⏱ **ACCELEROMETER**

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# Ninja Physics - Math Geek Facts

## Applied Math Concepts

- Cartesian Coordinates, 3D coordinates, x, y, and z axes.

- Positive and negative numbers - variations can be above or below 9.8 m/s².

- Negative acceleration or positive acceleration provides an application of negative numbers to students.

- Absolute value can be applied to determine the variation % by taking the absolute value of acceleration minus the positive and negative variations to determine the highest value.

- Addition, subtraction, division.
- Decimal places.
- Averages.
- Percentages.

- Graphing.
- Data Collection.
- Data Visualization.
- Data Analysis.

## PDQ 1 - A Steady Hand

There are three parts to calculate the displayed score:
- Use the simple average of the Z axis value over ten seconds. Take this average's variation from 9.81 and calculate it as a %;
- Take the largest variation, either positive or negative from a perfect 9.81 m/sec2 and also calculate it as a %;
- Add these two values together and subtract from 100% to get your final score.

**Example of how the calculation is done.**

**Run Average: 9.31**
Variation from 9.8 m/s²: 9.81 - 9.31 = .5
Convert to a percentage: .5 / 9.81 = 5.1%

**Largest Variation: 12**
Variation from 9.8 m/s²: 12 - 9.81 = 2.19
Convert to a percentage: 2.19 / 9.81 = 22.3%

**Final Score: 100% - 5.1% - 22.3% = 72.6%**

Rationale behind the scoring method: The highest variation is an equalizer since you could have a great average but still have had wild swings positive and negative that averaged out well. This approach penalizes the Ninja for any "wild" movements.

## PDQ 2 - Slow Walker

There are three parts to calculate the displayed score:
- Use the simple average of the Y axis value over ten seconds. Take this average's variation from 0 (a perfect score is zero acceleration) and calculate it as a %;

- Take the largest variation, either positive or negative from a perfect 0 m/s² and also calculate it as a %;

- Add these two values together and subtract from 100% to get your final score.

**Example of how the calculation is done:**

**Run Average: .15**
Variation from 0 m/s²: 0 - .15 = -.15
Take the absolute value: =.15
Base your % on a scale of 10.
Convert to a percentage: .15 / 10 = 1.5%

**Largest Variation: 2.5**
Variation from 0 m/s²: 0 - 2.5 = -2.5
Take the absolute value: = 2.5
Base your % on a scale of 10.
Convert to a percentage: 2.5 / 10 = 25%

**Final Score: 100% - 1.5% - 25% = 73.5%**

## Experiment - Ninja Walk

There are three parts to calculate the displayed score:
- The Z axis score is generated per the Steady Hand calculations and yields a final % score;

- The Y axis score is generated per the Smooth Walker calculations and yields a second, % score;

- The final Ninja Walk score is calculated by adding the Z and Y axis scores together and taking their average.

**Example:**

Z Axis Score (Per Steady Hand Calculations): 94.6%
Y Axis Score (Per Slow Walker Calculations): 86.2%
Average: 94.6 + 86.2 = 180.8 / 2 = 90.4%