Lesson: Vectors: Inclined Plane Problems

Location of How-To: **https://youtu.be/qn2jsogRvMc**

Title: How to Teach Inclined Plane Problems (Vectors)

Standards: CCSS.MATH.CONTENT.HSN.VM.A.3
        Solve problems that can be represented by vectors.

Math Practices: CCSS.MATH.PRACTICE.MP4
        Model with mathematics.

Materials List: Students are required to use either a laptop, tablet, or cell phone to access online materials. Students will be required to do problems on paper.

STEM Rationale: This activity is a STEM activity because students will be doing a problem that cuts across engineering, mathematics, and physics. It involves using vectors and vectors are used within a plethora of science fields.

Student Engagement: Students should have an understanding of vectors before engaging in this activity. What students will be asked is, "Why do all of you not crash through the chairs you are sitting on?"

        The chair responds to the weight of the person who is sitting in the chair. Students will be brought to understand how the chair responds to the force of those who sit on the chair with an equal but opposite force.

        Students will be given a hypothetical situation to ponder.

        "Imagine a car that is resting on a hill. In which situation would it be more difficult to push the car up the hill: (a) a car on a hill with a 2° incline, (b) a car on a hill with a 5° incline, or (c) a car on a hill with an 8° incline?"

        Students will have to explain the answer they chose by talking it over with a partner.

        Students will fill in the blank for this sentence: "As the incline of the hill gets more steep, the car will be __***(easier/harder)***__ to push up the hill."

        Students will have to explain why they chose the word they picked.

Once the class settles in on the correct answer and a rationale is correctly supported, students will have a chance to determine which trigonometric function reports a higher value as the angle increases, cosine or sine. Students who understand their graphs, understand the unit circle, or can work with a calculator should be able to see the sine function as the best fit.

Students will then take notes during an explanation of an inclined plane problem. The problem works through a situation involving an inclined plane, seen within the picture below.

It is imperative that students understand why the incline of the hill will match the acute angle within the red right triangle. There are several reasons why this is true and a rationale will be provided.

Next, students will be led to understand how the chair holds up each student, cars are being *partially* held up by the hill. The sine function is used to determine the force of the car that runs parallel to the incline. The incline pushes back on the car at a perpendicular to the incline.

Next, students will attempt problems using MATHguide's interactive quizmaster (2020).

Vectors: Inclined Plane Problems
View the Lesson | MATHguide homepage   Updated March 26th, 2020

Status: Waiting for your answers.

Problem: A 2750 pound object rests on a 11° inclined plane. How much force
(to the nearest tenth of a pound) must be applied to it (along the incline)
to move it? Round your answer to the nearest tenth.

Inclined Plane

MATHguide.com

Solution: [   ] pounds

Check Solution

The picture above is a what the quizmaster looks like. The quizmaster
creates a random problem (random incline angle and weight of an
object on the incline). Students will work out a solution on their own
papers. The quizmaster will determine if their solutions are correct.

When a student answers a problem incorrectly, the webpage will
highlight the answer in red and ask the student to try again. This
visual indicator makes it possible for a teacher to see students who are
having difficulties. When a student answers incorrectly, the teacher is
able to review student work and point students in a better direction.

Vectors: Inclined Plane Problems

Your response (marked red) is incorrect. Please try again.

Problem: A 2750 pound object rests on a 11° inclined plane. How much force (to the nearest tenth of a pound) must be applied to it (along the incline) to move it? Round your answer to the nearest tenth.

Inclined Plane

MATHguide.com

Solution: 200   pounds

Check Solution

Students will be assigned to do four problems from MATHguide's quizmaster.

For students who were absent, they can watch a MATHguide video (2020) that explains the entire process of how to solve inclined plane problems.

References

MATHguide (2020) Vectors: Inclined Plane Problems. Retrieved from
http://www.mathguide.com/cgi-bin/quizmasters2/VIP.cgi.

MATHguide (2020) Vectors: Inclined Planes. Retrieved from
https://www.youtube.com/watch?v=Qw-MWj7_IiI