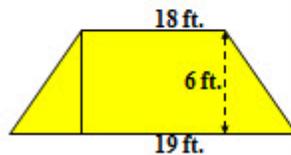


More Mining Math

Question 1

Perimeters - Trapezoid

Determine the perimeter of an entry 18 feet across the top, 19 feet across the bottom, and 6 feet high.



Solution:

$$X = \frac{19 \text{ ft.} - 18 \text{ ft.}}{2}$$

$$X = \frac{1.0 \text{ ft.}}{2}$$

$$X = .5 \text{ ft.}$$

$$Z = \sqrt{X^2 + Y^2}$$

$$Z = \sqrt{(.5 \text{ ft.})^2 + (6 \text{ ft.})^2}$$

$$Z = \sqrt{(.25 \text{ ft.}) + (36 \text{ ft.})}$$

$$Z = \sqrt{(36.25 \text{ ft.})}$$

$$Z = 6.02 \text{ ft.}$$

$$o = \text{Top Width} + \text{Bottom Width} + \text{Side 1} + \text{Side 2}$$

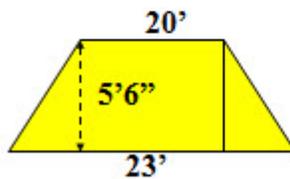
$$o = 18 \text{ ft.} + 19 \text{ ft.} + 6.02 \text{ ft.} + 6.02 \text{ ft.}$$

$$o = 49.04 \text{ feet}$$

Question 2

Perimeters - Trapezoid

⌘ Determine the perimeter of an entry 20 feet across the top, 23 feet across the bottom, and 5 feet 6 inches high.



⌘ Solution:

$$X = \frac{20 \text{ ft.} - 23 \text{ ft.}}{2}$$

$$X = \frac{3 \text{ ft.}}{2}$$

$$X = 1.5 \text{ ft.}$$

$$Z = \sqrt{X^2 + Y^2}$$

$$Z = \sqrt{(1.5 \text{ ft.})^2 + (5.5 \text{ ft.})^2}$$

$$Z = \sqrt{(2.25 \text{ ft.}) + (30.25 \text{ ft.})}$$

$$Z = \sqrt{(32.5 \text{ ft.})}$$

$$Z = 5.7 \text{ ft.}$$

$$o = \text{Top Width} + \text{Bottom Width} + \text{Side 1} + \text{Side 2}$$

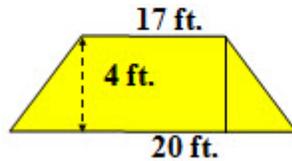
$$o = 20 \text{ ft.} + 23 \text{ ft.} + 5.7 \text{ ft.} + 5.7 \text{ ft.}$$

$$o = 54.4 \text{ feet}$$

Question 3

Perimeters - Trapezoid

⌘ Determine the perimeter of an entry 17 feet across top, 20 feet across bottom, and 4 feet high.



⌘ Solution:

$$X = \frac{17\text{ft.} - 20\text{ft.}}{2}$$

$$X = \frac{3\text{ft.}}{2}$$

$$X = 1.5\text{ ft.}$$

$$Z = \sqrt{X^2 + Y^2}$$

$$Z = \sqrt{(1.5\text{ ft.})^2 + (4\text{ ft.})^2}$$

$$Z = \sqrt{(2.25\text{ ft.}) + (16.0\text{ ft.})}$$

$$Z = \sqrt{(18.25\text{ ft.})}$$

$$Z = 4.27\text{ ft.}$$

$$o = \text{Top Width} + \text{Bottom Width} + \text{Side 1} + \text{Side 2}$$

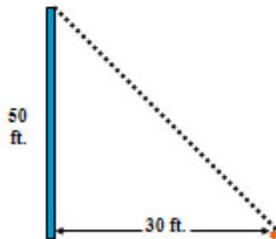
$$o = 20\text{ ft.} + 17\text{ ft.} + 4.27\text{ ft.} + 4.27\text{ ft.}$$

$$o = 45.54\text{ feet}$$

Question 4

Solve this Problem:

⌘ A mast is 50 feet high, the anchor pin is 30 feet away. How much wire rope is needed to secure the top of the mast to the anchor pin?



⌘ Solution:

First, identify that a right angle exists, then use Pythagoras Theorem

$$Z = \sqrt{X^2 + Y^2}$$

$$Z = \sqrt{(30\text{ ft.})^2 + (50\text{ ft.})^2}$$

$$Z = \sqrt{(900\text{ ft.}) + (2500\text{ ft.})}$$

$$Z = \sqrt{(3400\text{ ft.})}$$

$$Z = 58.3\text{ ft.}$$

Question 5

Atmospheric Air Pressure

What is the depth of the air shaft, if the Barometer reads 29.75 inches at top of the shaft and 30.95 inches at the bottom?

$$\text{Barometric Difference} = \text{Barometric Reading (Bottom)} - \text{Barometric Reading (Top)}$$

$$1 \text{ (mercury) inch} = 876 \text{ feet in (Barometric Pressure) air column}$$

Solution:

$$\text{Barometric Difference} = \text{Barometric Reading (Bottom)} - \text{Barometric Reading (Top)}$$

$$30.95 - 29.75 = 1.2 \text{ inches}$$

$$1.2 \text{ inches} \times 876 = \mathbf{1,051.2 \text{ feet}}$$

Question 6

Atmospheric Air Pressure

What is the depth of the air shaft, if the Barometer reads 29.35 inches at top of the shaft and 29.65 inches at the bottom?

$$\text{Barometric Difference} = \text{Barometric Reading (Bottom)} - \text{Barometric Reading (Top)}$$

$$1 \text{ (mercury) inch} = 876 \text{ feet in (Barometric Pressure) air column}$$

Solution:

$$\text{Barometric Difference} = \text{Barometric Reading (Bottom)} - \text{Barometric Reading (Top)}$$

$$29.65 - 29.35 = 0.3 \text{ inches}$$

$$0.3 \text{ inches} \times 876 = \mathbf{262.8 \text{ feet}}$$

Question 7

Practice Problem - Rubbing Surface

An entry is 10 feet high and 22 feet wide with a total length of 2,000 ft. What is the rubbing surface?

$$s = lo$$

$$o = \text{Top Width} + \text{Bottom Width} + \text{Side 1} + \text{Side 2}$$

Solution:

$$\begin{aligned} o &= W_1 + W_2 + S_1 + S_2 \\ o &= 10' + 22' + 10' + 22' \\ o &= 64 \text{ ft.} \end{aligned}$$

$$s = lo$$

$$s = 2,000 \text{ ft} \times 64 \text{ ft.}$$

$$s = \mathbf{128,000 \text{ sq. ft.}}$$

Question 8

Practice Problem - Rubbing Surface

An entry is 12 feet high and 18 feet 6 inches wide with a length of 1,500 feet. What is the rubbing surface?

$$s = lo$$

$$o = \text{Top Width} + \text{Bottom Width} + \text{Side 1} + \text{Side 2}$$

Solution:

$$\begin{aligned} o &= W_1 + W_2 + S_1 + S_2 \\ o &= 12' + 18.5' + 12' + 18.5' \\ o &= 61.0 \text{ ft.} \end{aligned}$$

$$s = lo$$

$$s = 1,500 \text{ ft} \times 61.0 \text{ ft.}$$

$$s = \mathbf{91,500 \text{ sq. ft.}}$$

Question 9

Practice Problem - Rubbing Surface

An entry is 5 feet high and 19 feet wide and 1,750 feet long. What is the rubbing surface?

$$s = lo$$

$$o = \text{Top Width} + \text{Bottom Width} + \text{Side 1} + \text{Side 2}$$

Solution:

$$\begin{aligned} o &= W_1 + W_2 + S_1 + S_2 \\ o &= 5' + 19' + 5' + 19' \\ o &= 48.0 \text{ ft.} \end{aligned}$$

$$s = lo$$

$$s = 1,750 \text{ ft} \times 48.0 \text{ ft.}$$

$$s = \mathbf{84,000 \text{ sq. ft.}}$$

Question 10

Practice Problem Rubbing Surface ; Trapezoid

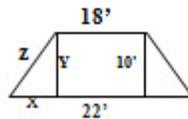
An entry measures 18 feet across the top and 22 feet across the bottom and 10 feet high with a length of 3,000 feet. What is the rubbing surface?

$$o = \text{Top Width} + \text{Bottom Width} + \text{Side 1} + \text{Side 2}$$

$$\text{Pythagoras's Theorem: } Z = \sqrt{X^2 + Y^2}$$

$$X = \frac{\text{Bottom Width} - \text{Top Width}}{2}$$

$$s = lo$$



Solution:

$$X = \frac{\text{Bottom Width} - \text{Top Width}}{2}$$

$$X = \frac{22' - 18'}{2}$$

$$X = \frac{4'}{2}$$

$$X = 2'$$

$$Z = \sqrt{X^2 + Y^2}$$

$$Z = \sqrt{2^2 + 10^2}$$

$$Z = \sqrt{4 + 100}$$

$$Z = \sqrt{104}$$

$$Z = 10.19 \text{ ft.}$$

$$o = \text{Top} + \text{Bottom} + \text{Side 1} + \text{Side 2}$$

$$o = 18' + (2 + 18 + 2) + 10.19' + 10.19'$$

$$o = 60.38 \text{ ft.}$$

$$S = lo$$

$$s = 3,000' \times 60.38 \text{ ft.}$$

$$s = 181,140 \text{ sq. ft.}$$

Question 11

Practice Problem - Rubbing Surface ; Circle

<p>What is the rubbing surface of a circular shaft 3,500 feet long with a diameter of 18 feet?</p> $o = \pi \times \text{Diameter}$ $(\pi = 3.1416)$ $s = lo$	<p>Solution:</p> $o = \pi \times \text{Diameter}$ $o = 3.1416 \times 18'$ $o = 56.5488 \text{ ft.}$ $s = lo$ $s = 3,500' \times 56.5488'$ $s = 197,920.8 \text{ sq.ft.}$
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Question 12

Practice Problem - Rubbing Surface ; Circle

<p>What is the rubbing surface of a circular shaft 2,500 feet long with a diameter of 15 feet 6 inches?</p> $o = \pi \times \text{Diameter}$ $(\pi = 3.1416)$ $s = lo$	<p>Solution:</p> $o = \pi \times \text{Diameter}$ $o = 3.1416 \times 15.5'$ $o = 48.6948 \text{ ft.}$ $s = lo$ $s = 2,500' \times 48.698'$ $s = 121,737.0 \text{ sq.ft.}$
--	---

Question 13

Methane Evaluation

A return airway has a quantity of 11,000 CFM, which has 0.4% gas. What is the quantity of gas?

$$Q_G = Q_R \times \%G$$

Solution:

$$Q_G = Q_R \times \%G$$

$$Q_G = 11,000 \text{ CFM} \times .004$$

$$Q_G = 44 \text{ CFM CH}_4$$

Question 14

Methane Evaluation

A return airway has a quantity of 32,000 CFM, which has 0.1% gas. What is the quantity of gas?

$$Q_G = Q_R \times \%G$$

Solution:

$$Q_G = Q_R \times \%G$$

$$Q_G = 32,000 \text{ CFM} \times .001$$

$$Q_G = 32 \text{ CFM CH}_4$$

Question 15

Methane Evaluation

A return airway has a quantity of 17,500 CFM, which has 2.0% gas. What is the quantity of gas?

$$Q_G = Q_R \times \%G$$

Solution:

$$Q_G = Q_R \times \%G$$

$$Q_G = 17,500 \text{ CFM} \times .02$$

$$Q_G = 350 \text{ CFM CH}_4$$

Question 16

Methane Evaluation

A return airway has a quantity of 12,500 CFM, with 110 CFM/CH₄. What is the percentage of gas?

$$\%G = \frac{Q_G}{Q_R}$$

Solution:

$$\%G = \frac{Q_G}{Q_R}$$

$$\%G = \frac{110 \text{ CFM}}{12,500 \text{ CFM}}$$

$$\%G = 0.0088$$

(convert to percentage)

$$.88 \% \text{ CH}_4$$

(round off)

$$.9 \% \text{ CH}_4$$

Question 17

Methane Evaluation

A return leg of an air shaft has a diameter of 17 feet, with a velocity of 180 fpm, and a quantity of gas of 75 CFM/CH₄. What is the percentage of gas?

$$\%_G = \frac{Q_G}{Q_R}$$

$$A = \pi \times R^2$$

$$Q = AV$$

Solution:

$$A = \pi \times R^2$$

$$A = 3.1416 \times 8.5^2$$

$$A = 3.1416 \times 72.25$$

$$A = 226.98 \text{ sq. ft.}$$

$$Q = AV$$

$$Q = 226.98 \text{ ft}^2 \times 180 \text{ fpm}$$

$$Q = 40,856 \text{ CFM}$$

$$\%_G = \frac{Q_G}{Q_R}$$

$$\%_G = \frac{75 \text{ CFM}}{40,856 \text{ CFM}}$$

$$\%_G = 0.0018$$

(convert to percentage)

.18 % CH₄ (.2 % CH₄)

Question 18

Methane Evaluation

The quantity of gas in the return airway was 120 CFM/CH₄ with 2.0 % CH₄. What was the quantity?

$$Q_R = \frac{Q_G}{\%_G}$$

Solution:

$$Q_R = \frac{Q_G}{\%_G}$$

$$Q_R = \frac{120 \text{ CFM/CH}_4}{.02}$$

$$Q_R = \mathbf{6,000 \text{ CFM}}$$

Question 19

Methane Evaluation

The quantity of gas in the return airway was 95 CFM/CH₄ with .5 % CH₄. What was the quantity?

$$Q_R = \frac{Q_G}{\%G}$$

Solution:

$$Q_R = \frac{Q_G}{\%G}$$

$$Q_R = \frac{95 \text{ CFM/CH}_4}{.005}$$

$$Q_R = 19,000 \text{ CFM}$$

Question 20

Methane Evaluation

A mine entry measured 10' high and 20' wide and the anemometer reading was 150 fpm, the methane reading was 1.0 %. What is quantity of gas liberated in a 24 hour period?

☞ A = HW

☞ Q = AV

☞ $Q_G = Q_R \times \%G$

☞ $Q_G (\text{CFM}) \times 60 (\text{minutes}) \times 24 (\text{hours})$

Solution:

A = HW

A = 10' x 20'

A = 200 ft²

Q = AV

Q = 200 ft² x 150 fpm

Q = 30,000 CFM

$Q_G = Q_R \times \%G$

$Q_G = 30,000 \text{ CFM} \times .01$

$Q_G = 300 \text{ CFM/CH}_4$

$Q_G (\text{CFM}) \times 60 (\text{minutes}) \times 24 (\text{hours})$

30 x 60 x 24

432,000/CH₄/24 hour

Question 21

Methane Evaluation — CH₄ ... Air to Add

The quantity of return air was 10,500 cfm and found to contain 2.3 % CH₄. How much extra air is needed to reduce the methane content to 1.5 %.

$$Q_G = Q_R \times \%G$$

$$\text{Air to add} = \frac{Q_G}{\text{new \% G}} - Q_R$$

Solution:

$$Q_G = Q_R \times \%G$$

$$Q_G = 10,500 \text{ cfm} \times .023$$

$$Q_G = 241.5 \text{ CFM/CH}_4$$

$$\text{Air to add} = \frac{Q_G}{\text{new \% G}} - Q_R$$

$$\text{Air to add} = \frac{241.5 \text{ cfm/CH}_4}{.015} - 10,500 \text{ cfm}$$

$$\text{Air to add} = 16,100 - 10,500 \text{ cfm}$$

$$\text{Air to add} = \mathbf{5,600 \text{ cfm}}$$

Question 22

Methane Evaluation - CH₄ Air to Add

The quantity of return air was 14,500 cfm and found to contain 3.4 % CH₄. What is the *total volume* needed to reduce the methane content to 2.0 %.

$$Q_G = Q_R \times \%G$$

$$\text{Air to add} = \frac{Q_G}{\text{new \% G}} - Q_R$$

Solution:

$$Q_G = Q_R \times \%G$$

$$Q_G = 14,500 \text{ cfm} \times .034$$

$$Q_G = 493 \text{ CFM/CH}_4$$

$$\text{Air to add} = \frac{Q_G}{\text{new \% G}} - Q_R$$

$$\text{Air to add} = \frac{493 \text{ cfm/CH}_4}{.02 \text{ new \% G}} - (14,500 \text{ cfm})$$

$$\text{Total Volume} = \mathbf{24,650 \text{ cfm}}$$

Question 23

Equal Orifice *

If the new section requires 18,000 cfm & the water gauge is 1.2 inches, what is the size of the regulator need to be?

$$E.O. = \frac{.0004 \times Q \text{ (new)}}{\sqrt{I}}$$

$$E.O. = \frac{.0004 \times 18,000 \text{ cfm}}{\sqrt{1.2 \text{ in.}}}$$

$$E.O. = \frac{7.2}{1.09}$$

$$E.O. = 6.6 \text{ sq.ft.}$$

Question 24

Equal Orifice *

If a new section requires 17,500 cfm, the water gauge is 2.8 inches, what is the size of the regulator?

$$E.O. = \frac{.0004 \times Q \text{ (new)}}{\sqrt{I}}$$

$$E.O. = \frac{.0004 \times 17,500 \text{ cfm}}{\sqrt{2.8 \text{ in.}}}$$

$$E.O. = \frac{7.0}{1.67}$$

$$E.O. = 4.19 \text{ sq.ft.}$$

Question 25

Example:

1. Calculate the volume of a rectangular sump with a length of 25 feet, a width of 10 feet and a depth of 15 feet.

$$\text{Volume} = (l) \times (w) \times (d)$$

$$\text{Volume} = 25 \text{ ft} \times 10 \text{ ft} \times 15 \text{ ft}$$

$$\text{Volume} = 3,750 \text{ cubic feet}$$



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BDMS / PSU

Question 26

Example:

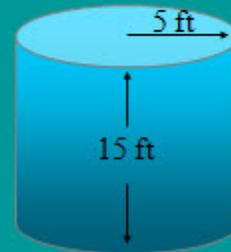
3. Calculate the volume of a cylinder with a radius of 5 feet and a depth of 15 feet.

$$\text{Volume} = \pi \times r^2 \times d_{\text{depth}}$$

$$\text{Volume} = 3.1416 \times (5 \text{ feet})^2 \times 15 \text{ feet}$$

$$\text{Volume} = 3.1416 \times 25 \text{ ft} \times 15 \text{ ft}$$

$$\text{Volume} = 1,178 \text{ cu ft}$$



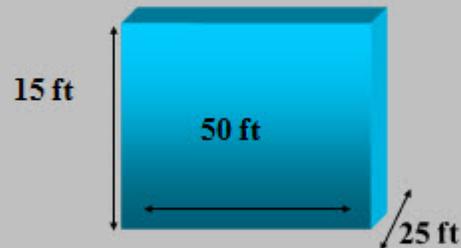
BDMS / PSU

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Question 27

Practice Exercise:

2. Calculate the volume of a rectangular sump with a length of 50 feet, a width of 25 feet and a depth of 15 feet.



Answer: 18,750 cu ft

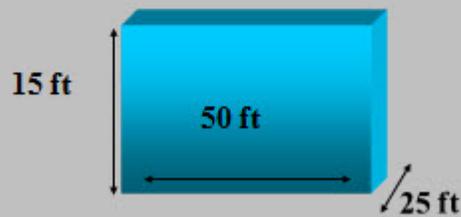
BDMS / PSU

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BDMS / PSU

Solution:

- Volume = length x width x depth
- Volume = 50 ft x 25 ft x 15 ft
- Volume = 18,750 ft³

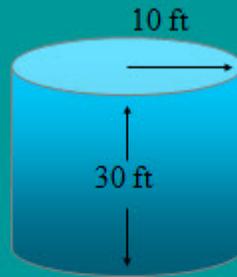


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Question 28

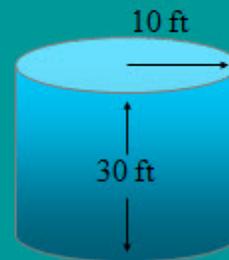
Solution:



- **Volume = $\pi \times r^2 \times d_{\text{depth}}$**
- **Volume = $\pi \times (10 \text{ ft})^2 \times 30 \text{ ft}$**
- **Volume = $3.1416 \times 100 \text{ ft}^2 \times 30 \text{ ft}$**
- **Volume = $9,424.8 \text{ cu ft}$**

Practice Exercise:

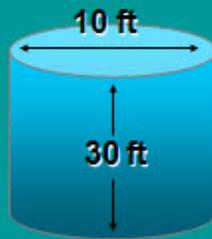
4. Calculate the volume of a cylindrical storage tank with a radius of 10 feet and a depth of 30 feet.



Answer: 9,424.8 cu ft

Practice Exercise:

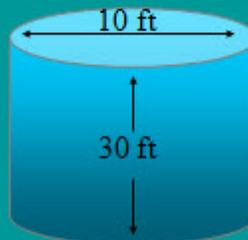
5. Calculate the volume of a cylindrical storage tank with a diameter of 10 feet and a depth of 30 feet.



Answer: 2,355 cu ft

Solution:

- Volume = $\pi \times r^2 \times d_{\text{epth}}$
- Volume = $\pi \times (5 \text{ ft})^2 \times 30 \text{ ft}$
- Volume = $3.1416 \times 25 \text{ ft}^2 \times 30 \text{ ft}$
- Volume = 2,356.2 cu ft



Question 30

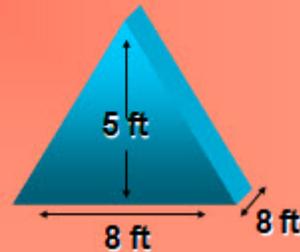
Example:

6. Calculate the volume of a triangle with a base of 8 feet, a height of 5 feet and a length of 8 feet.

$$\text{Volume} = \frac{\text{Base} \times \text{Height} \times \text{Length}}{2}$$

$$\text{Volume} = \frac{8 \text{ ft} \times 5 \text{ ft} \times 8 \text{ ft}}{2}$$

$$\text{Volume} = 160 \text{ cu ft}$$



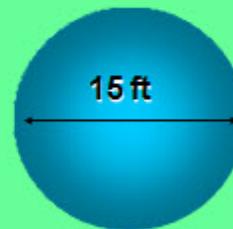
Question 31

Example:

- Calculate the volume of a sphere with a diameter of 15 feet.

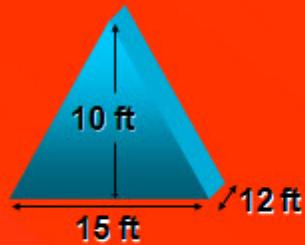
$$\text{Volume} = \frac{3.1416 \times (15 \text{ ft})^3}{6}$$

$$\text{Volume} = 1,767.15 \text{ cu ft}$$



Question 32

Practice Exercise:

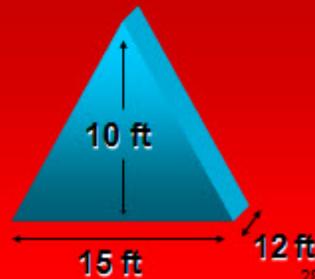


Answer: 900 cu ft

7. Calculate the volume of a triangle with a base of 15 feet, a height of 10 feet and a length of 12 feet.

Solution:

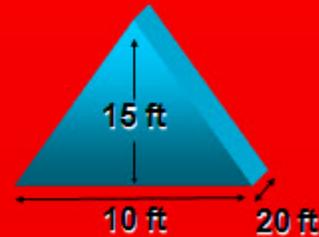
- Volume = $\frac{\text{Base} \times \text{Height} \times \text{Length}}{2}$
- Volume = $\frac{15 \text{ ft} \times 10 \text{ ft} \times 12 \text{ ft}}{2}$
- Volume = 900 ft³



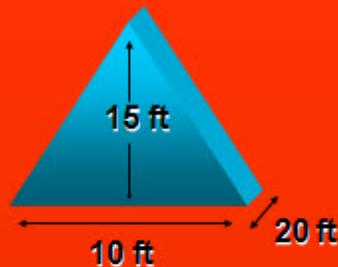
Practice Exercise:

8. Calculate the volume of a triangle with a base of 20 feet, a height of 15 feet and a length of 10 feet.

Answer: 1,500 cu ft



Solution:



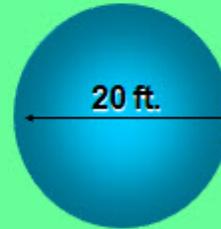
- Volume = $\frac{\text{base} \times \text{height} \times \text{length}}{2}$
- Volume = $\frac{20 \text{ ft} \times 15 \text{ ft} \times 10 \text{ ft}}{2}$
- Volume = 1,500 ft³

Question 34

Practice Exercise:

9. Calculate the volume of sphere with a diameter of 20 feet.

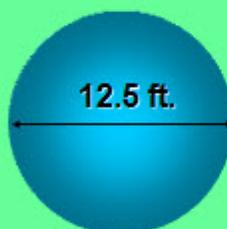
Answer: 4,187 cu ft



Question 35

Practice Exercise:

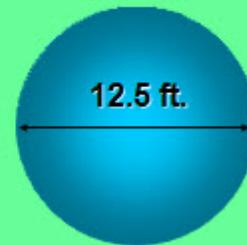
10. Calculate the volume of sphere with a diameter of 12.5 feet.



Answer: 1,022 cu ft

Solution:

- Volume = $\frac{\pi \times (\text{diameter})^3}{6}$
- Volume = $\frac{3.1416 \times (12.5 \text{ ft})^3}{6}$
- Volume = 1,022.65 ft³



Question 36

Problem 2:

- **What is the required brake horsepower to pump 150 gpm (gallons per minute) against a total dynamic head of 370 ft if the pump operates at 70 % efficiency?**

Solution Problem 2:

- $HP_B = \frac{QH (8.33)}{33,000 E}$
- $HP_B = \frac{(150\text{gpm})(370 \text{ ft})(8.33)}{(33,000)(.7)}$
- $HP_B = \frac{462315}{23100}$
- $HP_B = 20.01 \text{ hp}$