ScienceCube

Composition of Forces

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1. **Measure the magnitude of force when stretching a rubber band by a certain length.**
2. **Explain the change in the magnitude of two forces acting on the same object according to the angle between them.**

Fundamental Concept

1. Two Non-Parallel Forces

(1) **(2)**

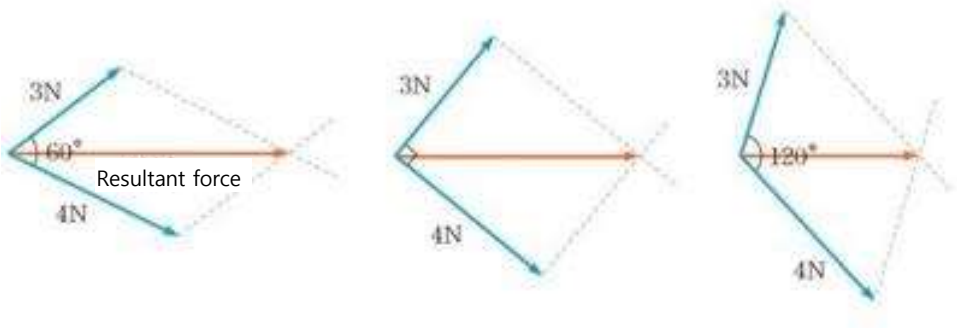
[Two Non-Parallel Forces]

(1) When two people pull an object simultaneously at an angle, the object moves as if it is being pulled by a single force in a direction between the two.

(2) When two people lift an object, if they apply force in different directions, the object moves upward as if it is being lifted by a single force.

2. Angle between Two Forces and Resultant Force

(1) Angle and Resultant Force between Two Forces of Different Magnitudes: The magnitude of the resultant force varies according to the angle between the two forces. The larger the angle, the smaller the resultant force.



[Angle between two forces and resultant force]

(2) Angle and Resultant Force between Two Forces of Equal Magnitude

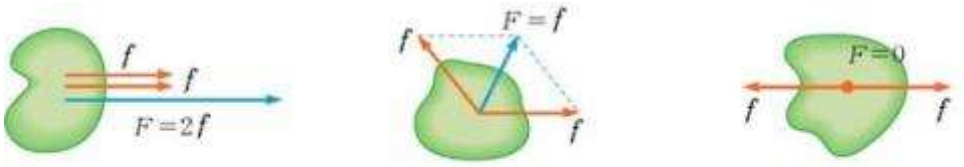
① Direction of Resultant Force: It points to the middle of the two forces.

② Magnitude of Resultant Force

- When the angle between the two forces is 0°: The resultant force is twice the magnitude of one force.

- When the angle between the two forces is 120°: The resultant force is equal to the magnitude of one force.

- When the angle between the two forces is 180°: The resultant force is zero..



[Resultant force of two equal forces]

Experiment

Materials Needed

Interface, Science# program, Two force sensors, Wooden board (30cm x 30cm), Nail, Rubber band, Floral wire, Protractor, Ruler, Pencil

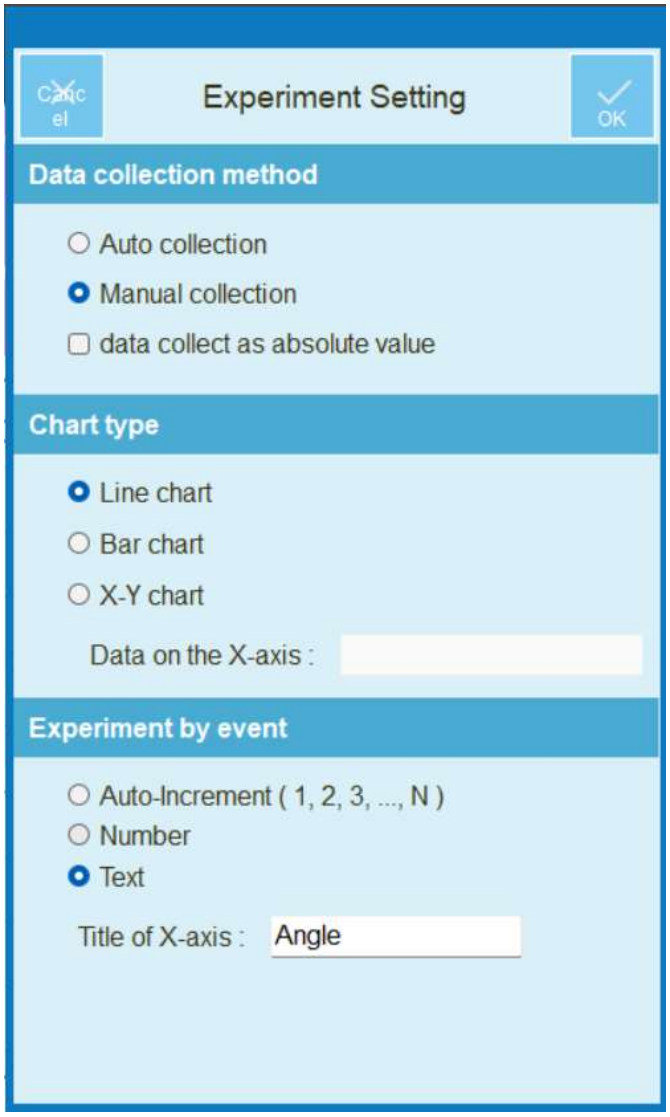
Preparation of the Apparatus

1. Place the wooden board at an angle and fix a nail at the corner.
2. Draw a diagonal line passing through the nail using a ruler.
3. Fold the floral wire in half to create two equal loops..

4. Hang the looped rubber band on the nail (use two or three rubber bands together if necessary).

Interface Settings

1. Run Science#.
2. Connect the two force sensors to the interface.
3. Click the button to set up the experiment environment as shown below, or click the button for auto setup.



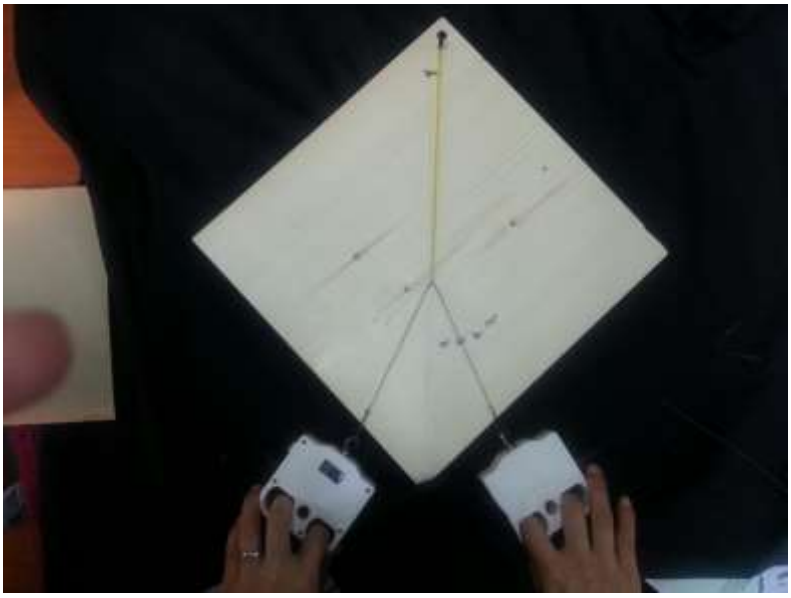
4. Hang the floral wire loop on the rubber band and hook the two loops of the floral wire to the hooks of the force sensors. Zero the force readings without applying any force by clicking the button. 

Data Collection

1.  Pull the force sensors along the diagonal line until the force reaches 10N while observing the data.

2. Mark the point where the rubber band stretches with a pen.
3. Using a protractor, draw lines forming angles of 60º, 90º, and 120º from the marked point.

4. Hook the two force sensor hooks on both sides of the floral wire loop and pull the rubber band to the marked point.
5. Adjust the angle of the force sensors to 60º using the baseline (ensure the floral wire is as close to the wooden board as possible).



6.  Click the button to measure the force magnitude on both hands and enter the corresponding angle on the X-axis.
7. Adjust the angle to 90º and 120º and measure and record the force magnitude on both hands for each angle.
8.  Click the button to end the experiment.

Data Analysis

Recording Data

1. Theoretically calculate the force required for two equal forces to lift a 10N object according to the angle between them..

Description	60º	90º	120º
F1 (Left force magnitude)			
F2 (Right force magnitude)			

2. Measure and graph the force magnitude according to the angle between the two forces

when lifting a 10N object with two equal forces.

Application of Data

1. Measure and record the force magnitude according to the angle between the two forces when lifting a 10N object with two equal forces..

Description	60°	90°	120°
F1 (Left force magnitude)			
F2 (Right force magnitude)			

2. Explain the relationship between the angle between the two forces and the force acting on the object when lifting the same weight.

3. If the theoretically calculated values do not match the actual measured values, consider the reasons for the discrepancy.


Report
(For Teachers)
Report
(For Students)