

Conservation of momentum

Preamble: Momentum is conserved in a closed system. Make sure you are clear about the meaning of this statement before going further with this investigation. Momentum is the product of mass and velocity. Make sure you are clear about this before going further with this investigation. Rockets and other vehicles that manoeuvre in space rely on conservation of momentum to accelerate (i.e. speed up, slow down, change direction). Remember that momentum is derived from Newton's third law ($F_1 = -F_2$), for an applied force there is an equal but oppositely directed force experienced.

In most of our daily experiences we are unaware of the conservation of momentum as systems are not closed – there are always external forces.

Task: To design an investigation into a closed system that

1. provides supporting evidence for the conservation of momentum.
 2. uses the law of conservation of momentum to determine the value of a variable that is difficult to determine by measurement.
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- A. Prepare an overall aim for the investigation.
 - B. Identify and state a hypothesis (this will involve methods and how they can be applied rather than statements about values).
 - C. Design a procedure to follow that will allow you to
 - a. Allows you to create a close to closed system.
 - b. Measure all masses and velocities while doing task 1.
 - c. Measure some of the masses and velocities while doing task 2.
 - d. Record accurate and repeatable data in an ethical manner.
 - e. Compare your data with other available data.
 - f. Use calculations to determine an unknown value in an investigation.
 - D. Analyse the collected data in a meaningful way that will support your hypothesis and allow you to meet the aims of the task.
 - E. Prepare a conclusion that uses your data.
 - F. Prepare a discussion that comments about; the reliability of your data and method used to collect it; any systematic and random errors (use of graphs can help here); how you would improve this practical investigation.

Options:

Task 1:

- We are planning a visit to the ice skating rink.
- You might have access to skate boards, roller skates or blades.
- We have spring-loaded trolleys.
- We have an air track.

Task 2:

- How fast does the air come out of a balloon? (average speed)
- How fast does a nerf gun launch a dart?
- Which causes the biggest change in momentum – bouncing off or sticking to?

Stage 1 Physics
Practical Investigation.

| | | A | B | C | D | E |
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| Investigation | Designing investigations 1 | Designs a logical, coherent, and detailed physics investigation. | Designs a well-considered and clear physics investigation. | Designs a considered and generally clear physics investigation. | Prepares the outline of a physics investigation. | Identifies a simple procedure for a physics investigation. |
| | Using Apparatus 2 | Manipulates apparatus and technological tools carefully and highly effectively to implement well-organised, safe, and ethical investigation procedures. | Manipulates apparatus and technological tools carefully and mostly effectively to implement organised, safe, and ethical investigation procedures. | Manipulates apparatus and technological tools generally carefully and effectively to implement safe and ethical investigation procedures. | Uses apparatus and technological tools with inconsistent care and effectiveness and attempts to implement safe and ethical investigation procedures. | Attempts to use apparatus and technological tools with limited effectiveness or attention to safe or ethical investigation procedures. |
| | Obtaining, Recording and displaying 3 | Obtains, records, and displays findings of investigations, using appropriate conventions and formats accurately and highly effectively | Obtains, records, and displays findings of investigations, using appropriate conventions and formats mostly accurately and effectively. | Obtains, records, and displays findings of investigations, using generally appropriate conventions and formats with some errors but generally accurately and effectively. | Obtains, records, and displays findings of investigations, using conventions and formats inconsistently, with occasional accuracy and effectiveness. | Attempts to record and display some descriptive information about an investigation, with limited accuracy or effectiveness. |
| Analysis and Evaluation | Analyse data, make conclusion 1 | Systematically analyses data and their connections with concepts, to formulate logical and perceptive conclusions and make relevant predictions. | Logically analyses data and their connections with concepts, to formulate consistent conclusions and mostly relevant predictions. | Analyses data and their connections with concepts, to formulate generally appropriate conclusions and make simple predictions, with some relevance. | Describes basic connections between some data and concepts, and attempts to formulate a conclusion and make a simple prediction that may be relevant. | Attempts to connect data with concepts, formulate a conclusion, and make a prediction. |
| | Evaluating procedures 2 | Logically evaluates procedures and suggests a range of appropriate improvements. | Evaluates procedures and suggests some appropriate improvements. | Evaluates some procedures in physics and suggests some improvements that are generally appropriate. | For some procedures, identifies improvements that may be made. | Acknowledges the need for improvements in one or more procedures. |
| Application | Using terms and conventions 1 | Uses appropriate physics terms, conventions, formulae, and equations highly effectively. | Uses appropriate physics terms, conventions, formulae, and equations effectively. | Uses generally appropriate physics terms, conventions, formulae, and equations, with some general effectiveness. | Attempts to use some physics terms, conventions, formulae, and equations that may be appropriate. | Uses some physics terms or formulae. |
| | Work skills 2 | Demonstrates initiative in applying constructive and focused individual and collaborative work skills. | Applies mostly constructive and focused individual and collaborative work skills. | Applies generally constructive individual and collaborative work skills. | Attempts individual work inconsistently, and contributes superficially to aspects of collaborative work. | Shows emerging skills in individual and collaborative work. |
| Knowledge and Understanding 3 | Communicating knowledge and understanding 3 | Uses a variety of formats to communicate knowledge and understanding of physics coherently and highly effectively. | Uses a variety of formats to communicate knowledge and understanding of physics coherently and effectively. | Uses different formats to communicate knowledge and understanding of physics, with some general effectiveness. | Communicates basic information to others, using one or more formats. | Attempts to communicate information about physics. |