton's first law of motion** states that if the forces acting on an object are balanced, the resultant force on the object is zero, and:

- if the object is at rest, it stays stationary
- if the object is moving, it keeps moving with the same speed and in the same direction.

If only two forces act on an object with zero resultant force, the forces must be equal to each other and act in opposite directions.

**Figure 1 The linear air track**  
 A glider on a linear air track floats on a cushion of air (Figure 1). As long as the track stays level, the glider moves at the same speed and direction along the track. That is because friction is absent. Newton's first law tells you that the glider will continue moving with the same speed in the same direction.

**Figure 2 Overcoming friction**  
 When a heavy crate is pushed across a rough floor at a constant speed without changing its direction, the push force on it is equal in size, and acting in the opposite direction, to the friction of the floor on the crate (Figure 2). Newton's first law states that the crate will continue moving with the same speed, and in the same direction.

**Unbalanced forces**  
 When the resultant force on an object is not zero, the forces acting on the object are not balanced. The movement of the object depends on the size and direction of the resultant force.

- When a jet plane is taking off, the thrust force of its engines is greater than the force of air resistance (or drag) on it. The resultant force on the plane is the difference between the thrust force and the force of air resistance acting on it. The resultant force is therefore greater than zero.
- When a car driver applies the brakes, the braking force is greater than the force from the engine. The resultant force is the difference between the braking force and the engine force. It acts in the opposite direction to the car's direction, so it slows the car down.

The examples show that if an object is acted on by two unequal forces acting in opposite directions, the resultant force is:

- equal to the difference between the two forces
- in the direction of the larger force.

**Figure 3 A passenger jet on take-off**

**P8 Forces in balance**

For example, Figure 4 shows two forces, **A** and **B**, acting on an object in opposite directions. If **A** = 5 N and **B** = 9 N, the resultant force on the object is 4 N (= 9 N – 5 N) in the direction of **B**. If the two forces act in the same direction, the resultant force is equal to the sum of the two forces and is in the same direction.

**Figure 4 Forces in opposite directions**

**Figure 5 A tug-of-war**  
 Figure 5 shows a tug-of-war in which the pull force of each team is represented by a vector. A scale of 10 mm to 200 N is used. Team A pulls with a force of 1000 N, and team B pulls with a force of 800 N. So the resultant force is 200 N in team A's direction.

**Force diagrams**  
 When an object is acted on by more than one force, you can draw a free-body force diagram to work out the resultant force on the object. A free-body force diagram shows the forces acting on an object without any other objects or other forces shown. Each force is shown on the diagram by a vector, which is an arrow pointing in the direction of the force. Figure 4 is a simple example of a free-body force diagram. Figure 5 is not a free-body force diagram because it shows more than one object.

**Figure 6 Braking**

**Study tip**  
 A common error is to think that when the resultant force on an object is zero it must be stationary – it may just be travelling at a constant speed in the same direction.

**Key points**

- The resultant force is a single force that has the same effect as all the forces acting on an object.
- If the resultant force on an object is:
  - zero, the object stays at rest or at the same speed and direction
  - greater than zero, the speed or direction of the object will change.
- If two forces act on an object along the same line, the resultant force is:
  - their sum, if the forces act in the same direction
  - their difference, if the forces act in opposite directions.
- A free-body force diagram of an object shows the forces acting on it.

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