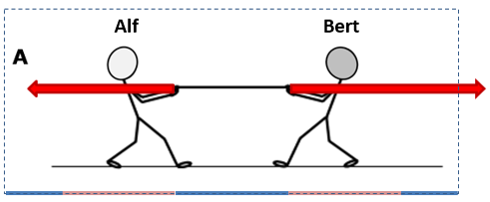
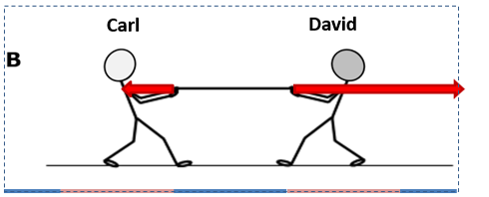
**Resultant force**

The resultant force is the force left over to make things change.





1. Which tug of war has the biggest resultant force?

Put a tick (✓) in the box next to the correct answer.

|  |  |  |
| --- | --- | --- |
| **A** | Tug of war A |  |
|  |  |  |
| **B** | Tug of war B |  |
|  |  |  |
| **C** | Both the same |  |

1. How would you explain your answer?

Put a tick (✓) in the box next to the correct answer.

|  |  |  |
| --- | --- | --- |
| **A** | Bert pulls with the biggest force |  |
|  |  |  |
| **B** | Carl pulls with the smallest force |  |
|  |  |  |
| **C** | Carl and David have the biggest difference in force |  |
|  |  |  |
| **D** | Bert and David both pull the same way |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Resultant force** |

**Overview**

|  |  |
| --- | --- |
| 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: | * Deduce the relative size of resultant forces by comparing pairs of unbalanced forces |
| Question type: | Diagnostic, two-tier multiple choice |
| Key words: | Resultant force |

**What does the research say?**

When Erikson and Hobbs (1978) investigated students’ ideas about two forces acting on the same object they found that, in a study of 32 Canadian students aged 6-14, the students appeared to think of several forces engaged in a struggle, with the bigger force dominating the weaker one. Osborne (1985) found similar thinking amongst students in New Zealand.

This question probes how students are thinking about this by comparing two pairs of forces with the bigger resultant force in the example with smaller individual forces.

**Ways to use this question**

Students should complete the questions individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation. The follow on question will give you insights into how they are thinking and highlight specific misunderstandings that some may hold.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

N.B. The scales and boxes on the PowerPoint are equal in size to help compare the size of the forces.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

1. B b. C

**How to respond - what next?**

The most common wrong answer is likely to be a) A, b) A which suggests the student is thinking that the bigger force ‘beats’ the smaller one in each pair and it is this force that then acts on the rope. If students give this response, then their misunderstanding can be challenged with carefully chosen examples: for example you could ask them to consider what would happen if two equally strong body builders had a tug of war (dead heat and no force to make things change), and compare this with what would happen if a typical parent had a tug of war with their three year old (much smaller forces, but a clear winner).

Answer a) B, b) B is half-way to the right answer and careful questioning is likely to guide a student to the more complete reason.

Answer a) C, b) D indicates the student is unlikely to understand how the length of a force arrows represents the strength of a force. If students need to work on this then key concept *PFM1.2: Describing forces* may be useful.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: EPSE and UYSEG

**References**

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Osborne, R. (1985) ‘Building on children’s intuitive ideas’, in Osborne, R. and Freyberg, P., *Learning in Science,* Heinemann, Aukland, New Zealand.