1) A pump is delivering less than the expected rate of discharge. What can cause this to happen?

		A) Discharge head too low
Right	X	B) Discharge head too high
		C) Check valve open
		D) Pump is primed

2) A map with a scale of 0.875 in.= 100 feet indicates that manhol"A" is 11.20 in. from manhole "B" What is the actual distance between manholes?

	a)	980.0 ft.
	b)	781.3 ft.
X	c)	1,280.0 ft. **Right**
	d)	2,343.8 ft.

$$\frac{\text{Scale factor x Measurement}}{\text{Scale}} \text{ '= Actual Diatance}$$

$$\frac{11.20 \text{ in. x } 100 \text{ ft.}}{0.875 \text{ in.}} = \mathbf{1{,}280.0 \text{ feet,}}$$

= "c"

3) If a repair job can be done by 7 people in 8.5 hours, how long will it take for 4 people to do a similar job?

	a)	4 Hours, 30 min.
	b)	14 Hours, 9 min.
	c)	4 Hours, 51 min.
X	d)	14 Hours, 53 min. **Right**

1) Set up the problem;

If a repair job can be done by 7 people in 8.5 hours,

then it would take 4 people, $\frac{7}{4}$ of the time.

So, 8.5 hrs. x $\frac{7}{4}$ = 14.9 hrs.

2) Convert Decimal Hours to Hours, Minutes;

14.9 hrs. = 14 hrs. + (.88 hrs. x 60 sec./hr.) = 52.5 min.

= **14 hrs., 52.5 min. = "D"**

4) In sewer maintenance, what is a pig?

Right	X	A) A bullet shaped object passed through a force main
		B) A power rod
		C) Any foul smelling equipment
		D) The hydraulic rodding truck

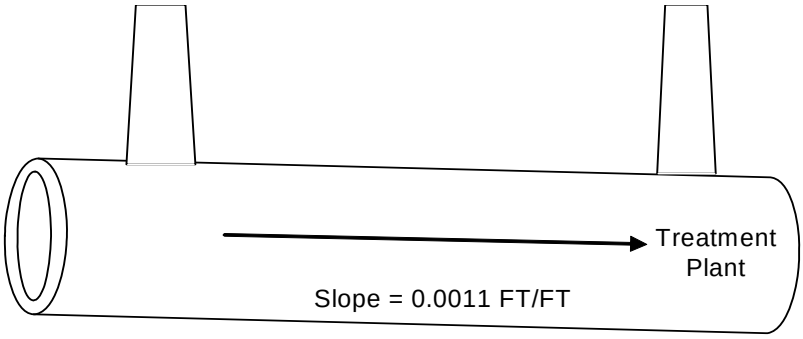
RISE = 1.38 ft.

3) Add or Subtract the 'rise'
to get the other Elevation;

The manhole farthest is at 665.3 ft.
So, the other manhole must be LOWER.

You SUBTRACT the 'rise' from 665.3 ft.

665.30 ft.
- 1.38 ft.
663.92 ft. = "B"



665.3 ft.
(Higher Elevation)
upstream

(Lower Elevation)
downstream

6) Mechanical ventilation of a lift station is required to

Right [X] A) Ensure safe working access
[ ] B) Reducing chlorine demand
[ ] C) Reduce corrosion
[ ] D) Increase dissolved oxygen (DO) in raw wastewater

7) If a pump outputs 625 GPM against a total dynamic head of 211 feet, and the pump is 71% efficient, what is the brake HP if the fluid being pumped has a specific gravity of 1.12?

[ ] a) 26.5 HP
[ ] b) 32.3 HP
[ ] c) 4.2 HP
[X] d) 41.8 HP **Right**

$$WHP = \frac{GPM \times TDH}{3960 \times S.G.}$$

$$= \frac{625\ GPM \times 211.0\ ft.\ TDH}{3960 \times 1.12\ (S.G.)}$$

$$= 14.3\ (output\ HP)$$

$$\frac{14.3\ (output\ HP)}{71\%} = 41.8\ HP$$

= "D"

8) A sewer jet with a 1475 gallon tank has a 80 Gal./Min. pump. If the operator has to fill the truck 5 times in an 8 hour day, how much time is spent actually cleaning sewers during that day?

[ ]	a)	11	Hrs.	31	Min.	
[ ]	b)	3	Hrs.	50	Min.	
[X]	c)	1	Hrs.	32	Min.	**RIGHT!**
[ ]	d)	2	Hrs.	28	Min.	

1) Calculate the total water used:

1475 gal. x 5 fill-ups = 7,375 gallons

2) Divide by gal./Min. Pump rate:

$$\frac{7{,}375 \text{ gal.}}{80 \text{ gal./min.}} = 92.2 \text{ Min.}$$

3) Convert minutes to hours:

$$\frac{92.2 \text{ Min.}}{60 \text{ min/Hr.}} = 1.54 \text{ hrs.}$$

4) Convert Hrs. to hrs. & Min.

Separate the decimal hours & convert to minutes

$$1.54 \text{ hrs.} - 1.00 \text{ hrs.} = 0.54 \text{ hrs.} \times 60 \text{ min./hr} = 32.2 \text{ Min.}$$

= 1 hrs., 32 Min.

= "C"

9) The following flows were recorded for the months of February, March, and April, …

February, 197.3 cu. ft./sec. March, 100,186.2 Gal./Min. April, 255.7 MGD

What was the average daily flow for this three-month period?

X	a) 5.9 MGD	**Right!**
	b) 527.2 MGD	
	c) 127.3 MGD	
	d) 4.7 MGD	

1) Convert all units to MGD (or any of the same units), then total the flows:

February, $= \frac{197.3 \text{ cu. ft./sec.}}{1.55 \text{ MGD per ft}^3\text{/sec.}} = 127.3 \text{ MGD}$

March, $= \frac{100{,}186.2 \text{ Gal./Min.} \times 60 \text{ min./hr.} \times 24 \text{ hrs./day}}{1{,}000{,}000}$

$= 144.3 \text{ MGD}$

April, = 255.7 MGD

total the flows

February,	127.3 MGD
March,	144.3 MGD
April,	+ 255.7 MGD
	527.2 MGD

Month	Days
January,	31
February,	28
March,	31
April,	30
May,	31
June,	30
July,	31
August,	31
September	30
October,	31
November,	30
December,	31

2) Calculate the number of days & divide it into the total flow:

February,	=	28 Days
March,	=	31 Days
April,	=	30 Days
		89 Days

Average flow $= \frac{527.2 \text{ MGD}}{89 \text{ Days}}$ **= 5.9 MGD**

= "A"

10) A contractor is building a house with a basement elevation of 884.6 ft. The stub-out connection elevation is 876.5 ft. If the minimum alowable slope is 3/8 in. /ft. How far from the road can the builder place the house?

	a)	246.5 ft.	
X	b)	259.2 ft.	**Right!**
	c)	331.7 ft.	
	d)	27.4 ft.	

FORMULAS NEEDED;

1% slope = .001 ft./ft.

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

1) Convert in./ft. Slope to ft./ft.Slope;

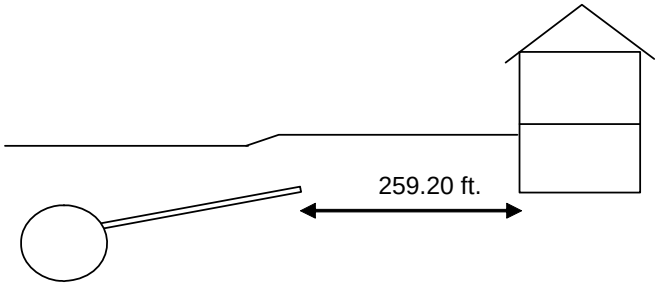
(3/8 " /ft. = .38 in./ft.)

$$\frac{0.38 \text{ in./ft.}}{12 \text{ in./ft.}} = 0.0313 \text{ ft./ft.}$$

2) Calculate the Rise;

Stub-out Elev. - Basement Elev. = Rise

884.6 ft.
- 876.5 ft.
8.1 ft.



3) Calculate slope;

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}} \qquad 0.0313 \text{ ft./ft.} = \frac{8.1 \text{ ft.}}{\text{Run}}$$

$$\text{Run} = \frac{8.1 \text{ ft.}}{0.0313 \text{ ft./ft.}} = \mathbf{259.20 \text{ ft.}}$$

= "B"

11) When opening a power rodder properly, do the following

	A)	Push the rodding tool into an obstruction and hold it there
	B)	Rotate rod in one position
Right X	C)	Make sure all the torque is out of a broken rod
	D)	Rod past dropped joints or through a crushed pipe

12) A common name appurtenance used to keep an accidental flow of wastewater from entering a building is called

	A)	Barrel
	B)	Cleanout
Right X	C)	Backwater valve
	D)	Catch basin

13) A degreasing agent is added to a 11.5 ft. diameter wet well that is 9.5 ft. deep. 4.5 lbs. is required for every 1 ft^2 of surface area. If the degreaser weighs 3.5 lbs. per gallon and has a concentration of 16.4 mg/l , how many lbs. Of chemical must be added to the well?

	a) 4,438.1 lbs.
	b) 0.48 lbs.
	c) 3,494.5 lbs.
X	d) 467.2 lbs. **Right!.**

FORMULAS NEEDED;

area of a circle = D^2 x .785

1) Calculate the surface area of the well;

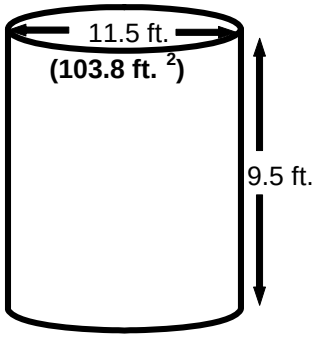
area of a circle = D^2 x .785

= 11.5 ft. x 11.5 ft. x x .785 = 103.8 ft^2

2) Multiply the required dosage by the surface area;

103.8 $ft.^2$ x 4.5 lbs./$ft.^2$ = **467.2 lbs. = "D"**

None of the other information is needed



14) The most important traffic safety consideration is the

		A) Time of day
		B) Size of the job
Right	x	C) Wearing of hard hats and safety vests
		D) Location of the job

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

Right	x	A) Chlorine
		B) Muriatic acid
		C) Potassium chloride
		D) Sodium chloride

1) Calculate the volume of the cylinders (in gallons);

Vol. Of a cylinder = D^2 x .785 x L

Volume of Tank :

= 6.0 ft. x 6.0 ft. x .785 x 33 ft.

= 932.6 $ft.^3$

x 7.48 $gal./ft^3$

6,975.7 gal.

Volume of Piston(s):

= 0.375 ft. x 0.375 ft. x .785 x 0.46 ft.

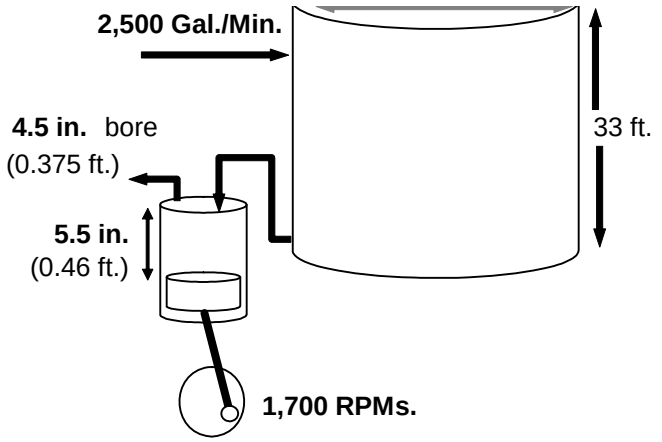
= 0.05 $ft.^3$

x 7.48 $gal./ft^3$

0.378 gal.

x 4 Cylinders

1.51 gal.



2) Multiply the piston volume by the number of strokes per minute for pumping rate;

1,700 rev./min. x 1.51 Gal. = 2,567 Gal./Min.

3) Subtract the inflow from the pumping rate to get *'effective pumping rate'*;

2,567 Gal./Min. **-** 2,500 Gal./Min. = 67 Gal./Min.

4) Calculate the time using the flow formula;

$$\text{Flow} = \frac{\text{Volume}}{\text{Time}} \quad \textit{or} \quad \text{Time} = \frac{\text{Volume}}{\text{Flow}}$$

$$\text{Time} = \frac{6{,}975.7 \text{ Gal.}}{67 \text{ Gal./Min.}} = 104.11 \text{ min.}$$

4) Convert to hrs. min.;

$$\frac{104.11 \text{ min.}}{60 \text{min./hr.}} = 1.74 \text{ hrs.}$$

= 1 hr(s) +. (.7 hrs x 60 min./hr.)

= 1 hr(s), 44. min.

= "A"

17) 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
Right x	D)	Infiltration from a high water table

18) Given the following information, would it be less expensive to finish the job in 2 days, or finish the job in one day by working overtime?

Actual job time = 13.00 hrs
Travel time & set-up time = 1.25 hrs
Average Work day = 8.00 hrs
Hourly pay rate = $ 21.25
Overtime is 1.50 times the normal hourly rate

	a)	Cheaper to do the work with O.T.
x	b)	Cheaper to do the work in two days
	c)	Costs the same either way
	d)	None of the above

Right

CALCULATE THE COST BOTH WAYS

1) Cost for completing the work in one day, with overtime;

(Add up the total hours worked, then subtract 8.00 hours to determine hours paid at O.T.)

13.00 hrs *(Actual job time)*
+ 1.25 hrs *(Travel time & set-up time)*
- 8.00 hrs *(straight time)*
6.25 hrs *(paid at O.T. Rate)*

(Convert O.T. hours to straight time hours)

6.25 hrs *O.T. x 1.50* = 9.38 hrs. pay

(Add them together for total hours paid)

9.38 hrs. pay + 8.00 hrs = 17.38 hrs. total pay

2) Cost for doing the work in two days

1.25 hrs *(Set-up, Day 2)*
1.25 hrs *(Set-up, Day 1)*
\+ 13.00 hrs
15.50 hrs (Total pay)

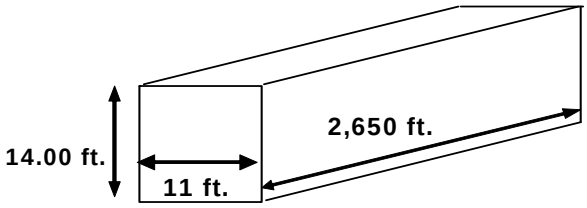
19) A(n) 11 ft. wide x 2,650 ft. long trench must be excavated and the spoils removed from the premises. The spoil weighs 3,600 lbs./cu. yd. and each truck can carry 11 tons. How many truck loads are required if the trench is 14.0 feet deep?

	a)	4,946 Trucks	
x	b)	2,474 Trucks	Right
	c)	7,420 Trucks	
	d)	2,473 Trucks	

FORMULAS NEEDED;

Volume of a rectangle = L x W x H

1 ton = 2,000 lbs. 1 $yd.^3$ = 27 $ft.^3$



1) Calculate the volume of the trench in (Yd^3);

Volume of a rectangle = L x W x H

Volume of a rectangle =

11 ft. x 14.00 ft. x 2,650 ft.

= 408,100 $ft.^3$

Convert to yd^3

$$\frac{408{,}100\ ft.^3}{27\ ft^3/yd^3} = 15{,}115\ \text{cu. yd.}$$

3) Calculate the wieght of fill in tons;

3,600 lbs./cu. yd x 15,115 cu. yds. = $\frac{54{,}413{,}333\ \text{lbs.}}{2{,}000\ \text{lbs./ton}}$ = 27,206.7 tons

4) Calculate the number of trucks;

$\frac{27{,}206.7\ \text{tons}}{11\ \text{tons/truck}}$ = 2,473.3 Trucks

You must round up to 2,474 Trucks or there will be .3 truckoads left over.

2,474 Trucks = B'

20) Grease in sewers is mechanically removed by

Right	x	A)	High-pressure jets
		B)	Sawing
		C)	Not usually a problem in sewers
		D)	Power rodders

21) A kilowatt (KW) is equivalent to

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

1 kilowatt = 1,000 watts

1 HP = 746 watts *(or 746 watts per HP)*

$\frac{1{,}000\text{watts}}{746\ \text{watts per HP}}$ = 1.34 HP

22) If the grade of a sanitary sewer has a slope of 0.10% for 1,200 feet, what is the rise of the pipe?

	a) 1201.2 Feet	
x	b) 1.20 Feet	Right
	c) 0.01 Feet	
	d) 0.12 Feet	

FORMULAS NEEDED;

$$\text{SLOPE} = \frac{\text{RISE}}{\text{RUN}}$$

(Slope = 0.10% or .00)

$$.001 = \frac{\text{RISE}}{1{,}200 \text{ ft.}}$$

Slope =

.001 x 1,200 ft. = RISE

.001 x 1,200 ft. = **1.20 ft. = "B"**

23) Convert 425 degrees Fahrenheit to Celsius

	a) 457 °C	
	b) 797 °C	
x	c) 218 °C	Right
	d) 236 °C	

FORMULAS NEEDED;

$$\frac{(^{o}F-32)}{1.8} = {}^{o}C$$

$$\frac{(425\ ^{o}F-32)}{1.8} = 218\ ^{o}C$$

= "C"

24) 31 mg/l. of chemical was previously used to treat a flow of 7,525,000 gal./day. The chemical cost is $1.37 /lb. A chlorine residual test determined that 17 mg/l. of chemical would be satisfactory. How much money would be saved per month by using the 17 mg/l. dose instead of the 31 mg/l. dose? (1 mo. = 30 days)

	a) $32,387.54 /mo.
x	b) $36,111.24 /mo. **Right**
	c) $79,960.60 /mo.
	d) $43,849.36 /mo.

FORMULAS NEEDED;

lbs./day = MGD x mgl x 8.34

$$\frac{7{,}525{,}000 \text{ gal./day.}}{1{,}000{,}000} = 7.53 \text{ MGD}$$

1) Subtract the amount of chemical you are using from what you were previously using, to get the amount of chemical you are saving;

31 mg/l. - 17 mg/l. = 14 mg/l. (not used)

2) Use the chemical formula to determine how much the chemical "not used" would have costed;

lbs./day = MGD x mgl x 8.34

lbs./day = 7.53 MGD x 14 mg/l. x 8.34

lbs./day = 878.6 lbs./day

878.6 lbs./day x 30 $\frac{\text{days}}{\text{Mo.}}$ x $1.37 /lb. = **$ 36,111.24 per month = "B"**

25) Infiltration my result from

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

26) Which one of the following is a property of chlorine gas?

Right	x	A) Heavier than air
		B) Harmless to humans
		C) Highly flammable
		D) Lighter than air

27) 51 mg/l. of root control must be added to a 54 in. sewer that is 2,127 feet long. If the root control chemical is in a solution that consists of only 41% of the chemical, how many lbs. of the solution must be added to the sewer?

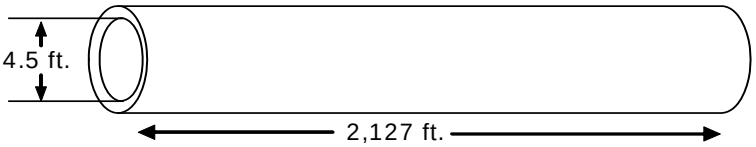
x	a) 262.37 lbs. **Right**
	b) 44.10 lbs.
	c) 292.54 lbs.
	d) 6,351.06 lbs.

FORMULAS NEEDED;

lbs./day = MGD x mgl x 8.34

Volume of a cylinder = D^2 x .785 x L

1 ft^3 = 7.48 Gallons



1) Calculate the Volume of Pipe, then convert to Million Gallons;

Volume of a cylinder = D^2 x .785 x L

4.5 ft. x 4.5 ft. x 2,127 ft. x .785 = 33,811 $ft.^3$

1 ft^3 = 7.48 Gallons

33,811 ft^3 x 7.48 gal./ft^3 = $\frac{252,909 \text{ gal.}}{1,000,000}$ = .25 MGD

2) Use formula to Calculate lbs./day;

lbs./day = MGD x mgl x 8.35

lbs./day = .25 MGD x 51 mg/l. x 8.34

lbs./day = 108 lbs./day

3) The chemical is only 41% pure. You will need more;

$\frac{108 \text{ lbs./day}}{.41}$ **= 262.37 lbs./day**

= "A"

28) What is a mechanical means to remove material from a sewer?

		A) Herbicides
Right	x	B) Cutting
		C) Pumping
		D) Sweeping

29) The purpose of a lift station sign-in log is to

		A) Budget lift station visits
Right	x	B) Identify who makes changes in station operation
		C) Track employee movement for disciplinary actions
		D) All of the above

30) An automatic chemical feeder treats 17 MGD at a concentration of 54 mg/l. How many lbs./day of chemical is required?

	a) 1,024 lbs./day
	b) 6,867 lbs./day
x	c) 7,656 lbs./day **Right**
	d) 823 lbs./day

FORMULAS NEEDED:

lbs./day = MGD x mgl x 8.34

1) Use formula to Calculate lbs./day;

lbs./day = MGD x mgl x 8.34

= 17 MGD x 54 mg/l. x 8.34

= **7,656 lbs./day**

= "C"

31) What tools are used with a power rodder?

		A) Finger grips
		B) Pruning shears
Right	x	C) Spring blades
		D) Videotape camera

32) The minimum scouring velocity normally used for sanitary collection lines is

		A) 1.0 ft/sec
Right	x	B) 2.0 ft/sec
		C) 5.0 ft/sec
		D) 10.0 ft/sec

33) Calculate the water horsepower if the pump it operates provides 1,475 GPM against 125 feet total dynamic head (TDH)?

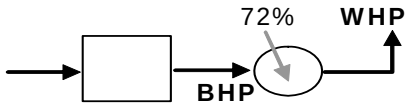
	a) 63 HP
	b) 88 HP
	c) 12 HP
x	d) 47 HP Right

34) If the pump in problem 33 is 72% efficient, then what is the brake HP?

x	a) 64.7 HP Right
	b) 122.6 HP
	c) 16.4 HP
	d) 63.6 HP

FORMULAS NEEDED;

$$WHP = \frac{GPM \times TDH}{3960}$$



Problem #30;

Calculate HP;

$$WHP = \frac{1{,}475\ GPM \times 125\ feet}{3960}$$

WHP = 46.6 HP 'D'

Problem #31;

Calculate BHP;

$$\frac{WHP}{Eff.} = BHP \qquad \frac{47\ HP}{.72} = 64.7\ HP = \text{"A"}$$

35) What equipment is effective in removing an emergency stoppage?

	A) Strip chart recorder
	B) Ultrasonic meter
	C) Front-end loader
Right x	D) Hand rodder

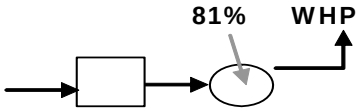
36) If a pump outputs 450 GPM against a total dynamic head of 650 feet, and the pump is 81% efficient, what is the brake HP?

	a) 59.8 HP
x	b) 91.2 HP
	c) 53.7 HP
	d) 62.9 HP

Right

FORMULAS NEEDED;

$$WHP = \frac{GPM \times TDH}{3960}$$



Calculate HP;

$$WHP = \frac{450\ GPM \times 650\ feet}{3960}$$

$$WHP = 73.9\ HP$$

Calculate BHP;

$$\frac{WHP}{Eff.} = BHP \qquad \frac{73.9\ HP}{.81} = 91.2\ HP$$

= "B"

37) The formula for calculating the volume of a cylinder is;

	A) V = L x W x H
	B) V = Distance/time
x	C) V = D^2 x .785 x D
	D) V = D^2 x 746 x D

Right

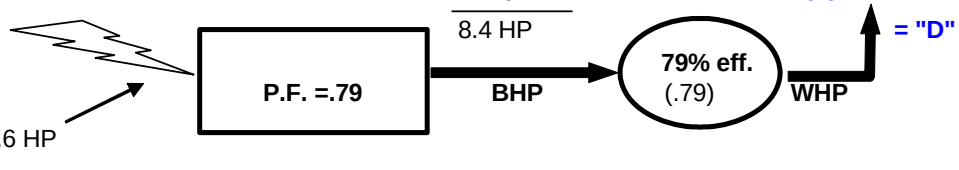
39) The power factor of a motor is .79 and the pump has an efficiency of 79% . If the motor consumes 7,900 watts, what is the water horsepower?

	a) 10.6 HP
	b) 17.0 HP
	c) 8.4 HP
x	d) 6.6 HP **Right**

FORMULAS NEEDED;
1 hp = 746 Watts

1) Convert Watts to HP;
1 hp = 746 Watts

$$\frac{7{,}900 \text{ watts}}{746 \text{ Watts/HP}} = 10.6 \text{ HP}$$



2) Calculate BHP
10.6 HP
x .79 P.F.
8.4 HP

3) Calculate WHP
8.4 HP
x .79 eff.
6.6 HP **= "D"**

40) Employers must provide employees with information about possible health effects from contact with hazardous materials. This is called “right-to-know” legislation. Which document provides “right-to-know”?

Right	x	A) Material Safety Data Sheet
		B) NPDES permit
		C) Sewer ordinance
		D) Clean Water Act

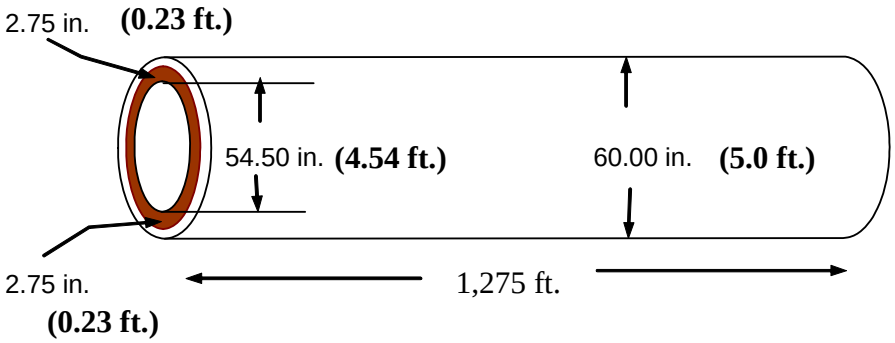
41) The interior of 1,275 ft. of 60 in. pipe is uniformly coated with 2.75 in. of grease. How many gallons will this pipe hold when filled with water?

x	a) 154,423 Gal.	Right
	b) 33,810,668 Gal.	
	c) 172,178 Gal.	
	d) 26,541,375 Gal.	

FORMULAS NEEDED;

1 FT.^{3} = 7.48 Gallons

Vol. Of a Cylinder = D^2 x .785 x L



Subtract the grease from the diameter for new diamerter;

(Because the grease is on both sides, it must be subtracted twice)

5.00 ft. - .23 ft. - .23 ft. = 4.54 ft.

Calculate the Volume of the Pipe:

Vol. Of a Cylinder = D^2 x .785 x L

= 4.54 ft. x 4.54 ft. x .785 x 1,275 ft. = 20,644.78 ft.^{3}

Convert ft^3 to Gallons;

1 FT.3 = 7.48 Gallons

20,644.78 ft. x 7.48 = **154,423 Gal.** **= "A"**

42) Who must review plants for final approval before a new sewer can be constructed?

	A)	County commissioner
	B)	City sewer Inspector
Right x	C)	Ohio EPA
	D)	Water Commission

43) What will happen if the discharge valve on a centrifugal pump is partially closed?

	A)	Amperage will increase, discharge head will increase
	B)	Amperage will decrease, discharge head will increase
	C)	Amperage will decrease, discharge head will remain constant
Right x	D)	Amperage will decrease, discharge head will decrease

oot per second flow is equal to _____ gallons per hour.

	A) 2,794
	B) 3,500
	C) 6,000
x	D) 26,928

$\frac{1\ ft^3/sec.}{1.55\ MGD/CFS} = 0.645\ MGD$ $\qquad 0.645\ MGD \times \frac{1{,}000{,}000\ gal.}{24\ hrs./day} =$ **26,882 gal./hr.**

45) Colored dye is dumped into a manhole. The dye first appears 3 min., 17 sec. later in a manhole 1,850 feet downstream and disappears 21 min. and 49 sec. after the dye was first dumped into the manhole. What is the velocity of the flow in the sewer?

	a) 1.41 Ft./Sec.
x	b) 2.46 Ft./Sec.
	c) 9.39 Ft./Sec.
	d) 0.81 Ft./Sec.

Right

FORMULAS NEEDED;

$velocity = \frac{Distance}{Time}$

Convert Min., Sec. To Seconds;

Dye first appears:

3 min., 17 sec. =

3 min. x 60 sec./min. = 180 sec.

+ 17 sec.

197 sec.

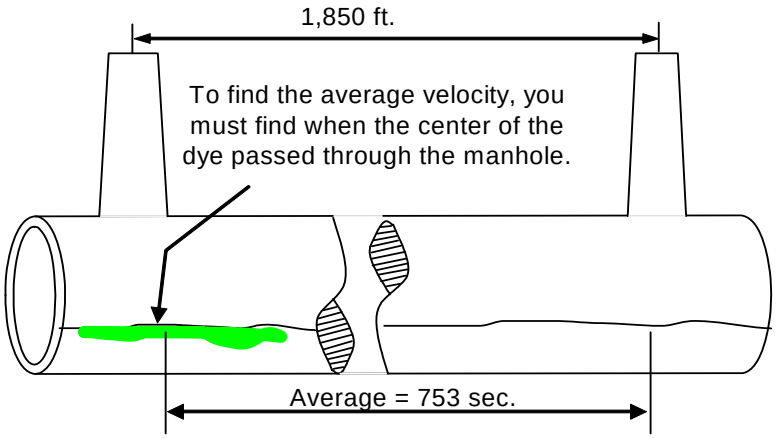
Dye disappears:

21 min., 49 sec. =

21 min. x 60 sec./min. = 1260 sec.

+ 49 sec.

1309 sec.



Average theStart & finish times;;

$\frac{197\ sec. + 1309\ sec.}{2} = 753\ sec.$

Use the formula to calculate the velocity;

$velocity = \frac{Distance}{Time}$

$\frac{1{,}850\ ft.}{753\ sec.} =$ **2.46 ft./sec. = "B"**

46) "Schedule 40" refers to pipe

	A) flow capacity
	B) friction loss
	C) tubing strength
Right x	D) wall thickness

47) A wastewater treatment plant receives the following:

Pump Station	=	3,250 GPM
Sewer "A"	=	12,500 People @ 95 GPCD
I&I	=	24,000 gal/day
Ind. Waste	=	67,000 gal/day
Sewer "B"	=	?

If the plant receives 7.3 MGD, what percentage of the total flow is contributedby sewer "B"?

	a) 77.5%
	b) 22.5%
	c) 81.6%
x	d) 18.4% **Right**

FORMULAS NEEDED;

GPCD = Gallons Per Capita Per Day

Add up known flows;

Pump Station		4,680,000 Gal./Day
Sewer "A"		1,187,500 Gal./Day
I&I		24,000 Gal./Day
Ind. Waste	+	67,000 Gal./Day
		5,958,500 Gal./Day

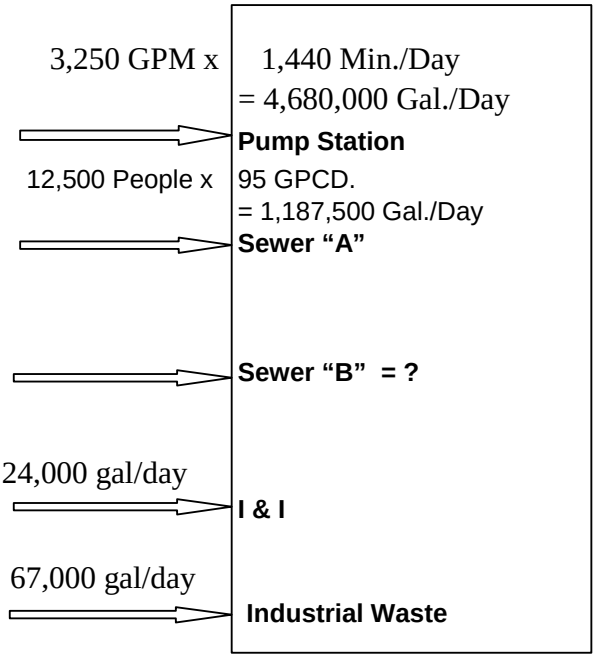
Subtract know flows from the plant flow to get to get Sewer 'B';

		7,300,000 Gal./Day
	-	5,958,500 Gal./Day
		1,341,500 Gal./Day (Sewer "B")

Divide I & I flow by the plant flow & multiply by 100;

$$\frac{1{,}341{,}500 \text{ Gal./Day}}{7{,}300{,}000 \text{ Gal./Day}} \times 100 = \textbf{18.4\%}$$

= "D"



** Before picking your answer, look at your I & I flows, does 1,341,500 Gal./Day I & I look like it might be 18.4% of 7,300,000 Gal./Day plsnt flow?
If not, you probably divided by the wrong number.

48) Employee hazards in collection system operations include

	A)	Noxious or toxic gasses or vapor.
	B)	Oxygen deficiency.
	C)	Physical injuries.
Right x	D)	All of the above

49) A wet well is 9 feet deep by 21 feet in diameter. When the pump is not running, the water rises 33.0 in. in 2 min. 52 sec. If the level falls 5.2 in. in 14.0 min. while the pump is running, what is the pump rate in GPM?

	a)	2,404 Gal./Min.
x	b)	2,564 Gal./Min. **Right**
	c)	2,680 Gal./Min.
	d)	11,740 Gal./Min.

FORMULAS NEEDED;

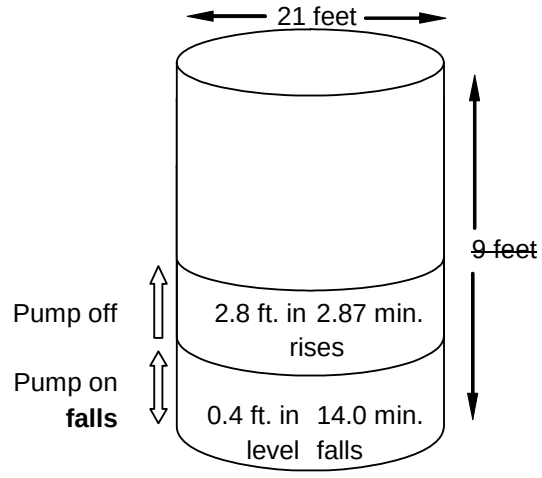
Volume of Cylinder = D^2 x .785 x Depth 1 $ft.^3$ = 7.48 Gal.

$$\text{Flow} = \frac{\text{Volume}}{\text{Time}}$$

Simplify;

33.0 in. **= 2.8 ft.**
5.2 in. **= 0.4 ft.**

$$2 \text{ min, } + \left\{\frac{52 \text{ sec.}}{60 \text{ sec/min}}\right\} = \mathbf{2.87 \text{ min.}}$$



Calculate inflow with the pump off;

Volume of Cylinder = D^2 x .785 x Depth
= 21 ft. x 21 ft. x .785 x 2.8 ft.
= 952.01 $ft.^3$
Convert to gallons;
= 952.01 $ft.^3$ x 7. 48 gal/ft^3 = 7,121.03 Gal.

$$\text{Flow} = \frac{\text{Volume}}{\text{Time}} \qquad \text{Flow} = \frac{7{,}121.03 \text{ Gal.}}{2.87 \text{ min.}}$$

= 2,484 Gal./Min. (Inflow)

Calculate change in volume with the pump on;

Volume of Cylinder = D^2 x .785 x Depth
= 21 ft. x 21 ft. x .785 x 0.4 ft.
= 150.01 $ft.^3$
Convert to gallons;
= 150.01 $ft.^3$ x 7. 48 gal/ft^3 = 1,122.10 Gal.

$$\text{Flow} = \frac{\text{Volume}}{\text{Time}} \qquad \text{Flow} = \frac{1{,}122.10 \text{ Gal.}}{14.00 \text{ min.}}$$

= 80 Gal./Min.

Add or subtract the change in volume to the inflo

The level falls when the pump is on.
This means the pump is keeping up add the
to the 2,484 GPM Inflow.

2,484 GPM
\+ 80 GPM
2,564 GPM = "B"

50) If a sewer must have a flow rate of 27 MGD with a velocity between 1.50 ft./sec. and 2.75 ft./sec.
What must the minimum size be?

x	a) 53 in.	**Right**
	b) 72 in.	
	c) 71 in.	
	d) 52 in.	

FORMULAS NEEDED;

$ft^3/sec. = 1.55 \times MGD$ $\quad$ $Area\ (ft^2) = D^2 \times .785$ $\quad$ $ft^3/sec. = ft^2 \times ft./sec.$ (Flow = Area x Velocity)

Convert MGD to $ft^3/sec.$

$ft^3/sec. = 1.55 \times MGD$

$= 1.55 \times 27\ MGD$

$= 41.9\ ft^3/sec.$

Decide which velocity you will use;

If the question asks for the minimum pipe size, you will need to design the pipe toward the HIGHEST velocity
If the question asks for the maximum pipe size, you will need to design the pipe toward the LOWEST velocity

In this case, it asks for the *minimum* velocity, so you will use the *2.75 ft./sec. velocity*

Use the formula, $ft^3/sec. = ft^2 \times ft./sec.$ To get the area;

$ft^3/sec. = ft^2 \times ft./sec.$

$41.9\ ft^3/sec. = ft^2 \times 2.75\ Ft./Sec.$

$$\frac{41.9\ ft^3/sec.}{2.75\ Ft./Sec.} = 15.22\ ft^2$$

Use the formula, $Area\ (ft^2) = D^2 \times .785$ To get the D^2

$Area\ (ft^2) = D^2 \times .785$

$15.22\ ft^2 = D^2 \times .785$

$$\frac{15.22\ ft^2}{.785} = D^2$$

$19.4\ ft^2 = D^2$

Then squaere root the D^2, to get the Diameter

$D^2 =$ D (Diameter)

$19.4\ ft^2 = 4.40\ ft.$

Convert to inches

$4.40\ ft. \times 12\ in./ft. = 52.8\ in.$ **= "A"**

We are looking for the **minimum** velocity
52.0 in. would be too small & cause the velocity to rise above 2.75 ft./sec.