

Helpful Formula

$$\text{Pitch} = \text{Rise} / \text{Run}$$

$$\text{Grade} = \text{Rise} / \text{Run}$$

$$M = (Y_2 - Y_1) / (X_2 - X_1); X = \text{Run}, Y = \text{Rise}, C = \text{Grade Length}$$

$$X^2 + Y^2 = C^2$$

$$X^2 = C^2 - Y^2$$

$$X = \sqrt{C^2 - Y^2}$$

Round your answer to the nearest hundredth

1. Find the grade inclination for 1 mile grade (1 mile=5280, ft = 1 foot)
Start 5000 ft above sea level and the end point 3500 ft above sea level.
Find the approximate grade **slope**.
2. Find the **pitch** of the roof for whose run is 5 ft by a 10 ft rise.
3. Find the descent inclination for:
5 mile descent (the same as a 5mile grade).
Starts 4 miles above sea level
Ends at sea level (sea level = 0)
4. Find the rise of a roof whose pitch is 4 and whose run is 3 ft.
5. Find the run of a roof whose pitch is 3 and whose rise is 6 ft.

Answer Sheet

1. $m \approx 0.03$

2, pitch = 2

3. $m = 4/3$

4. rise = 12 ft

5. run = 2 ft

Math-in-CTE Lesson Plan Template

Lesson Title: Coordinate System and Slope		Lesson # 5
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Occupational Area: Engineering Technology/Drafting		
CTE Concept(s): Computer Aided Design (CAD)		
Math Concepts: Coordinate System		
Lesson Objective: The student will be able to work with slopes and other concepts relating to the rectangular plane. Measurement unit conversions as well as the Pythagorean theorem will be emphasized		
Supplies Needed: Graphing Paper, Pencils, Drawing Boards, T-Squares.		

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
<p>1. Introduce the CTE lesson.</p> <p>Lesson induction questions:</p> <p>Have you or your family driven in steep mountain roads? Have you ever seen STEEP GRADE ROAD SIGNS?</p> <p>Allow students to input their experience to spin off to assessment of how they would measure or figure out how to measure steepness.</p> <p>Through question probing, assess students' math awareness as it relates to CTE topic.</p> <p>Vocabulary:</p> <p>Road Sign, Cartesian plane, y-intercept, end point, coordinate pairs, descent, steepness, pitch of roof, span, parameter, Pythagorean theorem, and slope.</p>	<p><u>Road sign</u>: Road indicators of distance and driving conditions.</p> <p><u>Cartesian Plane</u>: A system for locating points numerically on a plane that uses horizontal distance defined by an x axis and vertical distance by a y axis.</p> <p><u>Y-intercept</u>: The Point at which the graph of an equation crosses the y axis.</p> <p><u>End point</u>: The points at either extreme of a segment.</p> <p><u>Coordinate pair</u>: A pair of numbers that locates a point in the coordinate plane, ex: (x, y)</p> <p><u>Descent</u>: The act of going lower.</p> <p><u>Steepness</u>: A measurement of inclination.</p> <p><u>Pitch of a roof</u>: The inclination of a roof expressed as rise divided by the span</p> <p><u>Span</u>: The difference between the opposite sides of a building.</p> <p><u>Parameter</u>: A benchmark. In math, refers to the slope and y intercept of a linear equation.</p> <p><u>Pythagorean Theorem</u>: A relationship or formula that allows one to determine the sides of right triangles</p> <p><u>Slope</u>: A measurement of rise over run that defines steepness on a Cartesian plane.</p>

<p>D2. Assess students' math awareness as it relates to the CTE lesson.</p> <p>Draw Cartesian plane and ask them if it might be helpful to determine measurement of steepness?</p>	<p>Teacher will draw on board an x-y plane. The teacher will plot some coordinate pairs and ask student for the possibility of converting the sign figures into x-y coordinates.</p>
<p>3. Work through the math example <i>embedded</i> in the CTE lesson.</p> <p>Through whole class discussion, discuss:</p> <p>Y-intercept on y axis (0 feet, 5000 feet) as starting point of drive in descent.</p> <p>The ending point as (x feet, 3500 feet)</p> <p>At this point discuss the conversion of 1 mile run as an equivalent of 5280 feet run. Probe to assess students' preparedness on how to carry out unit conversion beginning with definition 1 mile = 5280 feet.</p> <p>The teacher will discuss how to obtain the unknown in ordered pair (x feet, 3500 feet) using the Pythagorean theorem.</p>	<p>The teacher will discuss with students the appropriate interval scales to fit sign figures into coordinate pairs.</p> <p>The teacher will discuss conversions with students: 1 mile = 5280 feet.</p> <p>The teacher and student will discuss the use of the Pythagorean theorem to solve for x in the coordinate pair representing the end point:</p> <p>$X = x_2 - x_1$ X= Run; X=? feet</p> <p>$Y = y_2 - y_1$ Y= Rise; Y=1500 feet</p> <p>C (grade length)=5280 feet</p> <p>$X^2 + Y^2 = C^2$</p> <p>$X^2 = C^2 - Y^2$</p> <p>$X = \sqrt{C^2 - Y^2}$</p> <p><u>X= 5062.45 feet</u></p> <p>The teacher and student will discuss the use of the slope formula:</p> <p>$M = (Y_2 - Y_1) / (X_2 - X_1)$</p> <p>Grade = Rise / Run</p> <p>Grade= <u>(5000 - 3500)</u> \approx - 0.30</p> <p>(0 - 5062.54) (rounded to the nearest hundredth the absolute inclination is 0.30)</p>



Vehicle position above sea level: 5000 feet.

Vehicle descends to 3500 feet above sea level.

Grade distance 1 mile.

What is the slope of the grade?

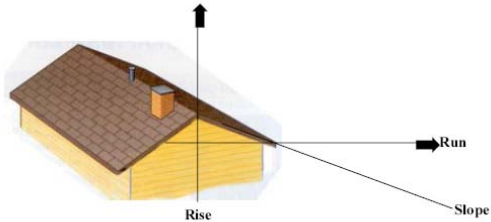
If you were at 5000 feet above sea level when you started downhill and at the end of the grade you were at 3500 above sea level, what would be the slope of the grade be assuming that 1 mile= 5280 feet?

Answer $X \approx 0.30$

Find the grade slope for the following conditions:

BEGINNING	ENDING	GRADE LENGTH
1) (0 feet, 3 feet)	(x feet, 0 feet)	5 feet
2) (0 feet, 6 feet)	(x feet, 0 feet)	10 feet
3) (0 feet, 12 feet)	(x feet, 0 feet)	20 feet
4) (0 feet, 24 feet)	(x feet, 0 feet)	40 feet
5) (0 feet, 48 feet)	(x feet, 0 feet)	80 feet

[Road Sign Work Sheet.doc](#)

<p>4. Work through <i>related, contextual</i> math-in-CTE examples.</p> <p>Work through additional example of determining THE PITCH OF A ROOF within the same lesson plan. Emphasize the y axis as parameter measuring vertical distance (rise) and the x axis as one measuring horizontal distance (run)</p>	<p style="text-align: center;">Pitch = Rise / Run</p> 
<p>5. Work through <i>traditional math</i> examples.</p> <p>After calculations of slopes as measurement of steepness and pitch of a roof in the original activities, students will calculate slope of lines given coordinate pairs.</p>	<p style="text-align: center;">1' foot = 12" inches</p>
<p>6. Students demonstrate their understanding.</p> <p>Students will calculate measures of grade inclination and pitch of roofs from problems written on the board by teacher.</p> <p>Subsequently students will drill and practice on five additional</p>	<p>Student problems in sloping slope</p> <p>I) Calculate the slope of the roof with the following information:</p> <ul style="list-style-type: none"> a) Rise us 2 feet (24 inches) b) Run us 6 feet (72 inches) <p style="text-align: center;">Answer 1/3</p>

<p>slope problems given coordinate pairs. Emphasis will be placed on identifying y-intercept coordinate pairs and their real-life interpretation</p>	<p>II) What would the Rise be if the Slope was 4 and the Run was 14 feet? Answer 56'</p> <p>1. Rise = 3' and run = 6' answer $\frac{1}{2}$ 2. Run = 10' and rise = 10' answer 1 3. Rise = 30' and run = 10' answer 3 4. Rise = 40' and run = 15' answer $\frac{8}{3}$ 5. Rise = 18' and run = 25' answer $\frac{18}{25}$ 6. Pitch = 3 and run is 18'. Find the rise. Answer 48' 7. Pitch = 5.5 and rise is 11'. Find the run. Answer 2'</p> <p>Roof Work Sheet.doc</p>
<p>7. Formal assessment. Project: Students will design an activity to measure grade steepness and pitch of a roof.</p>	<p>Give student a short a test named "Assessment Coordinate System and Slope of 5 questions.</p> <p>Assessment Coordinate System and Slope.doc</p>



If you were at 5000 feet above sea level when you started downhill and at the end of the grade you were at 3500 above sea level, what would be the slope of the grade be assuming that 1 mile= 5280 feet?

Find the grade slope for the following conditions:

BEGINNING

ENDING

GRADE LENGTH

1) (0 feet, 3 feet)

(x feet, 0 feet)

5 feet

2) (0 feet, 6 feet)

(x feet, 0 feet)

10 feet

3) (0 feet, 12 feet)

(x feet, 0 feet)

20 feet

4) (0 feet, 24 feet)

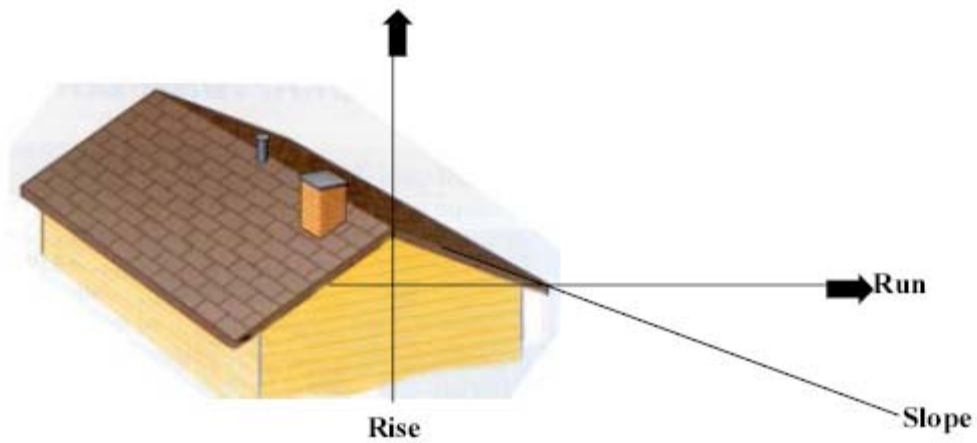
(x feet, 0 feet)

40 feet

5) (0 feet, 48 feet)

(x feet, 0 feet)

80 feet



I) Calculate the slope of the roof with the following information:

- a) Rise is 2 feet (24 inches)
- b) Run is 6 feet (72 inches)

II) What would the Rise be if the Slope was 4 and the Run was 14 feet?

1. Rise = 3' and run = 6'
2. Run = 10' and rise = 10'
3. Rise = 30' and run = 10'
4. Rise = 40' and run = 15'
5. Rise = 18' and run = 25'
6. Pitch = 3 and run is 18'. Find the rise.
7. Pitch = 5.5 and rise is 11'. Find the run.