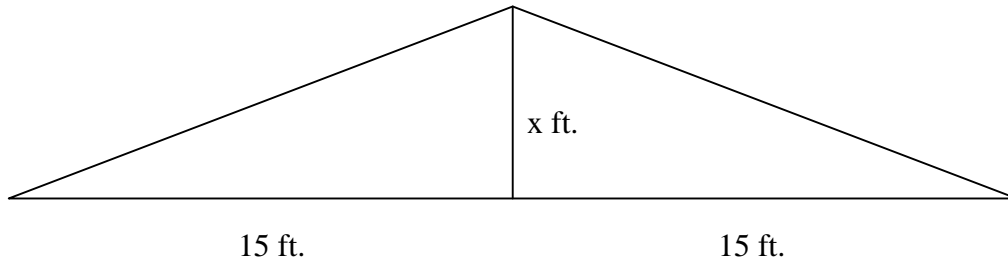


## #1 Construction Problem

(Key at End)

1. You want to build a rectangular-shaped house with a floor area of 1200 sq. ft. One possible set of dimensions for the length and width is 30 ft. by 40 ft. What are two other possible sets of dimensions that could be used for the length and width?
2. Suppose you decide to build the house 30 ft by 40 ft. and you want the walls to be 9 ft. high, how many square feet of plywood will you need to cover the walls?
3. To ensure that the adjacent walls for this 30 by 40 ft house are at right angles to each other, you decide to measure the length of the floor's diagonals. How long should these diagonals be to ensure the walls are at right angles to each other?
4. You decide to build a simple pitched roof with the highest points forming a line in the middle of the house parallel to the 40 ft. sides and the roof forming an isosceles triangle at each end of the house on the 30 ft. sides. If you want the roof to have a pitch of 1:3, that is, it rises 1 ft for every 3 horizontal ft., how high will the roof be above the top of the walls at the highest point? (Find  $x$  in the diagram below.)



5. To determine the cost of the shingles for the roof, you will need to find the total area of the roof, that is, you need to find the areas of the two sloping rectangles that form the roof. What is this total area?
6. The gable ends of the house, that is, the two 30 ft. by  $x$  ft high triangles as in the diagram above, will also be covered with plywood. How many sq. ft. of plywood will you need for both of these two gable ends?
7. To heat the house, you need to consider the volume of the house. Disregarding the volume above the ceiling which will not be heated, what is the volume of your house in cubic feet?
8. If you estimate that the flooring material (hardwood or carpet) for the house will cost \$20.00 a square yard, what will be the total cost of the flooring material?

9. You also want to save on heating costs so you will place insulating material in the attic covering the entire ceiling area. If this insulating material costs \$2.50 a sq. yd., what will be the cost of the insulating material for the attic?

10. Draw a floor plan for your 30 by 40 ft. house clearly labeling each room and hallway and its length and width. Choose a suitable scale and indicate this on your drawing. All dimensions in your drawing should be to scale.

### #1 Construction Problems Answer Key

1. Factoring/Area Problem. Other possibilities are 20 ft. by 60 ft. or 25 ft. by 48 ft., etc.

2. Rectangle Area Problem. Two walls will be 30 ft by 9 ft. and two will be 40 ft. by 9 ft. so that makes

$(2 \times 30 \times 9) + (2 \times 40 \times 9) = 540 + 720 = \mathbf{1260 \text{ sq. ft.}}$  of plywood to cover the walls.

3. Pythagorean Theorem. In a right triangle,  $a^2 + b^2 = c^2$  with sides a and b forming the right angle and side c being the hypotenuse. In this case, the hypotenuse is the diagonal so  $30^2 + 40^2 = x^2$ . So  $900 + 1600 = x^2$ . Then  $2500 = x^2$ . So  $x = 50$ . The diagonals must both be **50 ft.** for the walls to be at right angles to each other.

4. Ratio/Proportion/Slope problem. The slope of the roof is  $1/3$  so since the horizontal distance from the edge of the roof to the point directly beneath the roof's highest point is 15 ft., the rise must be x such that  $x/15 = 1/3$ . So **x = 5 ft.**

5. Pythagorean Theorem/Area problem. The roof is made up of two rectangles which are each 40 ft. long. To determine the width of each rectangle, the hypotenuse of the right triangle forming half of each gable end must be found. That hypotenuse is the square root of  $(15^2 + 5^2)$ , that is the square root of 250 which is approximately 15.8 ft. Rounding to the nearest foot which also allows for a slight overhang, the area of each rectangle is thus  $40 \times 16 = 640 \text{ sq. ft.}$  so both rectangles together make **1280 sq. ft.** needed for shingles. Other reasonable rounding and approximations are acceptable.

6. Triangle Area Problem. We already determined in problem # 4 that the gable end triangles are 5 ft. high so the area of each gable end is the area of a triangle with base 30 ft and height 5 ft. Since the area of a triangle =  $\frac{1}{2}bh$ , we obtain  $(\frac{1}{2})30(5) = 75 \text{ sq. ft.}$  for each gable end triangle or **150 sq. ft.** for both.

7. Volume of a rectangle solid. The Volume =  $lwh$  so  $V = (40)(30)(9) = \mathbf{10800 \text{ cu. ft.}}$

8. Area/cost/conversion problem. The floor has an area of 1200 sq. ft. for the 30 ft. by 40 ft. house. We need the area in sq. yd because the flooring is priced per sq. yd. There are 9 sq. ft. in a sq. yd. so  $1200 \div 9 = 133 \frac{1}{3} \text{ sq. yd.}$  Since there will be some wastage, we will need at least 134 sq. yd. so take  $134 \times \$20.00 = \$2680$ . So the cost of the flooring material is approximately **\$2680 .**

9. Area/cost problem. Again the area will be about 134 sq. yd from the calculations in Problem #8 so  $134 \times \$2.50 = \mathbf{\$335}$  . The cost of the attic insulation is \$335.

10. Many designs are possible. Using grid paper and a suitable scale will facilitate the design process.