Sidney's Big Book of Water and Wastewater Math

Indigo Water Group

Unit Conversions to Know by Heart

1 inch = 2.54 centimeters
1 meter = 3.28 feet
1 mile = 5280 feet

1 acre = 43,560 ft^2
1 m^2 = 10.76 ft^2

1 gallon = 3.785 liters
1 ft^3 = 7.48 gallons
1 m^3 = 35.31 ft^3

1 ft water = 0.433 psi

1 gallon = 8.34 lbs when specific gravity is 1.0
1 kg = 2.2 lbs

1% = 10,000 mg/L
1 mg/L = 1 ppm
1 µg/L = 1 ppb

1 day = 1440 minutes
1 hp = 0.746 kW

1 gram = 15.43 grains
1 grain per gallon = 17.1 mg/L

Water Formulas

pounds per day = (concentration in mg/L)*(flow rate in mgd)*(8.34)

chlorine dose = demand + residual

$$\text{velocity} = \frac{\text{flow}}{\text{area}} \qquad V = \frac{Q}{A}$$

$$\text{flow rate} = \frac{\text{volume}}{\text{time}} \qquad Q = \frac{V}{t}$$

$$\text{overflow rate} = \frac{\text{flow rate}}{\text{area}}$$

$$\text{weir loading rate} = \frac{\text{flow rate}}{\text{feet of weir}}$$

(concentration 1)*(volume 1) = (concentration 2)*(volume 2) $\qquad C_1V_1 = C_2V_2$

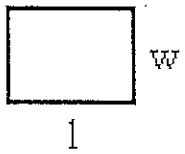
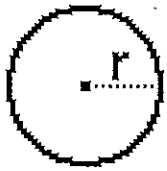
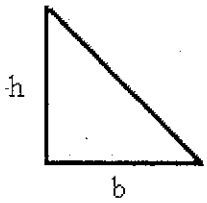
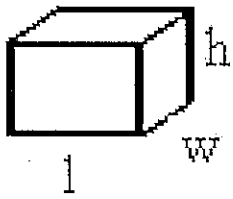
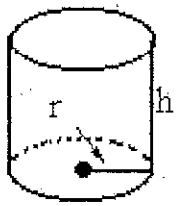
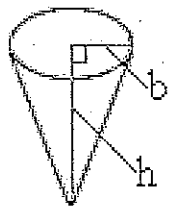
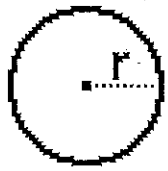
(conc. 1)*(volume 1) + (conc. 2)*(volume 2) = (conc. 3)*(volume 3)

$$C_1V_1 + C_2V_2 = C_3V_3$$

$$\text{horsepower} = \frac{(\text{flow in gpm})*(\text{lift in feet})}{3960}$$

Geometry
(volumes and areas)

Useful Geometric Formulas

	Area = (Length)*(Width) *Applies to squares and rectangles
	Area = $\Pi * r^2$ Area = $\Pi * r * r$ * The radius, r, is equal to one-half the diameter
	Area = $\frac{(\text{Base})*(\text{Height})}{2}$
	Volume = (Length)*(Width)*(Height)
	Volume = $\Pi * r^2 * h$ Volume = $\Pi * r * r * h$
	Volume = $\frac{\Pi * r^2 * h}{3}$
	Perimeter = (2)*(Π)*(r) Or Perimeter = (Π)*(d) where d = diameter

TANK GEOMETRIES

1. The formula for calculating the volume of a wet well is:
   a) V = L * W * C
   b) V = W * A * P
   c) V = W * L * H
   d) V = W * H * D

2. The diameter of a wet well is 10 ft. If filled to a depth of 10 ft. It will contain approximately:
   a) 2987 gal.
   b) 5872 gal.
   c) 6024 gal.
   d) 10,602 gal.

3. Find how many gallons of liquid are in a tank which measures 40' long, 25' wide and 12' high.
   a) 89760
   b) 79872
   c) 67859
   d) 90272

4. A cylindrical tank is 10 ft in diameter and 20 ft in height. What is the approximate capacity in liters?
   a) 44,450 liters
   b) 31,030 liters
   c) 5,942 liters
   d) 4,445 liters

5. Approximately how many gallons would 600 ft of 6" pipe hold?
   a) 740
   b) 880
   c) 900
   d) 930

6. What is the volume of water (in gallons) in an upright 25 foot diameter cylindrical tank with a water depth of 22 feet?
   a) 10,794
   b) 13,750
   c) 80,737
   d) 90,022
   e) 102,850

7. A plant has a 90-ft diameter sludge tank with a sidewall depth of 20 ft. The tank also has a conical bottom that is 8 ft deep. The tank has a sludge liquid level of 15 ft (sidewater depth). How many gallons of sludge liquid are in the tank?

a) 586,593
b) 713,424
c) 840,255
d) 1,093,936

?Operations Forum December 1998

JOB TANK GEOMETRIES JOB NO. 26

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SUBJECT _____

2. $V = \pi r^2 h$

$V = (3.14)(5\text{ ft})(5\text{ ft})(10\text{ ft})$

$V = 785\text{ ft}^3$

r = radius or $\frac{1}{2}$ the diameter

h = height of tank or water depth

now convert to gallons

$$785\text{ ft}^3 \left| \frac{7.48\text{ gallons}}{1\text{ ft}^3} \right| = 5872\text{ gallons}$$

3. V = length * width * height

$V = (40\text{ ft})(25\text{ ft})(12\text{ ft})$

$V = 12{,}000\text{ ft}^3$

$$12{,}000\text{ ft}^3 \left| \frac{7.48\text{ gal}}{1\text{ ft}^3} \right| = 89760\text{ gallons}$$

4. $V = \pi r^2 h$

$V = (3.14)(5\text{ ft})(5\text{ ft})(20\text{ ft})$

$V = 1570\text{ ft}^3$

$$1570\text{ ft}^3 \left| \frac{7.48\text{ gal}}{1\text{ ft}^3} \right| \left| \frac{3.785\text{ Liters}}{1\text{ gal}} \right| = 44{,}450\text{ Liters}$$

5. A pipe is just a tank on its side. First convert all of the dimensions to feet.

diameter = 6" = 0.5 ft

$V = \pi r^2 h$

$V = (3.14)(0.25\text{ ft})(0.25\text{ ft})(600\text{ ft})$

$V = 117.75\text{ ft}^3$

$$117.75\text{ ft}^3 \left| \frac{7.48\text{ gal}}{1\text{ ft}^3} \right| = 880.77\text{ gallons}$$

JOB TANK GEOMETRIES JOB NO. 27

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

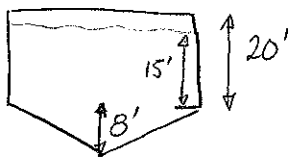
SUBJECT _____

6. $V = \pi r^2 h$

$V = (3.14 \times 12.5\ ft \times 12.5\ ft \times 22\ ft)$

$V = 10793.75\ ft^3$

$10793.75\ ft^3 \left| \frac{7.48\ gal}{1\ ft^3} \right| = 80737$ gallons

7. 

Step 1: find the volume of the top part of the tank

$V = \pi r^2 d$

$V = (3.14 \times 45\ ft \times 45\ ft \times 15\ ft)$

$V = 95377.5\ ft^3$

Step 2: find the volume of the cone

$V = \frac{1}{3} \pi r^2 d$

$V = (\frac{1}{3} \times 3.14 \times 45\ ft \times 45\ ft \times 8\ ft)$

$V = 16956\ ft^3$

Step 3: add the volumes and convert to gallons

$$\begin{array}{r} 95377.5\ ft^3 \\ +\ 16956\ ft^3 \\ \hline 112333.5\ ft^3 \end{array}$$

$112333.5\ ft^3 \left| \frac{7.48\ gal}{1\ ft^3} \right| = 840{,}255$ gallons

Geometry

1. A clearwell is 50 feet long by 8 feet wide by 10 feet deep. What is the volume of the clearwell in cubic feet?

Answer: cft

2. A sedimentation basin has a surface area of 625 sft. If the basin can hold a maximum of 6250 cubic feet of water, how deep is the basin?

Answer: ft

3. A water storage tank currenty holds 323136 gallons. If the water depth in the tank is 12 feet, what is the area of the tank is square feet?

Answer: ft

4. A clearwell is 30 feet long by 30 feet wide by 20 feet deep. What is the volume of the clearwell in gallons?

Answer: gallons

5. The distribution system has 3 storage tanks. Each tank is 25 feet long by 15 feet long by 12 feet deep. What is the maximum storage volume of the distribution system in gallons?

Answer: gallons

6. A sedimentation basin is 25 feet long by 15 feet wide by 12 feet deep. Find the perimeter of the basin in feet.

Answer: feet

7. The inside walls and bottom of a concrete tank must be painted. The floor of the tank is 25 feet long by 15 feet wide. If the tank is 12 feet deep, how many square feet of area require painting?

Answer: square feet

8. Find the volume of a pipe that is 2 feet in diameter and 300 feet long.

Answer: cft

9. A water tank currently holds 528730 gallons. If the tank is filled to a depth of 25 feet, what is the diameter of the tank?

Answer: feet

10. Find the length of 12-inch pipe required to hold 146.8 gallons.

Answer: feet

11. A round storage tank has a surface area of 78.54 square feet. The tank holds 1963.5 cubic feet of water. What is the diameter of the tank?

Answer: feet

12. The distribution system contains 2 large mains. Each main is 300 feet long and 15 inches in diameter. How much water can both mains hold? Express your answer in gallons.

Answer: gallons

13. Find the perimeter of a round sedimendation basin if the diameter is 20 feet.

Answer: feet

14. A tank must be painted on all of the inside surfaces. The tank is round with an open top. If the tank has a 10 foot radius, find the area to be painted in square feet. The tank is 15 ft deep.

Answer square feet

15. A 10 foot diameter tank has a conical bottom. The sidewater depth (top of cone to water surface level) is 15 feet. The cone is 8 feet deep at its deepest point. What is the volume of the cone in cubic feet?

Answer: cft

16. A 24 foot diameter tank has a conical bottom. The sidewater depth (top of cone to water surface level) is 20 feet. The cone is 6 feet deep at its deepest point. How many gallons of water are in the tank?

Answer: gallons

17. A round tank with a conical bottom holds293739 gallons. If the cone is 6 feet deep at its deepest point and the diameter of the tank is 50 feet, what is the depth of the main part of the tank?

Answer: feet

JOB _____ JOB NO. _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SUBJECT _____

1. $V = l \cdot w \cdot h$
$V = (50' \times 8' \times 10')$
$V = 4{,}000$ cf

2. $V = l \cdot w \cdot h$
$V = \text{Area} \cdot h$
$\frac{6250 \text{ cf}}{625} = \frac{625 \text{ sf} \cdot h}{625}$
$10 \text{ ft} = h$

3. Volume must be converted

$323{,}136 \text{ gallons} \left| \frac{1 \text{ cf}}{7.48 \text{ gal}} \right| = 43{,}200 \text{ cf}$

$\text{Volume} = \text{Area} \cdot h$
$\frac{43{,}200 \text{ cf}}{12} = \frac{\text{Area} \times 12 \text{ ft}}{12}$
$3600 \text{ sf} = \text{Area}$

4. $V = l \cdot w \cdot h$
$V = (30' \times 30' \times 20')$
$V = 18{,}000$ cf

$18{,}000 \text{ cf} \left| \frac{7.48 \text{ gal}}{1 \text{ cf}} \right| = 134{,}640 \text{ gal}$

5. $V = l \cdot w \cdot h$
$V = (25' \times 15' \times 12')$
$V = 4{,}500$ cf per tank

$\frac{4{,}500 \text{ cf}}{\text{tank}} \left| \frac{3 \text{ tanks}}{\text{system}} \right| \left| \frac{7.48 \text{ gal}}{1 \text{ cf}} \right| = 109{,}980 \frac{\text{gal}}{\text{system}}$

6. $\text{Perimeter} = 2l + 2w$
$P = (2 \times 25) + (2 \times 15)$
$P = 50 + 30$
$P = 80$ ft

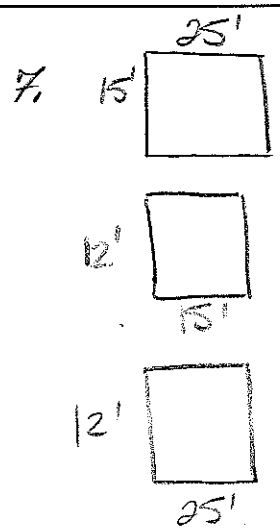
JOB _____ JOB NO. _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SUBJECT _____

7. 

$A = l \cdot w$
$A = 25 \times 15$
$A = 375 sf$

$A = l \cdot w \cdot 2$
$A = (15 X 12 X 2)$
$A = 360 sf$

$A = l \cdot w \cdot 2$
$A = (25 X 12 X 2)$
$A = 600$

TOTAL AREA = 375 + 360 + 600
= 1,335 sf

8. Volume = $\pi r^2 h$
$V = (\pi X 1' X 1' X 300')$
$V = 942.45 cf$

if diameter = 2 ft
then radius = 1 ft

9. $528730 \text{ gallons} \left| \frac{1 cf}{7.48 gal} \right| = 70,685.8 cf$

$V = \pi r^2 h$

$\frac{70,685.8 cf}{25} = \frac{\pi r^2 (25 ft)}{25}$

$\frac{2827.43}{\pi} = \frac{\pi r^2}{\pi}$

$899.99 = r^2$ take the square root of both sides

$30 = r$

The diameter = $2 \times r = 60$ ft

JOB _____ JOB NO. _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SUBJECT _____

10. 12 inches = 1ft diameter = 0.5 ft radius

$$146.8 \text{ gallons} \left| \frac{1 \text{ cf}}{7.48 \text{ gal}} \right| = 19.62 \text{ cf}$$

$V = \pi r^2 h$

$19.62 \text{ cf} = (\pi)(0.5 \text{ ft})(0.5 \text{ ft}) h$

$$\frac{19.62}{(\pi)(0.5)(0.5)} = h$$

$25 \text{ ft} = h$

11. $A = \pi r^2$

$$\frac{78.54}{\pi} = \frac{\pi r^2}{\pi}$$

$25 = r^2$

$5 = r$ diameter = 10 ft

12. $15 \text{ inches} \left| \frac{1 \text{ ft}}{12 \text{ inches}} \right| = 1.25 \text{ ft diameter} \div 2 = 0.625 \text{ ft radius}$

$V_{main} = \pi r^2 h$

$V = (\pi)(0.625 \text{ ft})^2 (300 \text{ ft})$

$V = 368.16 \text{ cf/main}$

$$\frac{368.16 \text{ cf}}{\text{main}} \left| \frac{2 \text{ mains}}{\text{system}} \right| \left| \frac{7.48 \text{ gal}}{1 \text{ cf}} \right| = 5,507.6 \text{ gallons}$$

JOB _____ JOB NO. _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

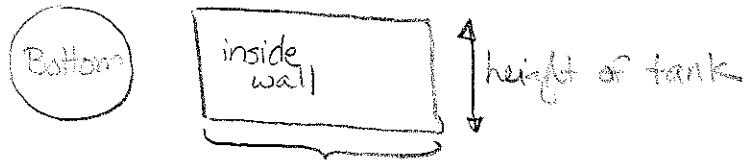
SUBJECT _____

13. Perimeter = πd

$P = (3.1416)(20\ ft)$

$P = 62.8\ ft$

14. TANK HAS 2 AREAS



this length is the perimeter of the circle

$A = \pi r^2$

$A = (3.1416)(5\ ft)^2$

$A = 78.54\ ft^2$

$A = Perimeter \times height$

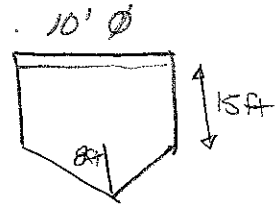
$A = \pi d \times h$

$A = (3.1416)(10\ ft)(15\ ft)$

$A = 471.24\ sf$

TOTAL AREA TO PAINT = $78.54\ sf + 471.24\ sf = 549.78\ sf$

15.



$Volume_{TOP} = \pi r^2 h$

$= (3.1416)(5)^2(15)$

$= 1178.1\ ft^3$

$Volume_{CONE} = \frac{1}{3}\pi r^2 h$

$= (\frac{1}{3})(3.1416)(5)^2(8)$

$= 209.44\ ft^3$

TOTAL VOLUME = $1178.1\ ft^3 + 209.44\ ft^3 = 1387.54\ ft^3$

JOB _____ JOB NO. _____

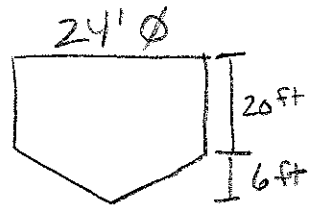
SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SUBJECT _____

16.



$V_{TOP} = \pi r^2 h$

$= (3.1416)(12\text{ ft})^2(20\text{ ft})$

$= 9{,}047.81\text{ ft}^3$

$V_{CONE} = \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}(3.1416)(12\text{ ft})^2(6\text{ ft})$

$= 904.78\text{ ft}^3$

TOTAL V = 9047.81 ft^3

904.78 ft^3

9952.59 ft^3

$9952.59\text{ ft}^3 \left| \frac{7.48\text{ gal}}{1\text{ ft}^3} \right| = 74{,}445\text{ gallons}$

17. $293739\text{ gallons} \left| \frac{1\text{ cf}}{7.48\text{ gal}} \right| = 39{,}270\text{ ft}^3$

$V_{TOTAL} = \pi r^2 h + \frac{\pi r^2 h}{3}$

$39{,}270\text{ ft}^3 = (3.1416)(25)^2 h + \frac{(3.1416)(25)^2(6')}{3}$

$39{,}270\text{ ft}^3 = 1963.5h + 3927$

$39{,}270 - 3927 = 1963.5h + 3927 - 3927$

$\frac{35343}{1963.5} = \frac{1963.5h}{1963.5}$

$18\text{ ft} = h$

Tank Geometries and Volumes

19. Find how many gallons of liquid are in a tank which measures 40' long, 25' wide and 12' high.
a) 79872
b) 67859
c) 90272
d) 89760

20. The diameter of a clear well is 10 ft. If filled to a depth of 10 ft. It will contain approximately:
a) 2987 gal.
b) 5872 gal.
c) 6024 gal.
d) 10,602 gal.

21. A cylindrical tank is 10 ft in diameter and 20 ft in height. What is the approximate capacity in liters?
a) 44,450 liters
b) 31,030 liters
c) 5,942 liters
d) 4,445 liters

22. Approximately how many gallons would 600 ft of 6" pipe hold?
a) 740
b) 880
c) 900
d) 930

23. The effluent weir of a clarifier is located along the rim of a 60-ft diameter tank. What is the approximate length of the weir?
a) 2826 feet
b) 377 feet
c) 188 feet
d) 540 feet

24. The entire surface of a free-standing cylindrical tank with an exposed, flat bottom must be painted. The tank does not have a top cover. The tank is 50 inches in diameter and 8 feet high. What is the total interior and exterior surface area to be painted?
a) 237 square feet
b) 105 square feet
c) 245 square feet
d) 118 square feet

25. What is the volume of water (in gallons) in an upright 25 foot diameter cylindrical tank with a water depth of 22 feet?

a) 10,794
b) 13,750
c) 80,737
d) 90,022
e) 102,850

26. You are going to add 6" of coal to one of the filters in your plant. The filter measures 10' x 12'. Each bag of coal contains 3 cubic feet. How many bags will you need to order?

a) 32 bags
b) 60 bags
c) 10 bags
d) 20 bags
e) 15 bags

27. Your system has just installed 2,000 feet of 8" pipe. How many gallons of water will it take to fill it?

a) 5,115
b) 521.4
c) 2,145
d) 6,971
e) 697.1

28. A plant has a 90-ft diameter storage tank with a sidewall depth of 20 ft. The tank also has a conical bottom that is 8 ft deep. The tank has a liquid level of 15 ft (sidewater depth). How many gallons of water are in the tank?

a) 586,593
b) 713,424
c) 840,255
d) 112,334

29. The flow velocity in a 6-in. diameter pipe is twice that in a 12-in diameter pipe if both are carrying 50 gal/min of wastewater.

a) True
b) False

Operations Forum January 1997

TANK GEOMETRIES

19. Volume = (length) × (width) × (height)

$V = (40') \times (25') \times (12')$

$V = 12{,}000\ ft^3$

$12{,}000\ ft^3 \left| \frac{7.48\ gallon}{1\ ft^3} \right| = 89{,}760\ gallons$

20. Volume = $\pi r^2 d$ where r = radius, d = depth

$V = (\pi)(5\ ft)^2(10\ ft)$

$V = (3.14)(5)(5)(10)$

$V = 785\ ft^3$

this is 5 ft because the radius is one-half the diameter

$785\ ft^3 \left| \frac{7.48\ gallon}{1\ ft^3} \right| = 5871.8\ gallons$

21. $V = \pi r^2 d$

$V = \pi (5\ ft)^2 (20\ ft)$

$V = (3.14)(5)(5)(20)$

$V = 1570\ ft^3$

$1570\ ft^3 \left| \frac{7.48\ gallons}{1\ ft^3} \right| \left| \frac{3.785\ L}{1\ gallon} \right| = 44{,}449.5\ LITERS$

22 Pipes are just long skinny tanks.

$V = \pi r^2 d$

$V = (3.14)(0.25')(0.25')(600')$

$V = 117.75\ ft^3$

diameter $d = 6'' = 0.5'$

radius $= 0.25'$

*always check units!

$117.75\ ft^3 \left| \frac{7.48\ gallons}{1\ ft^3} \right| = 880.8\ gallons$

23. For this problem, we need to find the perimeter or outer edge length of a circular tank.

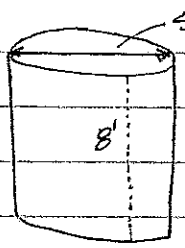
$P = \pi d$ where d = diameter

$P = (\pi)(60\ ft)$

$P = (3.14)(60\ ft)$

$P = 188.4\ ft$

24.



To solve this problem, we need to find the area of the tank bottom and the area of the side of the tank.

Area of bottom $= \pi r^2$

$= (\pi)(50"/2)^2$

I don't like to work in square inches, so let's convert the 50 inch diameter into feet.

$50\ inches \left| \frac{1\ foot}{12\ inches} \right| = 4.17\ feet$ ∴ radius = 2.085 ft

Area of bottom $= (\pi)(2.08\ ft)^2$

$= (3.14)(2.08\ ft)(2.08\ ft)$

$= 13.65\ ft^2$

The side of the tank is a rectangle that has been curled up.
The length of the rectangle is equal to the perimeter of the tank bottom.

$$\text{Area} = (\text{length}) \times (\text{width})$$
$$\text{Area} = (\pi d) \times (\text{width})$$
$$\text{Area} = (3.14)(4.17 \text{ ft})(8 \text{ ft})$$
$$\text{Area} = 104.75 \text{ ft}^2$$

We need to paint the tank bottom (both sides) and the walls of the tank (both sides.)

$$\begin{array}{r} 13.65 \text{ ft}^2 \\ 13.65 \text{ ft}^2 \\ 104.75 \text{ ft}^2 \\ + \quad 104.75 \text{ ft}^2 \\ \hline 236.8 \text{ ft}^2 \end{array}$$

25. $\text{Volume} = \pi r^2 d$ where r = radius, d = depth

$$V = \pi (12.5 \text{ ft})^2 (22 \text{ ft})$$
$$V = (3.14)(12.5)(12.5)(22)$$
$$V = 10793.75 \text{ ft}^3$$

$$10793.75 \text{ ft}^3 \left| \frac{7.48 \text{ gallons}}{1 \text{ ft}^3} \right| = 80737 \text{ gallons}$$

26. First, determine the volume you need to fill in ft^3

Volume = (length)(width)(height)

$V = (10\ ft)(12\ ft)(6\ inches)$

↙ convert to feet

$V = (10ft)(12ft)(0.5\ ft)$

$V = 60\ ft^3$

Then convert to bags

$$60\ ft^3 \left| \frac{1\ bag}{3\ ft^3} \right| = 20\ bags$$

27. First, convert 8" to feet

$$8\ inches \left| \frac{1\ ft}{12\ inches} \right| = 0.67\ ft$$ so radius is 0.34 ft

Volume = $\pi r^2 d$ d = depth, or in this case, length of pipe

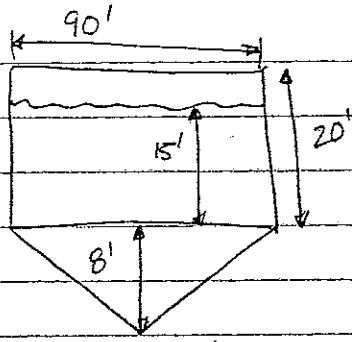
$V = \pi(0.34\ ft)^2(2000\ ft)$

$V = (3.14)(0.34ft)(0.34ft)(2000\ ft)$

$V = 725.97\ ft^3$

$$725.97\ ft^3 \left| \frac{7.48\ gallons}{1\ ft^3} \right| = 5430\ gallons$$

28.



We need to find the volume of the cylinder and the volume of the cone.

cylinder + cone

$V = \pi r^2 d + \frac{1}{3}\pi r^2 d$

$V = (\pi)(45')^2(15') + (\frac{1}{3})(\pi)(45')^2(8')$

$V = (3.14)(45')(45')(15') + (\frac{1}{3})(3.14)(45')(45')(8')$

$V = 95377.5\ ft^3 + 16956\ ft^3$

$V = 112333.5\ ft^3$

$112333.5\ ft^3 \left| \frac{7.48 \text{ gallons}}{1\ ft^3} \right| = 840255 \text{ gallons}$

29. $\text{Velocity} = \frac{\text{flow}}{\text{area}}$

Since the areas will be in ft^2, let's begin by converting the flow rate from gpm to ft^3/min.

$$\frac{50 \text{ gallons}}{\text{min}} \left| \frac{1 \text{ ft}^3}{7.48 \text{ gallons}} \right| = 6.68 \frac{\text{ft}^3}{\text{min}}$$

Next, let's find the radius of each pipe in feet

$$6 \text{ inches} \left| \frac{1 \text{ ft}}{12 \text{ inches}} \right| = 0.5 \text{ ft}, \quad \text{radius} = 0.25 \text{ ft}$$

$$12 \text{ inches} \left| \frac{1 \text{ ft}}{12 \text{ inches}} \right| = 1.0 \text{ ft}, \quad \text{radius} = 0.5 \text{ ft}$$

6" Pipe

$\text{Velocity} = \frac{\text{flow}}{\text{area}}$

$V = \frac{6.68 \text{ ft}^3/\text{min}}{\pi r^2}$

$V = \frac{6.68 \text{ ft}^3/\text{min}}{(3.14)(0.25')(0.25')}$

$\text{Velocity} = 34.0 \text{ ft/min}$

12" Pipe

$\text{Velocity} = \frac{\text{flow}}{\text{area}}$

$V = \frac{6.68 \text{ ft}^3/\text{min}}{\pi r^2}$

$V = \frac{6.68 \text{ ft}^3/\text{min}}{(3.14)(0.5')(0.5')}$

$\text{Velocity} = 8.5 \text{ ft/min}$

four times slower

False