

Geometry & Trigonometry Review

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6 April 2005

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Outline

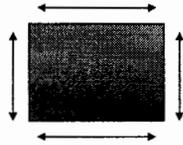
- Perimeter
- Area
- Right Triangles
- Geometry Problems
- Trigonometry Problems

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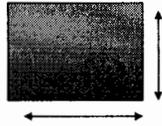
Geometry

Perimeter: Total length around the outside.



Add the length of the sides
 $a + b + c + d = \text{Perimeter of Rectangle (in feet, inches, meters, etc.)}$
 $4a = \text{Perimeter of a Square}$
 $a + b + c = \text{Perimeter of Triangle}$

Area: Represents the amount of space inside.

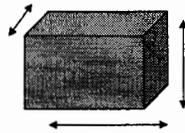


Area of Rectangle
Length x Width
(ft², meter²)

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Geometry



Volume = Length x Width x Height
(ft³, m³)



diameter or (radius = 1/2 (d))

Volume of Cylinder

$$V = \pi r^2 h \text{ or}$$

$$V = \frac{(\pi d^2 h)}{4}$$

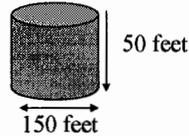
$\pi = 3.14$ (geometric physical constant used in cylindrical-type shapes (circles, ducts, tanks).

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Geometry Problems

In a fuel storage area, tank #1 is 150 feet in diameter and 50 feet high. What is the capacity of this tank in gallons?



$$\begin{aligned}
 V &= \frac{(\pi d^2 h)}{4} \\
 &= \frac{(3.14)(150 \text{ feet})^2(50 \text{ feet})}{4} \\
 &= 883,125 \text{ cubic feet (ft}^3\text{)}
 \end{aligned}$$

Convert to Gallons (see reference tables)

(a) Determine the conversion rate:

$$1.06 \text{ quarts} = 0.035 \text{ cubic feet}$$

$$4 \text{ quarts} = 1 \text{ gallon}$$

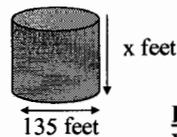
$$883,125 \text{ cubic feet} \times \frac{1.06 \text{ quarts}}{0.035 \text{ cubic feet}} \times \frac{1 \text{ gallon}}{4 \text{ quarts}} = \underline{\underline{6,686,518 \text{ gallons}}}$$

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Geometry Problems

You are advising an engineer on a fuel tank design. The tank must have a 2 million gallon capacity. The tank farm limits the diameter of the design to 135 feet. What is the required height of the tank in feet.



$$\begin{aligned}
 V &= \frac{(\pi d^2 h)}{4} \\
 V &= \frac{(3.14)(135 \text{ feet})^2(h)}{4}
 \end{aligned}$$

Hint: V must be cubic feet in order to use the equation
You are given feet as measure for the diameter.

(a) 1.06 quarts = 0.035 cubic feet

$$4 \text{ quarts} = 1 \text{ gallon}$$

$$2,000,000 \text{ gals} \times \frac{4 \text{ quarts}}{1 \text{ gallon}} \times \frac{0.035 \text{ cubic feet}}{1.06 \text{ quarts}} = 264151 \text{ cubic feet}$$

(b) Now, enter into equation.

$$264151 \text{ ft}^3 = \frac{(3.14)(135 \text{ feet})^2(h)}{4} \quad \text{Solve for (h)}$$

$$\underline{\underline{h = 18.5 \text{ feet}}}$$

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Geometry Problems

An engineer asks a safety professional on a design for a movie theater. He needs to know the volumetric area of a theater to safely have a 3,000 person capacity. A reference standard recommends that every person should have 6 square feet of space for comfort. What is the square footage required for this movie theater?

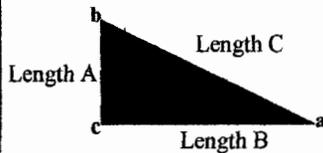
Determine total square footage required to accommodate 3,000 people.

$$3,000 \text{ persons} \times \frac{6 \text{ sq ft}}{1 \text{ person}} = \underline{\mathbf{18,000 \text{ ft}^2}}$$

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Trigonometry



Right triangles (e.g., triangles with a 90 deg angle) have the following mathematical relationships.

Can determine the length & sides of triangle with the following relationships:

To determine length of c:

$$a^2 + b^2 = c^2$$

Same relationship applies to all of the other angles.

$$\sin a = \frac{\text{Length A}}{\text{Length C}} \quad a \text{ is angle in degrees}$$

$$\cos a = \frac{\text{Length B}}{\text{Length C}} \quad a \text{ is angle in degrees}$$

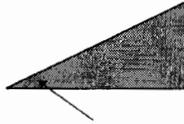
$$\tan a = \frac{\text{Length A}}{\text{Length B}} \quad a \text{ is angle in degrees}$$

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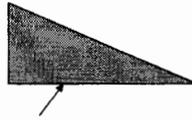
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Trigonometry Problem

Find the length of the following ramp if the height is 4.5 feet and the ramp's angle is 12 degrees.



At an angle of 5 degrees, and a ramp height of 3 feet, how much horizontal distance is required to accommodate this ramp at a warehouse facility?



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Trigonometry Problem

A ramp must be constructed to get electric forklifts to carry loads up to their max load test capacity. The engineer wants a ramp that is 25 feet long and 5 feet high. The forklift manufacturer recommends a maximum incline of 4% when carrying its max load test capacity. What is the angle of the ramp & calculate the ramp's incline to see if in compliance with mfr guidance?



- a. Determine the Angle Created by the Dimensions Given of the Ramp.

$$\sin(\text{angle}) = \frac{\text{Length A}}{\text{Length C}} = \frac{5 \text{ feet}}{25 \text{ feet}}$$

$$\text{Angle} = 11.5 \text{ degrees}$$

Divide the (5/25) & press "=" on calculator
Then, press "2nd" key, and press "SIN" key.

- b. Compare the angle with the Maximum Incline of 4%

$$\text{Incline\%} = \left(\frac{\text{Rise (or Height of an Incline)}}{\text{Total Length of Driveway}} \right) \times 100 = \left(\frac{5 \text{ feet}}{25 \text{ feet}} \right) \times 100 = \mathbf{20\%}$$

20% incline > 4% maximum incline recommended.

Answer: No, current ramp design is not safe for use using the forklifts & weights carried.

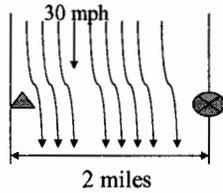
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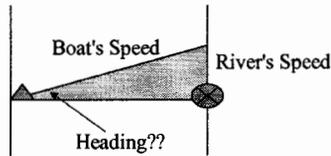
Trigonometry Problems

Basic trigonometry can be used for mathematically calculating Force, Speed, and other measurements

A boat must cross a 2 mile wide river. The river's current is approximately 25 miles per hour. At a speed of 30 miles per hour, at what angle (or heading) relative to the destination should the boat aim to in order to reach it safely.



Create a triangle to determine angle & reflect the speeds



$$\sin a = \frac{\text{River's Speed (mph)}}{\text{Boat's Speed (mph)}}$$

$$= \underline{\underline{56.4 \text{ degrees}}}$$

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Group Exercises

1. Your company is designing a spill containment measuring 50 feet long, 40 feet wide, and 3 feet high. In the dike, there is a cylindrical fuel tank measuring 25 feet high and 20 feet in diameter. The local law requires containment to hold 110% of the total storage capacity. Does this containment design meet this local requirement?

2. A forklift manufacturer recommends a maximum incline of 3.5% when transporting up to its load test limit of 450 lbs. There is a ramp that is 45 feet in driveway length, and a 5 feet rise. Will this ramp exceed the forklift manufacturer's recommendation if the forklift will routinely carry loads up to 450 lbs?

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Group Exercises

3. Using problem#2, what is the angle of the incline on this ramp?
4. Find the length of a ramp if the height is 6.5 feet and the ramp's angle is 5 degrees.
5. A boat carrying hazardous material must traverse river that is 3 miles long to a point directly across from its origin.. The river's current is 35 mph. If the boat will cruise at approximately 40 mph, what is the appropriate heading relative to the other side should the boat aim for in order to arrive at its destination directly.

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Group Exercise

6. A room has the following dimensions: 25 feet long, 14 feet high, 20 feet wide. If the recommended amount of air per person inside a room is 55 m³ per person, what is the maximum number of people allowed in this room.
7. In a tank farm, a fuel storage tank 145 feet in diameter and 48 feet high has no diking. If the local diking requirement is 115% of capacity, what should the dike's capacity be?

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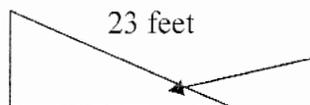
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Battle Drills
Geometry & Trigonometry

1. A cylindrical water storage tank must hold a volumetric capacity of 300,000 gallons to serve a population of 150 people. The commercial property where this tank must be built can only fit a tank with a diameter of 50 feet. Assuming that 50 feet diameter base will be used, how high in feet should the tank be constructed to meet the volumetric capacity?

- a. 11.0 feet
- b. 15.3 feet
- c. 21.6 feet
- d. 11.3 feet

2. Given the following values, calculate the angle indicated by the arrow.



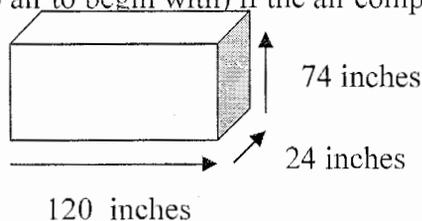
12 feet

- a. 22 degrees
- b. 59 degrees
- c. 12 degrees
- d. 23 degrees

3. If a room requires 55 m^3 of clean air per person and the room has 25000 cubic feet of air, how many people maximum is allowed to safely be in this room until the air runs out?

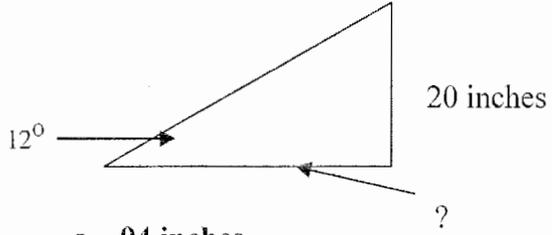
- a. 13 persons
- b. 14 persons
- c. 11 person
- d. 12 persons

4. Given the following figure, how long would it take to fill the room with air (assuming it had no air to begin with) if the air compressor can only produce 23 cubic feet of air per minute?



- a. 5.4 minutes
- b. 7 minutes
- c. 2 minutes
- d. 10 minutes

5. Given the following right triangle, determine the length as indicated with the arrow.



- a. 94 inches
- b. 23 inches
- c. 45 inches
- d. 22 inches