**Calculating the resultant force**

More than one force can push or pull an object.

The forces add together, but their direction is important.

**Examples**

1. **What is the resultant force on the bicycle?**

The forces are pushing against each other

The biggest force pushes forwards

The difference in the forces

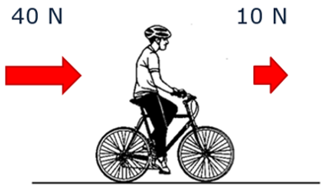
= the big force – the small force

= 60 -15

= 45

The resultant force is 45 N forwards

**2. What is the resultant force on the bicycle now?**

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The forces are both push forwards. They add together.

The resultant force = 40 + 10

= 50

The resultant force is 50 N forwards

**Questions:**

Calculate the resultant force in each example

|  |  |
| --- | --- |
| 1 | 2 |
| 3 | 4 |
| 5 | 6 |

*Physics > Big idea PFM: Forces and motion > Topic PFM1: Forces > Key concept PFM1.3: Balanced and unbalanced forces*

|  |
| --- |
| **Response activity** |
| **Calculating the resultant force** |

**Overview**

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| --- | --- |
| Learning focus: | The resultant force is the sum of the forces acting on the object, taking into account their direction. If there is no resultant force, the forces are balanced. Unbalanced forces change the speed, direction and/or shape of an object. |
| Observable learning outcome: | * Calculate the size and direction of the resultant force of two forces acting along the same straight line |
| Activity type: | Response, application and practice, problem |
| Key words: | Resultant force, Newton, direction |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: How much is left over?

**What does the research say?**

In *The language of mathematics in science* (2016), Boohan notes that a key difference between calculations in mathematics and science is that in science the numbers we calculate with most often have a *unit* as well as a number. Students need to pay attention to the manipulation of not just the numbers but the units as well. Addition and subtraction of values can only be done if they are expressed in the *same* units. In these questions the units have been chosen to be the same.

Students may be tempted to use number lines of positive and negative numbers to combine the forces. When forces are in opposite directions it is simpler to take the smaller force from the larger and to consider the direction separately. This approach can help to clarify the idea that forces have *both* size and direction.

This response activity gives students the opportunity to consolidate their understanding of balanced and unbalanced forces by calculating and describing resultant forces.

**Ways to use this activity**

This activity gives students the opportunity to practise applying their understanding and to clarify their thinking through practising calculations. To support this, students could answer the question in pairs or small groups.

Listening to individual groups as they work often highlights any difficulties they might have. These can often be overcome, through a whole class clarification or redirection part way through the activity.

Allowing only one student in each pair or small group to write down the answer on behalf of the group encourages discussion of both the science and of the presentation of the answer.

*Differentiation*

If some students are working with a teaching assistant, then a list of prompt questions for the TA could help to make this activity more purposeful.

**Expected answers**

1. 150 N forwards (right)
2. 15 N forwards (up and right)
3. 240 N forwards (right)
4. 26 N forwards (up and right)
5. 0 N
6. 150 N backwards (left)

**Acknowledgments**

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Images: EPSE and UYSEG

**References**

Boohan, R. (2016) *The language of mathematics in science*, Association for Science Education, Hatfield, England.