Name____________________

Physical Geography

Lab Activity #13

Due date__________

Slopes and Profiles

COR Objective 7, SLO 3

Slope refers to a change in elevation from one point to another. The steepness of a slope can be a big deal. Forest fires burn quicker up a steep slope. The angle of repose refers to the maximum angle a slope can be before it is no longer stable; a useful concept when building homes in mountainous regions.

13.1. Calculating Slope

Slope means rise over run, i.e. how much vertical distance you climb for every unit of horizontal distance you travel (Figure 13.1). Slope can be expressed multiple ways, which you will practice calculating in this lab.

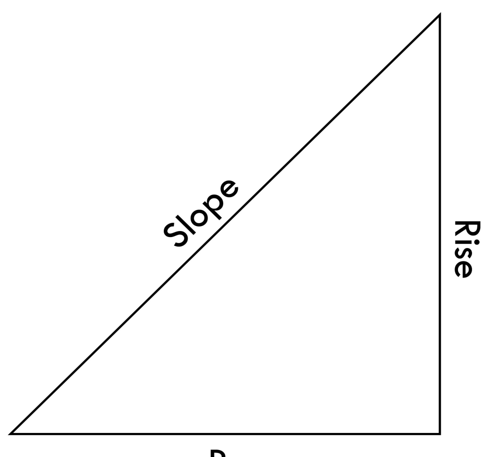


Figure 13.1. Conceptualizing slope

In order to calculate slope from a map we need to find two variables: the vertical distance traveled (*v*) and the horizontal distance traveled (*h*). Look at the map in figure 13.2.

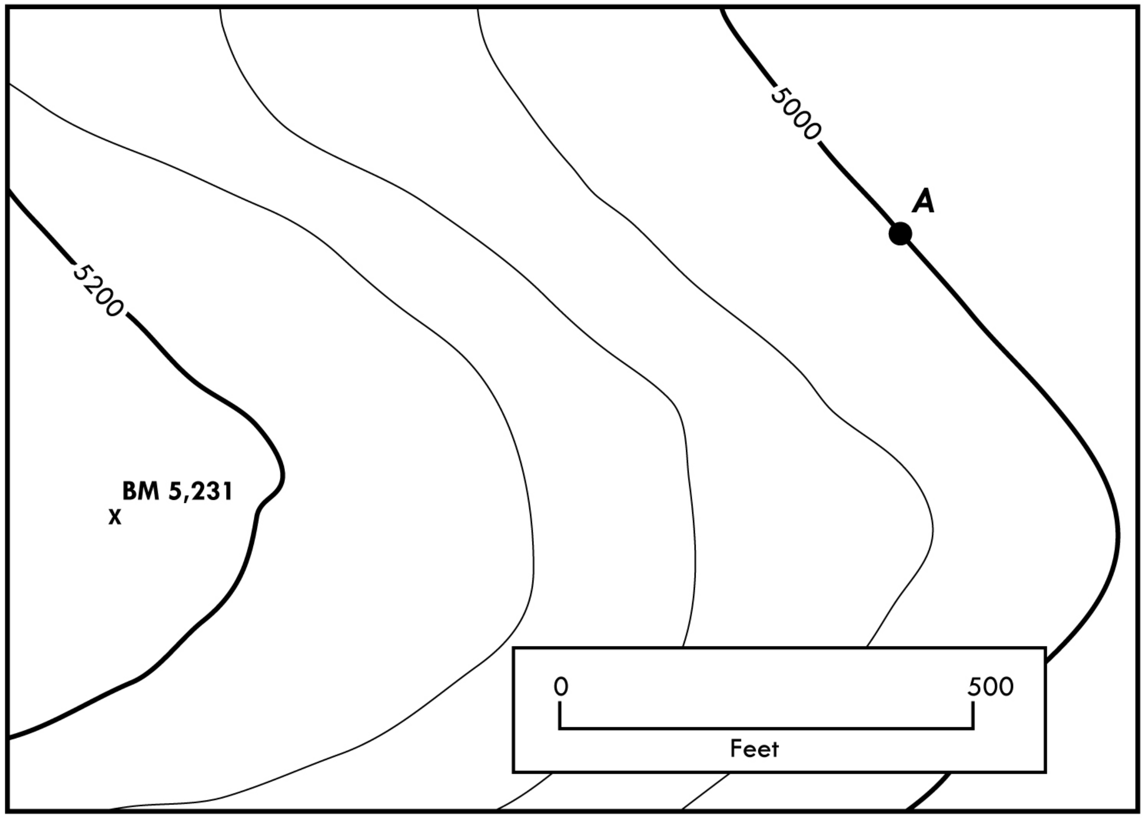


Figure 13.2.Topographic map example.

Let's imagine we want to know the slope from Point A to Benchmark (BM) 5,231. The number following "BM" is the specific elevation in feet above sea level at the X. We can find the elevation of Point A by using the contour line it intersects. Our variable *v* can be found by subtracting the smaller elevation from the larger one. We can then find *h* by using the graphic scale to measure the distance between our two points.

1. What is *v* for figure 13.2.?

2. What is *h* for figure 13.2.?

Now that we know *v* and *h* we can find the ratio, percent, and degree of our slope. We'll look at ratio first, which tells us how long it takes us to go up or down one foot. We calculate the ratio slope by using the formula

$$\textbf{Ratio} = h/v : 1$$

For example, if h = 10,000 feet and v = 600 feet, our ratio scale would be 17:1, meaning for every 17 feet you travel horizontally you climb one foot in elevation.

3. Using our values from questions 1 and 2, what is the ratio slope for figure 13.2.?

The next way to express a slope is as a percent. A percent slope or "grade" is often used in transportation to show how steep a road is. We calculate it using the same v and h variables, but in a different formula

Percent slope = (v/h) 100

4. Using our values from questions 1 and 2, what is the percent slope for figure 13.2.?

Finally, we can express a slope in terms of degrees. Using simple trigonometry and our h and v values, we can easily calculate the angle at which the slope heads up. The formula is

Degree of slope = arctan (v/h)

The "arctan" feature is often depicted as $\tan^{-1}$on scientific calculators.

5. Using our values from questions 1 and 2, what is the degree of slope, or slope angle for figure 13.2.?

You now know how to express the same slope three different ways. These numbers may not mean much to you at first, but they can make more sense when you begin to compare different slopes. For example, heading south from Antelope Valley College on 30th Street West to Marie Kerr Park would take you up a slope of 1% or 87:1. That's a slope you wouldn't notice in a car, but could feel if you were riding a bike. Conversely, driving south from Avenue K on 70th Street West to the California Aqueduct would take you up an average slope of 3% or 30:1. The steep last section of road that splits off of 70th to the Aqueduct has a slope of 8% or 13:1.

13.2. Finding slopes on topographic maps

Calculate the slopes for each of the locations listed below. Express the slope as a ratio, percent grade, and angle.

Use the Lancaster West quadrangle for the following questions.

6. What is the slope from the top of Quartz Hill (the hill itself, not the town) to BM 2471?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

7. What is the slope from the administration building at Antelope Valley College to the oil well located at NW ¼, SE ¼, Sec. 26, T 7 N, R 13 W?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

Use the Ship Rock, New Mexico Quadrangle for the following questions.

8. What is the slope of the north face of Ship Rock, (measure from the peak to 5,500')?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

9. What is the slope from BM 8840 at the top of Beautiful Mountains to BM 6345 (found to the NE)?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

10. What is the slope from the peak of Ship Rock to the end of its southern ridge?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

Use the Charleston Peak, Nevada Quadrangle for the following questions.

11. What is the slope from the Cold Creek Field Station (Sec. 6, T. 18 S, R. 56 E) to the highest peak on Indian Ridge?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

12. What is the slope of Hwy 52 from McWilliams Campground (Sec. 10, T. 19 S, R. 56 E) to the eastern edge of the map?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

13.3. Contour Profiles

A contour profile adds a 3rd dimension to our 2 dimensional topographic maps. It is a systematic way of representing the relief (i.e. elevation changes) over a specific route on a map. Figure 13.3 shows how the concept works. Imagine you are hiking from point A to point B. The contour profile at the bottom of the figure shows the type of terrain you would encounter.

Typically contour profiles are drawn with a certain amount of vertical exaggeration. This means the vertical scale (the real world distance covered when travelling an inch up the profile) is greater than the horizontal scale (the real world distance covered when travelling an inch along the line from point A to Point B). We do this so we can actually visualize the relief on our contour profiles.

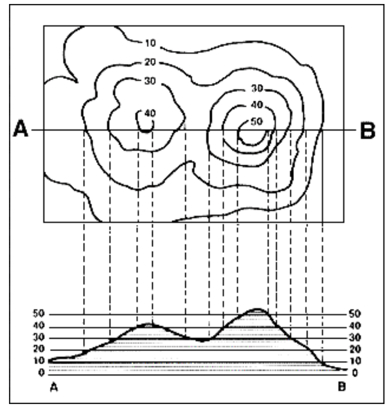


Figure 13.3. Contour profile (courtesy USGS)

13. Let's say a contour profile has a horizontal scale of 1 inch = 1,000 feet. What would its fractional scale be?

    1: ________________

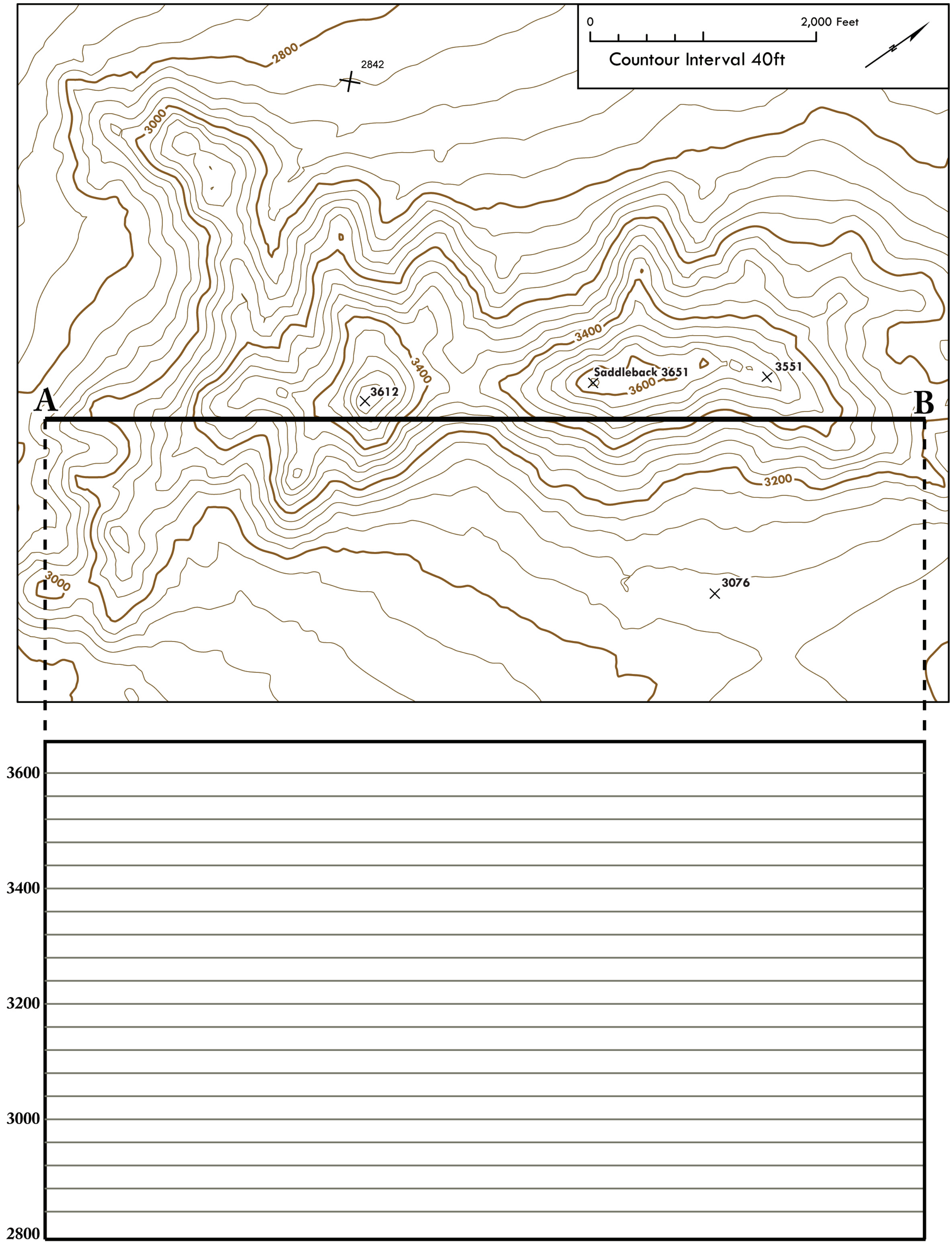
14. Using the same scale for the vertical would result in a flat profile. If we use a vertical scale of 1 inch = 100 feet, what would the fractional vertical scale be?

    1: ________________

You can calculate the vertical exaggeration of a profile by taking the fractional scale value of the horizontal scale and divide by the fractional scale value of the vertical scale.

15. What is the vertical exaggeration of this profile?

16. On the following page construct a contour profile for the topographic map of Saddleback Butte, California. Every time the line running from A to B crosses a contour line, draw a point on the graph directly below on the proper elevation line. When you have all your points, connect them to see the profile of Saddleback Butte.


0
2,000 Feet
Countour Interval 40ft
2800
2842
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3400
3612
Saddleback 3651
3600
3551
3200
3076
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3600
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