How Steep Is A 7% Grade?

Student Activity

Name _____

Class _____

Objectives

- See how slope is applied in the real world
- Connect gradient (as percentage) with slope (as rise/run)
- Graph Linear Functions
- Transform y=x with rotations and shifts
- Connect transformations with m and b in y=mx+b
- Use Background Image (with 84C)

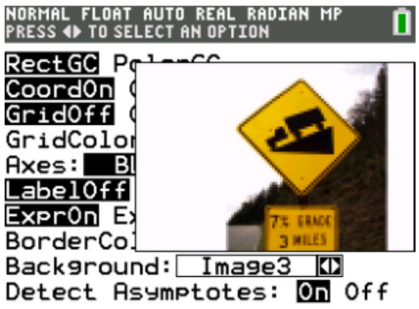
Materials

- TI-84 Plus C
- Metric ruler

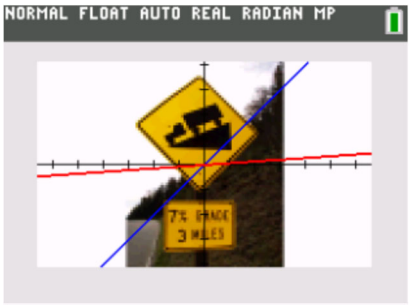
1. What does the warning sign in the figure above mean? How steep is a 7% grade?

2. The truck pictured on the warning sign sits on a "road" that is the hypotenuse of a right triangle. Do you think the slope of the hypotenuse is actually 7%? If not, then estimate the slope.

3. Set up your TI-84PlusC. If not already done, load the background image onto your calculator. Go to the FORMAT menu and scroll through the background images until the image is located (as seen at right). Note: It might be stored as any image from Image0 to Image9.

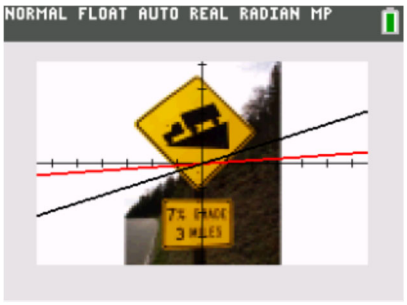


4. Go to the Y= menu and enter Y1=X. Go to the ZOOM menu and select 4:ZDecimal. You should have the graph seen at the right. The line Y=X has a slope of 100%. Enter an equation in Y2 that has a slope of 7%. If entered correctly, your screen will match the image at right. (If using a TI-84plus, you should have the 2 lines, but not the image.).

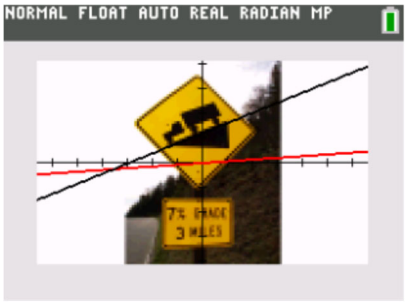


5. 100% is steeper than the "slope" pictured in the sign. 7% is not steep enough. Use trial and error to graph a line that appears parallel to the "road" in the sign. How steep is this "road"?

6. Compare the result from part 5 above with the actual highway sign in the photograph at the beginning of this activity. Use a metric ruler to measure the legs of the right triangle in millimeters. Make the comparison easier by converting this ratio (rise/run) to a percent.



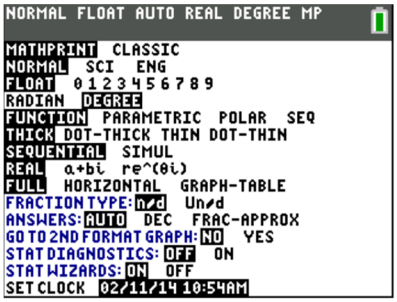
7. Your line from part 5 appears parallel to the road (hypotenuse) under the truck. (see figure at right) It would be easier to confirm if the line is parallel if you raise it so it coincides with the road. How must you modify the equation to raise the line? If necessary, adjust the slope so the line "fits" the road better. What is your new equation?

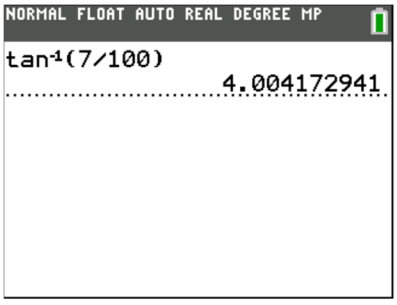


8. Compared with the slope of the "road" in the warning sign, a 7% grade does not appear very steep. How steep is 7% in degrees? (We're looking at the angle whose vertex is at the origin, and one ray is the positive x-axis, and the other ray is the line with the 7% slope)
   Estimate the slopes (in degrees) of both of the "roads".

   7% GRADE = $\frac{7}{100}$ slope = _____ degrees

   "Road" in Sign = _____ slope = _____degrees





Trigonometry is the study of ratios of the sides of right triangles. The angle of elevation of these 2 lines can be found by calculating the inverse of the tangent of the slopes. Be sure your calculator is in Degree MODE. Press M. Then arrow down and right to highlight DEGREE. Press e to select DEGREE. Then press `î to return to the HOME screen. Calculate the degrees of the 7% slope by pressing `† . 0 7) e. Repeat these steps to calculate the angle of elevation of the "road" in the warning sign. (The figures at right show the MODE menu with DEGREE selected and the HOME screen with the inverse tangent of 7%.

9. Calculate the slopes (in degrees) of both of the "roads":

7% GRADE = $^{7}/_{100}$ slope = about 4 degrees

Steepness of "Road" in Sign = _____ slope = degrees

Four degrees may not seem very steep. But ask a truck driver if that's a steep hill, or even better, try riding your bicycle up a hill that's rated 7% for 3 miles. It's steeper than it seems!

10 Here's another way to think about the steepness of the hill. The sign says the hill is 3 miles long. What's the total change in elevation?