Key Steps in Trigonometry Applications

1) Draw a picture of the problem, if a drawing is not included in the original problem.

2) Find right-triangle(s) inherent and useful to the problem. If you can only find non-right triangles perhaps there are similar triangles to work with. Perhaps you can cut a non-right triangle into two right triangles.

2) Label the triangle(s). Label both known and unknown sides and angles.

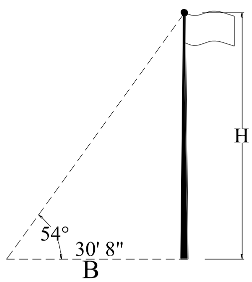
3) Determine which relation(s) is relevant.

4) Set up an appropriate equation with one unknown measurement.

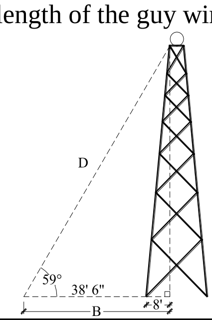
5) Solve the equation to determine the missing measurement.

6) Repeat as necessary until all measurements are determined or the original question has been answered

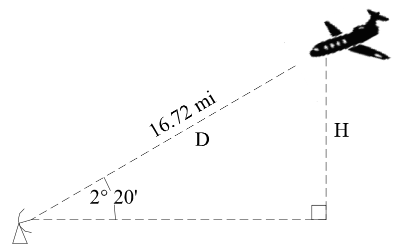
Problem 1
Find the height of the flag pole.



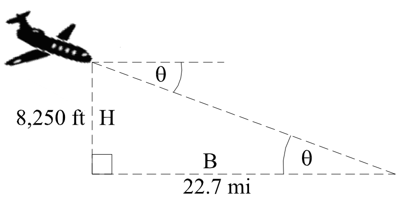
Problem 2
Find the length of the guy wire.



Problem 3
Find the plane's elevation in feet.



Problem 4
Find the plane's angle of descent.

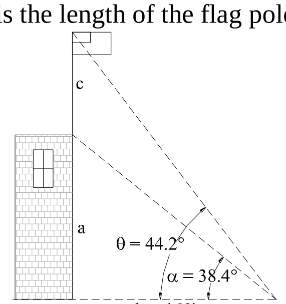


Problem 5
700' into a tunnel, an air shaft must be drilled so as to reach the surface 635' uphill from where the tunnel starts. For optimum efficiency, the air shaft must take the shortest route to the surface. At what angle will the shaft intersect the tunnel? Note: the shortest route will intersect the surface at 90°. *Why?*

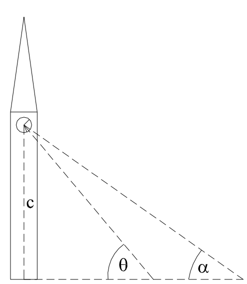
Problem 6
Find the angle a 22' ladder makes with the ground if its base is set 6' 9" from the wall.

With more complex geometries, the triangles are not necessarily so obvious. The crucial task is to try to fit right-triangles into the geometry. Of course, there are other relationships to consider as well such as the Pythagorean Theorem, similar triangles, arc lengths, complementary angles and so on. Use only Right Triangle Trigonometry

Problem 7
Marc is standing 160 feet from a tall building. From there, he measures the angle (from the horizontal) to the top of the building at 38.4°. There is a flag pole on the edge of the roof. Marc measures the angle to the top of the flag pole too. That angle measures 44.2°. What is the length of the flag pole?



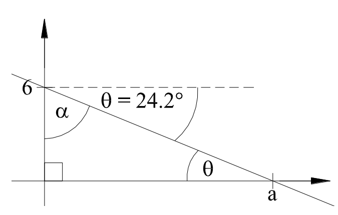
Problem 8
While Lydia is walking toward a tall Clock Tower she measures the angle (from the horizontal) to the clock at 34.6°. After she moves 25 m closer, she measures the angle again. It now measures 46.2°. How high is the clock above the ground?



Problem 9

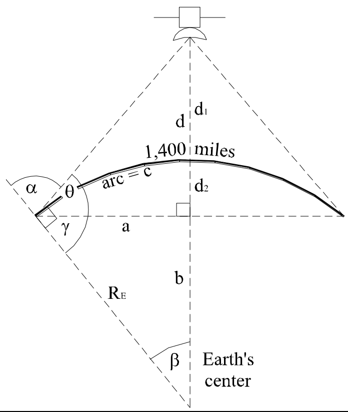
(a) Find the equation for the line (in slope-intercept form) which crosses the y-axis at (0, 6) at an angle of -24.2°. That is, the line is angled downward.

(b) Find the x-intercept.



Problem 10

A satellite is tracked from two stations that are 1,400 statute miles apart on the Earth. At the point that the satellite is exactly midway between the stations, the "line of sight" to the satellite is offset 72° 18' 48" from directly overhead. How high is the satellite's orbit above the Earth? Earth radius ≈ 3,960 mi.

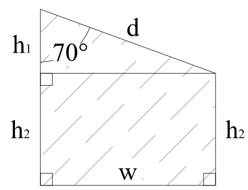


Problem 11

A trapezoid window has a width of 4', a height of 4' and the interior angle of 70°

(a) Find its area.

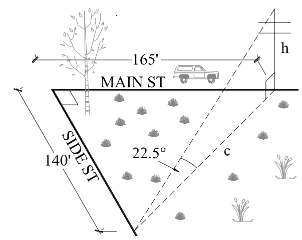
(b) Find its perimeter.



w = 4', $h_1 + h_2 = 4'$

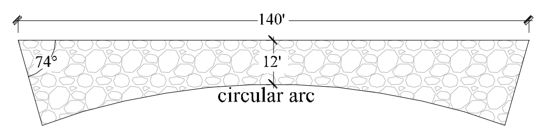
Problem 12

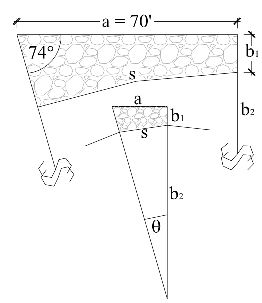
A telephone pole is located 165' down a main street. Perpendicular to that main street is a side street. 140' down that side street a sighting is taken to the top of the pole @ 22.5°. How tall is the pole?



Problem 13

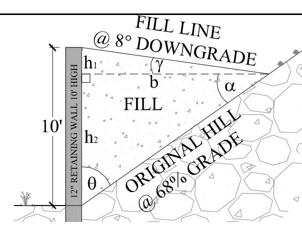
A hi-way bridge spans 140'. The underside is formed with a circular arc. The sides are canted inward at 74°. The bridge is 12' thick in the center and 24' (diagonally) along the sides. Find the bridge's cross-sectional area.





Problem 14

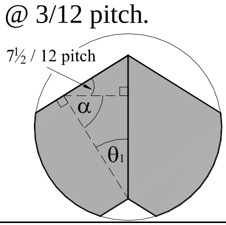
A 10 ft vertical retaining wall is built at the base of a hill which has a 68% grade. The area behind the wall is to be filled so that the final grade slopes from the retaining wall back towards the hill at an 8° down-slope. How much fill (cu-yds) is required for each foot of length of the retaining wall?

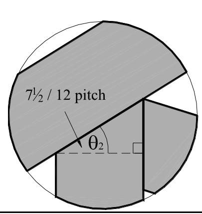


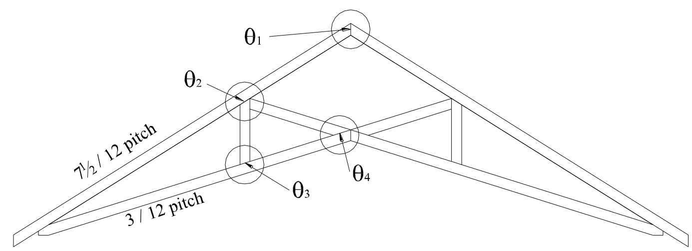
$h_1 + h_2 = 10'$

Problem 15

A scissor truss is made by joining a number of components. Find the cutting angles θ_1, & θ_2 for a scissor truss with a top rafter @ 7 ½ / 12 pitch and a bottom rafter @ 3/12 pitch.

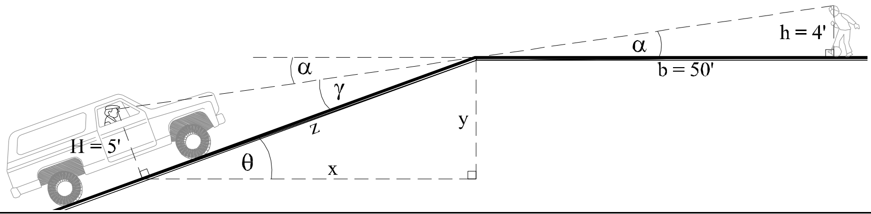






Problem 16

A driver is going up a road sloped at 12% which eventually flattens out. A 4' tall child is playing in the road 50' from the edge of the slope. The driver's eyes are 5' above the road bed when the vehicle is on flat ground. At what point will the driver begin to see the child?

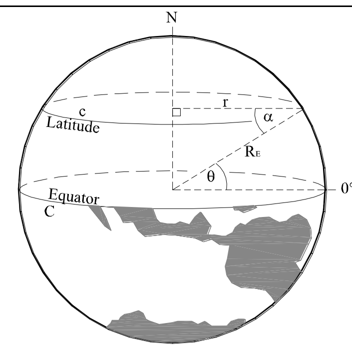


There are two situations we explore in working with geographic distances. The first is applications in which the Earth's surface should be treated as a curved surface with an average radius of roughly 3960 mi. The second is applications where the distances are small enough so that the curvature of the Earth is negligible and the Earth's surface can be treated as flat.

Problem 17

(a) Find the conversion from one degree latitude to surface miles. This is constant throughout Earth.

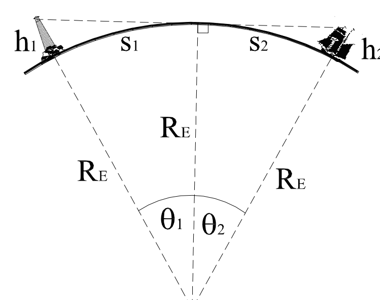
(b) Find the conversion (at θ° latitude) from one degree longitude to surface miles. This varies with latitude.



$R_E \approx 3{,}960$ mi, $RE \approx 6{,}370$ km

Problem 18

A Ship at sea has a lookout in the crows nest 20 m above the water looking for a lighthouse that is situated on a rock outcropping. The light of the lighthouse is 45 m above the water. At what distance will the lookout see the light directly?



$R_E \approx 3{,}960$ mi, $RE \approx 6{,}370$ km

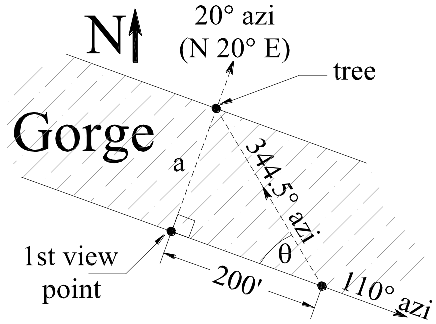
The next 3 Problems assume all distances are small enough so that the Earth's curvature is negligible.

Problem 19

A map shows Madras @ 44° 43' N, 121° 12' W, Redmond @ 44° 15' N, 121° 12' W and Sisters @ 44° 15' N, 121° 40' W. What is the straight-line distance between (a) Redmond and Madras, (b) Redmond and Sisters (c) Sisters and Madras.

Problem 20

Valerie needs to calculate the distance across the Crooked River Gorge so her company can build a bridge for a movie set. As she looks across the gorge she spots a tree on the other side directly across from where she is standing. Her compass gives a reading of 20° azi (aka N 20° E) toward the tree. Valerie turns clockwise 90° (so she is looking up the gorge) and walks 200 feet along the rim of the gorge. At that point, she takes a second compass reading toward the same tree. That reading is 344.5° azi (N 15.5° W). How wide is the gorge to the nearest foot?



Problem 21

A tank travels 1,000 yds from pt A to pt B on a N 30° E bearing and then changes direction and travels due east 1,200 yds from pt B to pt C. What direction and how far must the tank travel to return to its starting point most directly?