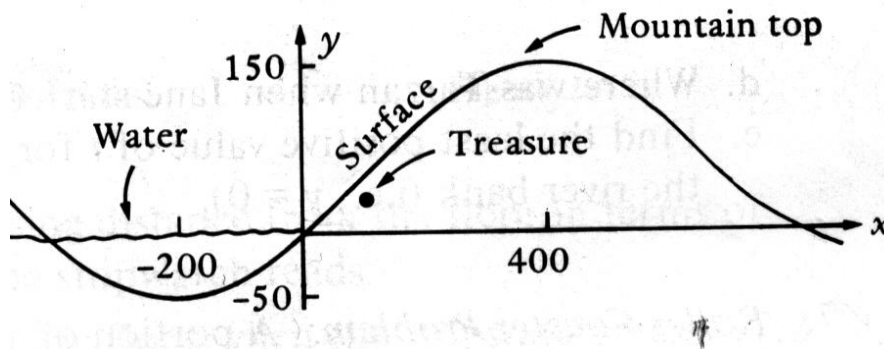


Name: \_\_\_\_\_

### **Sinusoidal Functions as Mathematical Models Extra Credit**

CORRECT solutions will count as bonus points on a quiz grade. You must justify your answers to receive full credit.

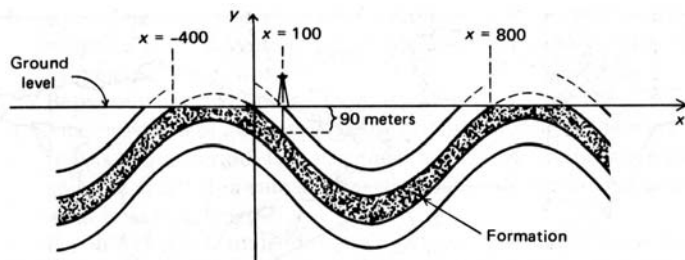
1. You are on an expedition seeking a treasure that is buried in the side of a mountain. The mountain range has a sinusoidal cross-section. A valley to the left is filled with water to a depth of 50 meters, and the top of the mountain is 150 meters above the water level. You set up an x-axis at water level and a y-axis 200 meters to the right of the deepest part of the water. The top of the mountain is at  $x = 400$  meters.



- Write an equation expressing  $y$  in terms of  $x$  for points on the surface of the mountain.
- Does this graph pass through the origin? Prove your answer algebraically.
- The treasure is located within the mountain at the point  $(130, 40)$ . (This point is NOT on the graph!) Would it be shorter to dig a horizontal or vertical tunnel to the treasure? Justify your answer.

2. An old rock formation is warped into the shape of a sinusoid. Over the centuries, the top has eroded away, leaving the ground with a flat surface from which various layers of rock are cropping out. Since you have studied sinusoids, the geologists call upon you to predict the depth of a particular formation at various points. You construct an  $x$ -axis along the ground and a  $y$ -axis at the edge of an outcropping as shown. A hole drilled at  $x = 100$  meters shows that the top of the formation is 90 meters deep at that point.

a. Write an equation of the formation expressing  $y$  in terms of  $x$ .



b. If a hole were drilled to the top of the formation at  $x = 510$ , how deep would it be?

c. What is the maximum depth of the top of the formation, and what is the first positive  $x$ -value where it reaches this depth?

d. How high above the present ground level did the formation reach before it eroded away?

e. For what values  $x$  between 0 and 800 meters is the top of the formation within 120 meters of the surface?

f. The geologists decide to drill holes to the top of the formation every 150 meters from  $x = 50$  through  $x = 800$ . The drilling costs \$75 per meter of depth. Find the cost of drilling each hole and the total cost of the drilling.