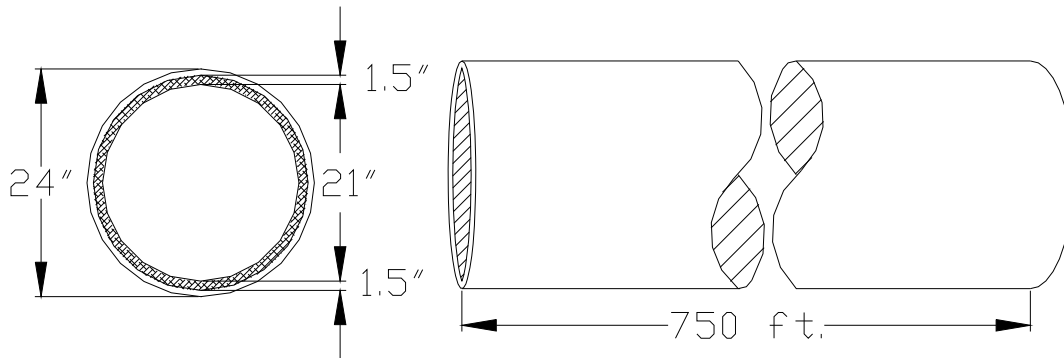


22) The interior of 750 ft of 24 in. pipe is uniformly coated with 1.5 inches of grease. How many gallons will this pipe hold when filled with water?

Formula(s) needed: $1\text{ft}^3 = 7.48\text{ gal.}$, $\text{Area} = D^2 \times .785$



1) A 24" diameter pipe – 1.5" of grease all the way around leaves an inside diameter of 21 inches or 1.75 ft. ($21" \div 12\text{in./ft.} = 1.75"$)

2) Using the formula; $\text{Area} = D^2 \times .785$, calculate the area of the pipe. Then multiply time the pipe length to find the volume in ft^3 .

$$\text{Area} = D^2 \times .785$$

$$\text{Area} = 1.75\text{ ft.} \times 1.75\text{ ft.} \times .785$$

$$\text{Area} = 2.4\text{ ft}^2$$

$$2.4\text{ ft}^2 \times 750\text{ ft.} = 1,803\text{ ft}^3$$

3) Convert cubic feet to gallons. ($1\text{ft}^3 = 7.48\text{ gal.}$)

$$1,803\text{ ft}^3 \times 7.48\text{ gal./ft}^3 = 13,487\text{ gallons}$$

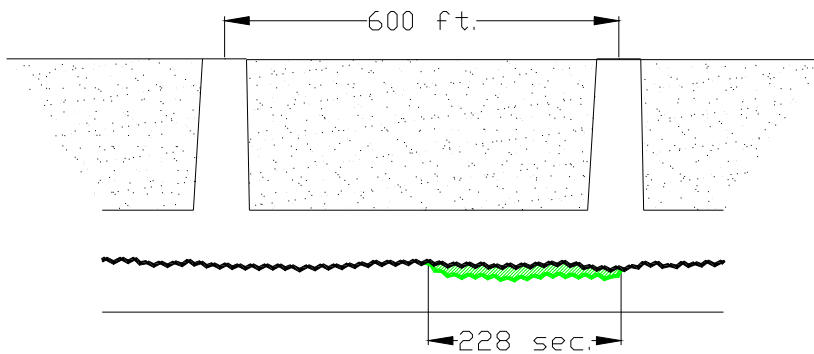
a) 13,487 gal.

23) **Simplify & re-write the question:**

Colored dye is dumped into a manhole. The dye first appears ~~3 minutes and 18 seconds~~ (198 seconds) later in a manhole 600 feet downstream and disappears ~~4 minutes and 19 seconds~~ (259 seconds) after the dye was first dumped into the manhole. What is the velocity (FPS) of flow in the sewer?

Formula(s) needed: $velocity = \frac{Distance}{time}$

1) To find the midpoint of when the dye was first seen and when it disappears, average the two times. $\frac{198 \text{ sec.} + 259 \text{ sec.}}{2} = 228.5 \text{ sec.}$

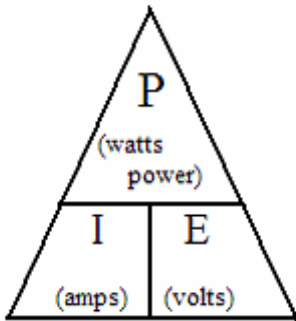
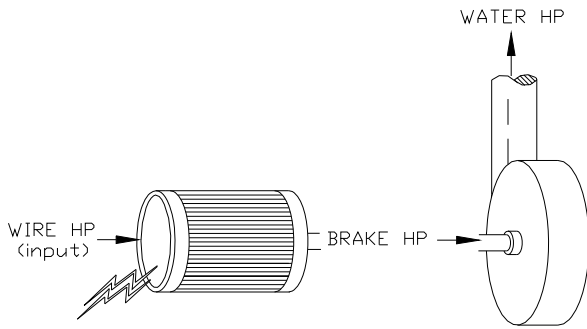


2) Using the formula, $velocity = \frac{Distance}{time}$ calculate the velocity.

$$Velocity = \frac{600 \text{ feet}}{228.5 \text{ sec}} = 2.63 \text{ ft./sec.}$$

b) 2.63 FPS

PUMP FORMULAS & DEFINITIONS

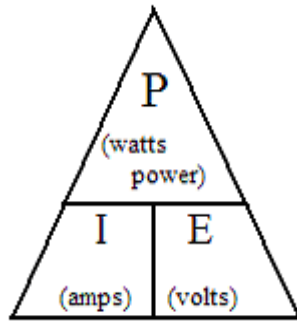


$$P \text{ (watts)} = I \text{ (amps)} \times E \text{ (volts)}$$

$$1 \text{ HP} = 746 \text{ watts}$$

$$\frac{33,000 \text{ ft. lbs.}}{8.34 \text{ lbs/gal}} = 3960$$

$$\text{HP Watts} = 746 \times \text{HPwatts}$$



$$P \text{ (watts)} = I \text{ (amps)} \times E \text{ (volts)}$$

$$1 \text{ HP} = 746 \text{ watts}$$

WATER HP = (output hp)

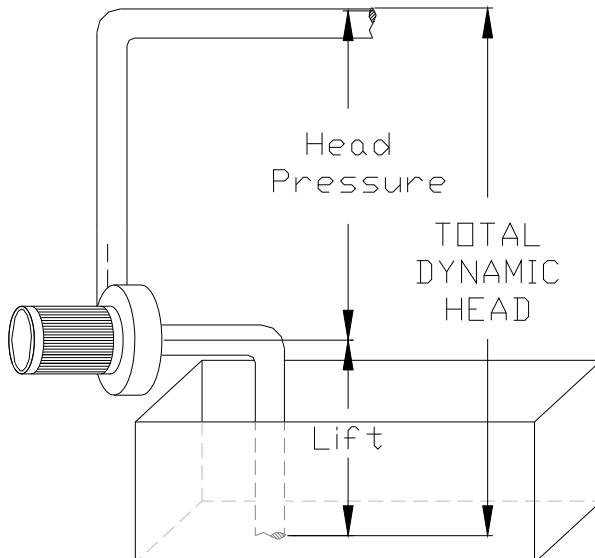
$$\text{WATER HP} = \frac{\text{FLOW (GPM)} \times \text{TDH (ft.)} \times \text{Specific Gravity(S.G.)}}{3960}$$

3960

1 HP = 33,000 ft. lbs.



TDH (total dynamic head) =
Suction head (lift) + head pressure



ANSWERS TO PUMP QUESTIONS

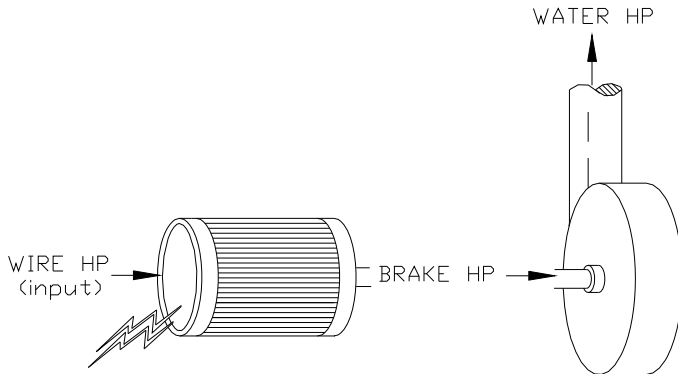
(not needed)

24) If a pump discharges 8.2 MGD and the force main is 2,200 feet long, what is the total head loss assuming friction loss is .27 feet per 100 feet of pipe?

- 1) For every 100 ft. of pipe, add .27 ft. of pipe loss.
2,200 ft. of pipe x .27 ft./ft. = 6 ft.
- 2) Add that to the total pipe length.
2,206 ft. of pipe loss
b) 2,206 feet

25) The power factor of a motor is .82 and the pump has an efficiency of 79%. If the motor consumes 12,000 watts, what is the water horsepower?

Formulas needed: WATTS = 746 x HP



- 1) Convert watts to HP.
 $\frac{12,000 \text{ watts}}{746 \text{ watts/HP}} = 16.08 \text{ HP Wire HP}$
- 2) Factor in losses.
(79%)
 $16.08 \text{ HP} \times .79 \times .82 \text{ PF} = 10.4 \text{ HP}$

d) 10.4 HP

26) An electric motor is supplied by 480 volts and 32 amps, given no loss, what horsepower can the motor supply to the water?

Formulas needed: Power (Watts) = Amps x Volts, WATTS = 746 x HP

- 1) Use the formula $Watts = Amps \times Volts$ to find watts.
Watts = Amps x Volts
Watts = 32 amps x 480v
Watts = 15,360w

- 2) Convert watts to HP.
 $\frac{15,360w}{746 \text{ watts/HP}} = 20.6 \text{ HP Wire HP}$

c) 20.6 HP

50)) **If a repair job can be done by 3 people in 19 hours, how long would it take 7 people to do a similar job?**

- a) 6 hours, 20 min.
- b) 44 hours, 20 min.
- c) 13 hours, 18 min.
- d) 8 hours, 9 min.

51) **A trench of 8' wide x 11' deep x 1725' long. A 27" sanitary sewer is going to be installed in this trench. 18 inches must be left out at the top for concrete. How much backfill will be required to fill the trench?**

- a) 4,602 YDS³
- b) 13,805 YDS³
- c) 5,109 YDS³
- d) 4,095 YDS³

52) **How many tons of backfill would there be in problem 51 if each the backfill material was 3,500 lbs./yd³?**

- a) 8,053 tons
- b) 16,106 tons
- c) 24,159 tons
- d) 1,521 tons

53) **If a dump truck could carry 15 tons each, how many truck loads would be needed in problem 51?**

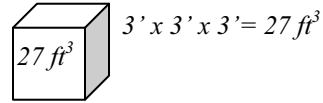
- a) 536 TRUCKS
- b) 1,074 TRUCKS
- c) 537 TRUCKS
- d) 101 TRUCKS

54) **A 5 foot wide 1,882 foot trench must be excavated and the spoil removed from The premises. The spoil weight is 2,900 LB/yd³ and each truck can carry 12 tons. How many truck loads are required if the trench is 16 feet deep?**

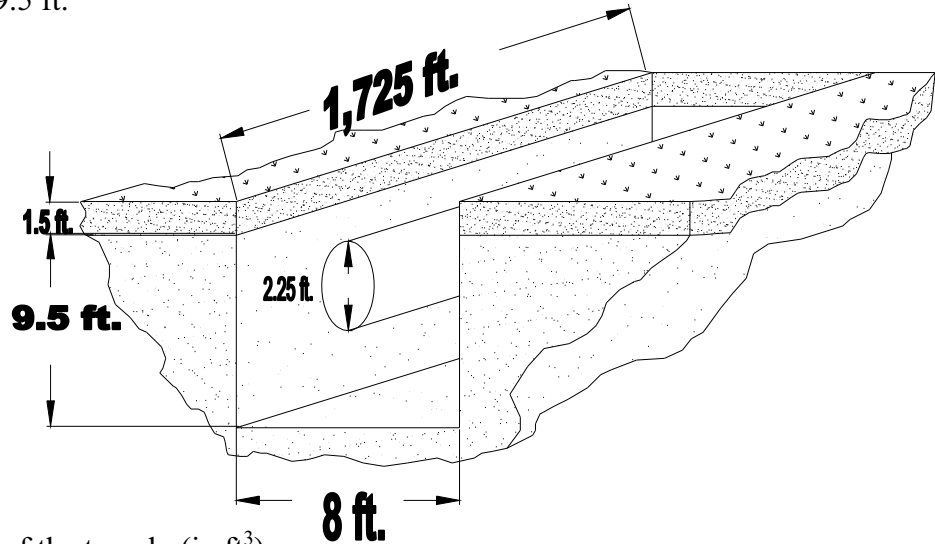
- a) 726 TRUCKS
- b) 674 TRUCKS
- c) 2,021 TRUCKS
- d) 673 TRUCKS

51) A trench of 8' wide x 11' deep x 1,725' long. A 27" (2.25 ft.) sanitary sewer is going to be installed in this trench. 18" (1.5 ft.) inches must be left out at the top for concrete. How much backfill will be required to fill the trench?

Formula(s) needed, Area of circle = $D^2 \times .785$, $1 \text{ yd}^3 = 27 \text{ ft}^3$



- 1) Subtract concrete thickness from depth.
 $11 \text{ ft.} - 1.5 \text{ ft.} = 9.5 \text{ ft.}$



- 2) Calculate the volume of the trench. (in ft^3)

$$8 \text{ ft.} \times 9.5 \text{ ft.} \times 1,725 \text{ ft.} = 131,100 \text{ ft}^3$$

- 3) Calculate the area of the pipe. Then multiply x the length to get volume. (in ft^3)

$$\begin{aligned} \text{Area} &= D^2 \times .785 \\ \text{Area} &= 2.25 \text{ ft.} \times 2.25 \text{ ft.} \times .785 = 4 \text{ ft}^2 \\ 4 \text{ ft}^2 \times 1,725 \text{ Ft} &= 6,855 \text{ ft}^3 \end{aligned}$$

- 4) Subtract the volume of the pipe from the volume of the trench to find the volume of backfill in ft^3 .

$$131,100 \text{ ft}^3 - 6,855 \text{ ft}^3 = 124,244 \text{ ft}^3$$

- 5) Convert cubic feet to cubic yards (yd^3).

$$\frac{124,244 \text{ ft}^3}{27 \text{ ft.}/\text{yd}^3} = 4,602.65 \text{ yd}^3$$

a) 4,602 yd^3

T28) Which of these chemicals may be used for odor control in sewers?

- A) Chlorine
- B) Muriatic acid
- C) Potassium chloride
- D) Sodium chloride

T29) Sources of excessively clear water in a collection system include

- A) A problem at the wastewater treatment plant
- B) A sanitary sewer leak
- C) Exfiltration from a high water table
- D) Infiltration from a high water table

T30) What information would you consider while clearing a stoppage in a sewer?

- A) Nothing-start adding pressurized water to clear the stoppage
- B) Cause of stoppage
- C) Time of day
- D) Staffing requirements

T31) With the completion of a sewer cleaning job, which one of the following must be done at the manhole?

- A) Complete and sign timesheets
- B) Wash down the truck
- C) Wash down street around work area, making sure the wash water is broomed into the M.H.
- D) None of the above

T32) Lift station failures include _____ failure.

- A) dip tube
- B) electrical system
- C) inverted siphon
- D) All of the above

T33) A kilowatt (KW) is equivalent to

- A) .67 amperes at a voltage of 120
- B) 746 watts
- C) 1.34 horsepower
- D) 1,000 megacycles

T34) Infiltration may result from

- A) Bad joints
- B) Improper closed circuit television operation
- C) Poor ventilation
- D) Direct downspout and drain connections