CWEA COLLECTION SYSTEM OPERATOR CERTIFICATION

MATH

FOR

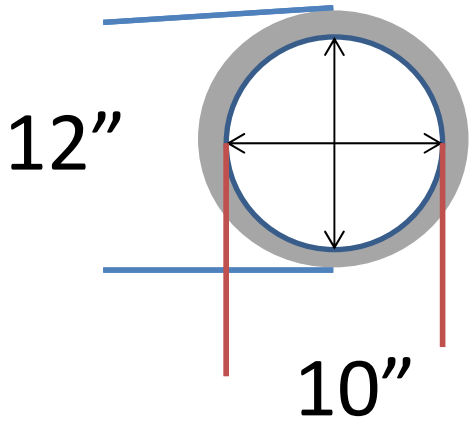
GRADES 1 AND 2

QUESTION # 6

The interior of 300 feet of 12- inch pipe is uniformly coated with one inch of grease. How many gallons will this pipe hold when filled with water?

QUESTION # 6

- 12” pipe uniformly coated with 1” of grease. What is the “true” diameter of the opening?

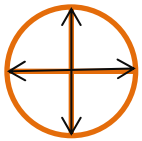


HOW TO CHANGE INCHES INTO FEET

- Take the inches that you need to change and divide them by 12
- There is 12 inches in a foot
- Example: 6”/12” = .5’
- Example: 8”/12” = .6666666667 if this happens, round up to the next number after three spots.
- example..6666666667 would be .667

FINDING THE AREA OF A CIRCLE

- When finding the area of a circle you need to take the diameter of the circle and times it by it self, and then multiply by .785
- Example: What is the diameter of a 6” pipe? 6”=.5’, so you take .5 X .5 X .785= 0.19625 or round up to 0.196
- Diameter is from one side of the circle to the other side.



QUESTION # 6

- 10”/12”= .833’
- .833 ’X .833’X .785 = .545sq.’X 300’=163.41cu.’
- 163.41cu.’ x 7.48gals/cu.’ = 1,222.3gals.

ANSWER TO QUESTION #6

1,222 GALLONS

QUESTION #12

A flow of 650 gpm would be how many mgd?

CONVERTING TIME

- TO CHANGE DAYS INTO HOURS: TAKE THE DAYS THAT YOU HAVE AND MULTIPLY BY 24/HRS. IN A DAY
- TO CHANGES HRS. TO MINUTES: TAKE THE HRS. THAT YOU HAVE AND MULTIPLY BY 60/MIN. IN A HOUR.
- TO CHANGES MINUTES INTO SECONDS: TAKE THE MIN. THAT YOU HAVE AND MULTIPLY BY 60/SEC. IN A MIN.

QUESTION # 12

- Take 650 gpm X 1440 min./day = ?
- (650gpm X 1440mpd =)
- Min. cancel min. leaving you with 650 gals. X 1440 day = 936,000 gpd.
- But they want this in million gallons/day.
- Take 936,000 gpd and divide (/) by 1,000,000 = .936mgd

ANSWER TO QUESTION # 12

0.936mgd

QUESTION # 14

If it takes 7 minutes and 30 seconds for dye to travel a distance of 860 feet through an eight inch sewer, what is the velocity in fps?

QUESTION # 14

- Need to change minutes into seconds
- Take 7min X60spm = 420sec + 30sec = 450sec
- Take the 860’ / 420sec = 1.91fps

ANSWER TO QUESTION # 14

1.91fps

Question #16

You receive a dispatch at 4:30 P.M. informing you that raw sewage is spewing out of a manhole onto the ground and into a small stream adjacent to a sparsely populated neighborhood. The caller reporting the problem indicated that it had been spilling sewage since 2P.M. and that she noticed it while driving by on the 405 freeway stuck in stop and go traffic. She indicated that she was not able to call right away and report the spill because of restrictions on using cell phone when driving a motor vehicle. You immediately dispatch a hydo-vac crew to the site to assist you in taking care of the problem. Upon arrival at the manhole at 5:15P.M., you notice right away the sewage is spilling out from around an unsecured 24-inch bolt down manhole cover. You field measure the height of the sewage from the top of the frame. Based on current engineered SSO volume estimation, a sewage spout 5 inches above a manhole rim with culver still in place tabulates out to 166 gallons per minute. You also notice that the SSO is flowing from between the manhole and the creek. As the creek was flowing rather high that afternoon after an earlier rainstorm, none of the spill would be recoverable. Your crews had setup their equipment and were able to clear the problem causing the mainline stoppage 22 minutes after your arrival. Based on the information supplied, how many reportable unrecoverable gallons of raw sewage had reached the creek?

QUESTION # 16

- Estimate spill time
- Convert into minutes
- Estimate amount of the spill in gallons per minute
- Multiply the spill time by the gallons per minute
- Equals “answer”

QUESTION # 16

- Caller indicated that she notice the spill at 2P.M.

(You receive a dispatch at 4:30 P.M. The caller reporting the problem indicated that it had been spilling sewage since 2P.M.)

- You arrive at 5:15P.M.
- Crew clear the problem in 22 minutes.
- What is your total time

QUESTION # 16

- Subtract 2P.M. from 5:15P.M. = 3hrs 15min
-
- Turn 3 hrs into minutes by multiplying by 60mph (3hrs X 60 mph = 180min)

- Add the 15 min onto the 180 min (15min + 180 min = 195 min)

QUESTION # 16

Crew time of 22min add to 195min you have =

22min + 195min =

217min

QUESTION # 16

166 gallons per minute.

QUESTION # 16

166 gpm X 217 min =

QUESTION # 16
ANSWER

36,022 gallons

LETS

REVIEW

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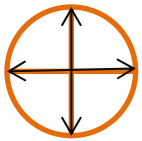

CONVERTING TIME

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- TO CHANGES MINUTES INTO SECONDS: TAKE THE MIN. THAT YOU HAVE AND MULTIPLY BY 60/SEC. IN A MIN.

EXAMPLE

- 3days X 24hrs/day = ? Days cancel days (3~~days~~ X 24hp~~d~~) leaving you with 3 X 24hrs = 72hrs.

- 24hrs /day X 60min / hrs =? Hrs. cancel hrs. (24~~hpd~~ X 60mp~~h~~) leaving you with 24/day X 60 min = 1,440 mpd (minute per day)

- 1440mpd X 60spm = ? Min. cancel min. (1440~~mpd~~ X 60sp~~m~~) leaving you with 1440/day X 60sec.=86,400 spd. (second per day)

QUESTION # 42

If a 6” force main has a metered flow of 200,000gpd, what is the velocity?

FLOW
FORMULA

Q = Flow (Quantity) (gpd, gpm, gps)

V = Velocity (fps)

A = Area (sq. ft.)

$$Q = A \text{ x } V$$

$$V = Q/A$$

$$A = Q/V$$

QUESTION # 42

- 6in/12inf = 0.5ft
- 0.5X0.5X0.785= 0.196sq.ft. (area)

- 200,000gpd/1440mpd=138.889gpm (needs to be in seconds)

- 138.889gpm/60spm=2.315gps

QUESTION # 42

- 6in/12inf = 0.5ft.
- 0.5X0.5X0.785= 0.196sq.ft. (area)

- 200,000gpd/1440mpd=138.889gpm (needs to be in seconds)
- 138.889gpm/60spm=2.315gps
- 2.315gps/7.48gcf= 0.309cfs

- 0.309cfs/0.196sq.ft.=1.58fps

QUESTION # 42
ANSWER

1.6FPS

(actual answer is 1.58)

QUESTION # 43

Wastewater is pumped through an 8” force main @ the rate of 425gpm. What is the velocity?

QUESTION # 43

8in/12inf = 0.667’

0.667’X0.667’X.785=0.349sqf

425gpm / 60spm = 7.08gps

7.08gps / 7.48gcuf = 0.946cfs

0.946cfs/0.349sqf = 2.71fps

QUESTION # 43
ANSWER

2.7FPS

(actual answer 2.712 round down)

QUESTION # 44

An 8” pipe serves 1,837 homes with 2.6 people per home using 100 gallons of water each day.

What is the velocity in fps?

QUESTION # 44

$$8 \text{ inches} / \frac{inches}{foot} = 0.667 \text{ feet}$$

$$0.667' \text{ X} 0.667' \text{ X } 0.785 = 0.349 \text{sqft}$$

QUESTION # 44

- 1,837 homes X 100$\frac{gallons/day}{home}$ = 183,700$\frac{gallons}{day}$
- 183,700gpd / 1440mpd = 127.569gpm
- 127.569gpm / 60spm = 2.126gps

QUESTION # 44

- Need to change the 2.126gps into feet per second
- $2.126 \frac{\cancel{gallons}}{second} / 7.48 \frac{\cancel{gallons}}{cu.foot} = 0.284 \frac{cubic\ feet}{second}$
- $0.284 \frac{\cancel{cubic}\ feet}{second} / 0.349 \cancel{sqft} = 0.813 \frac{feet}{scond}$

QUESTION # 44
ANSWER

0.81fps

CWEA COLLECTION SYSTEM OPERATOR CERTIFICATION

MATH

FOR

GRADES 3 AND 4

QUESTION # 1

A pump station has three constant speed pumps with a field measure horsepower of the pumps of 73 (pump #1), 78 (pump #2) and 71 (pump #3). By changing to new, more efficient pumps, the horsepower can be reduced to 65 horsepower per pump and maintain the same flow rate.

Total cost of conversion: $64,000.00

Power costs $0.63 cent/KwH

pump station Average flow 10.5mgd

Hour Meter Reading

	Beginning of Year	End of Year
Pump 1	110,356	115,293
Pump 2	24,224	25,031
Pump 3	38,331	39,622

Given the information above, determine the annual saving in dollars, if new pumps are installed:

QUESTION # 1

Determined the different in horsepower between the old pumps and the new pumps

	old	new	difference
Pump # 1	73hp	- 65hp =	8hp
Pump # 2	78hp	- 65hp =	13hp
Pump # 3	71hp	- 65hp =	6hp

QUESTION # 1

Change the horsepower of the pumps into kilowatts (one horsepower = .746kw)

Pump #1 $8\cancel{hp} \times \frac{.746kw}{1\cancel{hp}} = 5.968kw$

Pump # 2 $13\cancel{hp} \times \frac{.746kw}{1\cancel{hp}} = 9.698kw$

Pump # 3 $6\cancel{hp} \times \frac{.746kw}{1\cancel{hp}} = 4.476kw$

QUESTION # 1

Change the kilowatts of the pumps to cost per hour per pump ($0.63cent/Kw Hours)

Pump # 1 $5.968\cancel{kw} \text{ X } \frac{\$0.63\cancel{kw}}{1hour} =$ $3.76/hour

Pump # 2 $9.698\cancel{kw} \text{ X } \frac{\$0.63\cancel{kw}}{1hour} =$ $6.11/hour

Pump # 3 $4.476\cancel{kw} \text{ X } \frac{\$0.63\cancel{kw}}{1hour} =$ $2.82/hour

QUESTION # 1

Determine the annual hours that the pumps have run, by taking the end of year and subtracting from the beginning of year from your Hour Meter Reading

Hour Meter Reading

	Beginning of Year	End of Year
Pump 1	110,356	115,293
Pump 2	24,224	25,031
Pump 3	38,331	39,622

QUESTION # 1

	End of year	*Beginning of year*		*Total Annual Hours*
Pump # 1	**115,293**	**110,356**	**=**	**4,937**
Pump # 2	**25,000**	**24,224**	**=**	**807**
Pump # 3	**39,622**	**38,331**	**=**	**1,291**

QUESTION # 1

Take the hourly cost of the pumps and multiply by the annual hours per pump

Pump # 1 $\$3.76/\cancel{hr} \times \frac{4{,}937\cancel{hrs}}{1 year} = \$18{,}563.12/year$

Pump # 2 $\$6.11/\cancel{hr} \times \frac{807\cancel{hrs}}{1 year} = \$4{,}930.77/year$

Pump # 3 $\$2.82/\cancel{hr} \times \frac{1{,}291\cancel{hrs}}{1 year} = \$3{,}640.62/year$

QUESTION # 1

Take the annual cost per pump, and add them together, then you'll have your total annual saving in dollars

Pump # 1	$18,563.12/year
Pump # 2	$4,930.77/year
Pump # 3	$3,640.62/year
Annual Total	$27,134.51

QUESTION # 1
ANSWER

$27,134.51 / YEAR

QUESTION # 1

- Determine the different in horsepower between the old pumps and the new pumps
- Change the horsepower of the pumps into kilowatts (one horsepower = .746kw)
- Change the kilowatts of the pumps to cost per hour per pump ($0.63cent/KwHour)
- Determine the annual hours that the pumps have run, by taking the end of year and subtracting from the beginning of year from your Hour Meter Reading
- Take the hourly cost of the pumps and multiply by the annual hours per pump
- Take the total hours of your annual hours per pump, and add them together, then you'll have your annual saving in dollars.

QUESTION # 68

You are the superintendent of an 18 worker collection system maintenance operation. Last year 4 workers cleaned 150 miles of pipe using power rodding (40%) and high-velocity cleaners (60%). The power rodder cost $14,800 per year to own and operate (excluding labor) and the high-velocity cleaner cost $27,500 per year. The remaining workers replace 40,000 feet of 6 inch and 8 inch pipe at 680 work sites. The construction equipment cost $199,870 per year to own and operate. There are 220 working days per year and each worker costs $250 per day for salary and benefits.

What are the unit costs, in dollars per foot, for cleaning?

Determine what needs to be done

Need to figure out the cost of cleaning the line

The cleaning was done by only 4 of the workers
What was the cost of the workers cleaning the line

$$\frac{\$250.00}{\cancel{worker}} \text{ X } 4 \cancel{\text{ workers}} = \$1{,}000.00$$

$$\frac{220 \cancel{working\ days}}{year} \text{X} \frac{\$1{,}000.00}{\cancel{day}} = \frac{\$220{,}000.00}{year}$$

What tools were used for cleaning, and what was there cost

tools used	cost per year
power rodder	$14,800.00
high-velocity cleaner	$27,500.00
	$42,300.00

Determine what needs to be done

Footage of line clean that year

150 miles of lines were cleaned

Change miles into feet (5,280ft/mile)

$$150 \cancel{\text{miles}} \times \frac{5{,}280ft}{\cancel{mile}} = 792{,}000ft$$

TAKE THE TOTAL COST OF THE WORKERS AND EQUIPMENT, ADD THEM TOGETHER

Total cost of the workers	$220,000.00/year
Total cost of tools used	$42,300.00/year
Total cost	$262,300.00/year

DIVIDE THE TOTAL COST FROM THE TOTAL FOOTAGE OF LINE THAT WAS WORK ON

$$\frac{Total\ cost = \$262{,}300.00}{Total\ footage = 792{,}000\,ft.} =$$

0.331

QUESTION # 68

ANSWER

0.33

QUESTION # 68

- Determine what need to be done
  - How many workers did it take to do the job (cleaning)
  - What was the annual cost for the workers
  - What was the annual cost of the equipment
  - How many feet of line was worked on that year
- Take the total cost of the workers and equipment, add them together
- Divide the total cost from the total footage of line that was work on
- Equals unit cost, in dollars per foot

QUESTION # 74

An 8 inch diameter force main serves 1,837 homes.

For estimating purposes, there are 2.6 people per home and per capita use is 100 gallons per day.

What is the average flow velocity in feet per second?

QUESTION # 74

What does the term

"per capita"

means?

BY OR FOR EACH PERSON

QUESTION # 74

- 8in/ 12inpf = 0.667ft.
- 0.667X0.667 X0.785 = 0.349sqft

- $2.6\frac{\cancel{people}}{home}$ X$\frac{100gpd}{\cancel{person}}$ = $260\frac{gpd}{home}$

- $260\frac{gpd}{\cancel{home}}$X1,837 ~~homes~~ = 477,620gpd

- 477,620~~gpd~~/1440~~mpd~~ = 331.68gpm

- 331.68~~gpm~~/60s~~pm~~ = 5.528gps

QUESTION # 74

- 5.528~~g~~ps/7.48~~g~~pcf = 0.739cfs
- 0.739~~c~~fs/0.349~~sq~~f = 2.12fps

QUESTION # 74
ANSWER

2.1feet/second

QUESTION # 90

When doing sewer maintenance on a line every two months during the year. It takes the crew 30 minutes travel time, 35 minutes to clean and 10 minutes to set up. The cost is $50.00 per hour for two operators, two flaggers at $8.00 each per hour, $100.00 per hour for the combo truck and $10.00 per hour for a pickup truck. What would be your cost per year to clean that line?

QUESTION # 90

steps to take

1. Figure out how much time that it takes to do the job.
2. Figure out the total cost per hour to do the job.
3. Figure how many times that the job needs to be done.
4. Take the cost per hour times it by the time that it takes to do the job, then times that by how many times that job needed to be done = Answer

*The times that it takes to do the job and the total cost must be broken down to the common format. In this case we are breaking down to minutes.

QUESTION # 90

Step 1. Figure out how much time it takes to do the job.

35 MINUTES TO CLEAN

30 MINUTES TO TRAVEL

+10 MINUTES TO SETUP

75 MINUTES TOTAL

QUESTION # 90

Step 2. Figure out the total cost per hour to do the job.

$50.00 for two operators per hour

$8.00 for one flagger per hour

$8.00 for one flagger per hour

$100.00 for a combo truck per hour

+$10.00 for a pickup truck per hour

$176.00 per hour

QUESTION # 90

Step 2. Figure out the total cost per hour to do the job.

$50.00 for two operators per hour

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$8.00 for one flagger per hour

$100.00 for a combo truck per hour

+$10.00 for a pickup truck per hour

~~$176.00 per hour~~

*Need to change hours to minutes $176.00 ~~per hour~~ / 60minutes ~~per hour~~ =

$2.93 per minutes

QUESTION # 90

Step 3. Figure out how many times that job needs to be done.

12 ~~months per year~~ / 2 ~~months per year~~ =

6 times

QUESTION # 90

Step 4.

Cost to do the job = $2.93~~minute~~

Time that it took to do the job = × 75 ~~minutes~~

Total $219.75

Times the job needs to be done= × 6

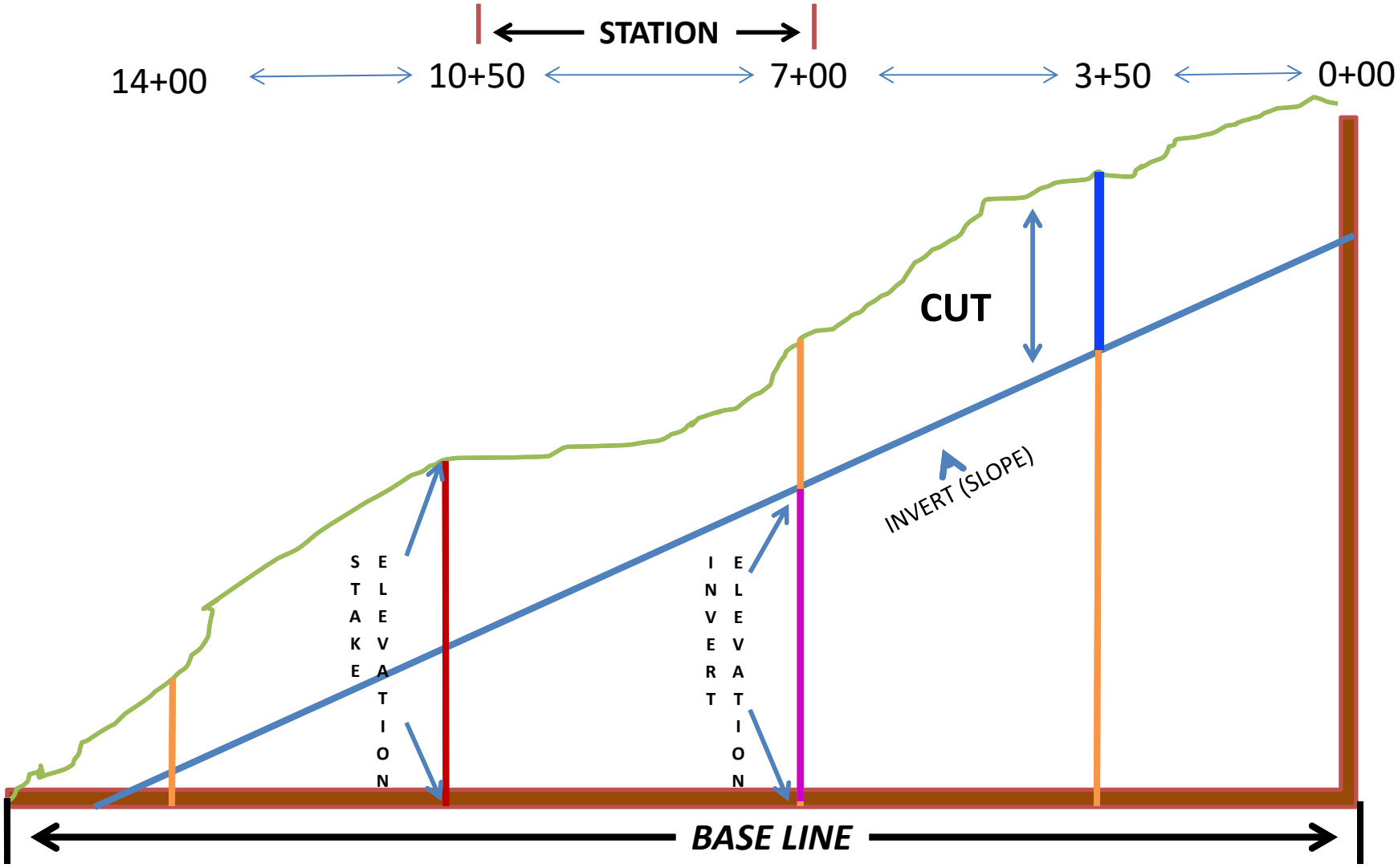
Answer $1318.50

CUT SHEETS

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

CUT SHEETS


STATION
14+00
10+50
7+00
3+50
0+00
CUT
INVERT (SLOPE)
STAKE ELEVATION
INVERT ELEVATION
BASE LINE

CUT SHEETS

SLOPE FORMULA

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

$$\text{Slope (\%)} = \frac{Rise = Cut}{Run = Station}$$

CUT SHEETS

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

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

$$\text{Rise} = (\text{Run})\ \ (\text{Slope})$$

CUT SHEETS

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1. Box G, in cut sheet A should read:
   a. No
   b. Yes
   c. Maybe
   d. None of the above

CUT SHEET

1. To know if shoring is required you need to know what the cut (depth) is.
2. On this sheet the Cut depth is given to us at 8.90ft.

Any cut of 5ft. or more needs shoring.

3. 8.90ft. Is more then 5ft. So, the answer is

CUT SHEETS

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1. Box G, in cut sheet A should read:
   a. No
   b. Yes
   c. Maybe
   d. None of the above

CUT SHEETS

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2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

2. Using the cut sheet above , calculate the value for box F.

a. 5.34
b. 4.43
c. 3.34
d. 4.40

CUT SHEETS

To find the answer for
box F, you take the stake elevation
1199.14ft.
and subtract the invert elevation
1195.80ft.
That
will give you the cut depth
(3.34ft.).

CUT SHEETS

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CUT SHEETS

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2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

3. Using the cut sheet above , find the cut sheet slope, in decimal form
   a. 1.04ft
   b. 0.004ft
   c. 250.00ft
   d. 0.040ft

CUT SHEETS

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

By using the Slope Formula ($\frac{Rise}{Run}$) We can find the Slope.

1. **Take the First Two Invert Elevation From the Chart and Subtract Them. This well give you your Rise that you need .**

1195.08 – 1194.88 = 0.20 (Rise)

2. **Take the First Two Stations on the Chart and Subtract Them. This Well Give You Your Run That You Need.**

1+88 (188) – 1+38 (138) = 50 (Run)

3. **As In The Formula Take the Rise (0.20) Divide by the Run (50) This Well Give You Your Slope 0.004**

$$\frac{0.20\ (Rise)}{50\ (Run)} = 0.004$$

CUT SHEETS

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3. Using the cut sheet above , find the cut sheet slope, in decimal form

a. 1.04ft

b. 0.004ft

c. 250.00ft

d. 0.040ft 3

CUT SHEETS

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2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

4. Using the cut sheet above, find the value for box A.

a. 2+58
b. 2+18
c. 2+98
d. 2.98

CUT SHEETS

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

With this question we need to find the Run

1. **We need to Subtract the Invert Elevation that is above the Invert Elevation on the same line of box A to find the Rise.**

1195.20 – 1195.08 = 0.12 (Rise)

2. **We have the Slope (0.004) from Question 3**
3. **Take the Rise and Divide by the Slope you'll have your Run**

$$\frac{0.12(Rise)}{0.004\ (Slope)} = 30$$

4. **Take the Station (1+88) that is above Box A Add the Run (30) to get the Missing Station in Box A**

188 (1+88) + 30 (Run) = 218 (2+18) The Missing Station

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

4. Using the cut sheet above, find the value for box A.

a. 2+58

b. **2+18**

c. 2+98

d. 2.98

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

5. Box I, in the cut sheet A, should read?

a. No
b. Yes
c. Maybe Yes, depending on soil conditions,
d. None of the above.

CUT SHEETS

The question is if shoring is require for box I.

To find this out we need to know some facts.

1. How deep is the cut in box F.

To find the depth of the cut you need to Subtract the Invert Elevation from the Stake Elevation to get the cut depth.

1199.14 (Stake Elevation) - 1195.80 (Invert Elevation) = 3.34ft. (Cut).

2. What are the soil conditions

Even though the depth (Cut) is less then 5ft. The soil conditions might required you to use shoring

Your answer should be

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

5. Box I, in the cut sheet A, should read?

a. No

b. Yes

c. Maybe Yes, depending on soil conditions,

d. None of the above.

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

6. Using the cut sheet above, calculate the value for Box C?

a. 1195.56
b. 1195.46
c. 1195.52
d. 1195.48

CUT SHEETS

Rise = (Run) (Slope)

With this question we need to find the ***Rise*** to find out what the Invert Elevation for box C will be.

1. Need to find the ***Run*** by taking station 2+88 (on the same line of box C), and subtract station 2+38 (the line above station 2+88) this will give you the ***Run*** part that you need.

   2+88 (288) -2+38 (238) = 50ft.

2. Take the ***Slope*** (0.004) that we found in the question 3 and Multiply by the ***Run*** (50), and that will give you the ***Rise*** that you will need

   0.004 (***Slope***) X 50ft. (***Run***) = ***0.2*** (***Rise***)

3. Take the Invert Elevation (1195.28) and add the ***Rise.*** This will give you the ***Invert Elevation*** for ***Box C***.

   1195.28 + 0.2 = 1195.48

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

6. Using the cut sheet above, calculate the value for Box C?

a. 1195.56
b. 1195.46
c. 1195.52
d. 1195.48

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

7. Using the Cut Sheet above, calculate the value for Box D?

a. 8.01
b. 8.10
c. 8.09
d. 8.00

CUT SHEETS

Need to find the Cut (Depth) for Box D

Subtract the ***Invert Elevation*** from the ***Stake Elevation***

1203.21 (*Stake Elevation*)

-1195.20 (*Invert Elevation*)

8.01 (Cut)

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

7. Using the Cut Sheet above, calculate the value for Box D?

a. **8.01**
b. 8.10
c. 8.09
d. 8.00

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

8. Using to Cut Sheet above, calculate the value for Box B?

a. 1203.98
b. 1204.25
c. 1204.37
d. 1203.72

CUT SHEETS

Need to find the ***Stake Elevation*** for Box B

To find the ***Stake Elevation*** take the ***Invert Elevation*** and add the ***Cut*** to get your ***Stake Elevation***

1195.08 (*Invert Elevation*)

+ 8.90 (*Cut*)

1203.98 (*Stake Elevation*)

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

8. Using to Cut Sheet above, calculate the value for Box B?

a. 1203.98

a. 1204.25
b. 1204.37
c. 1203.72

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

9. Using the Cut Sheet above, calculate the value for Box E ?

a) 5.98
b) 5.36
c) 6.02
d) 6.00

CUT SHEETS

1. Need to find the ***Invert Elevation*** for the C Box. We can refer back to Question # 6 to find that answer. There we find that the ***Invert Elevation*** is 1195.48
2. Take the ***Stake Elevation*** **(1201.50)**, and Subtract the ***Invert Elevation*** **(1195.48).** This well give you your ***Cut*** for Box E.

1195.48 **(*Invert Elevation*)**

-1201.50 **(*Stake Elevation*)**

6.02 (*Cut*)

CUT SHEETS

STATION	Stake Elev. (Elevation at Existing Grade)	Invert Elevation	Cut	Shoring Required
1+38	1205.22	1194.88	10.34	Yes
1+88	B	1195.08	8.90	G
A	1203.21	1195.20	D	Yes
2+38	1202.74	1195.28	7.46	H
2+88	1201.50	C	E	Yes
3+68	1199.14	1195.80	F	I

9. Using the Cut Sheet above, calculate the value for Box E ?

a) 5.98

b) 5.36

c) **6.02**

d) 6.00