Engineer Study Guide (Rev. 12/21/2022), Name_____Date_____

If you complete the entire study guide, fill out a training sign-in sheet for 4.5 hours, list the instructor as yourself, Agency SVFD and fill in the category credit

While studying the Engineer manual, fill in blanks for areas to help retain and summarize.

Good ☐ Review ☐ You may use these checkboxes to help a trainer understand what you feel confident with and what you want more review on or just don't understand. Check "Good" if you understand and feel like you can be tested on the topic. Check "Review" for an area you do not understand or do not fully comprehend.

Seven steps of pump operation are.....

1._____

2._____

3._____

4._____

5._____

6._____

7._____ _____

Good ☐ Review ☐

PTO stands for:

_____ _____ _____

When shifting a Mid-Ship pump, the complete cycle should take no less than ___ seconds

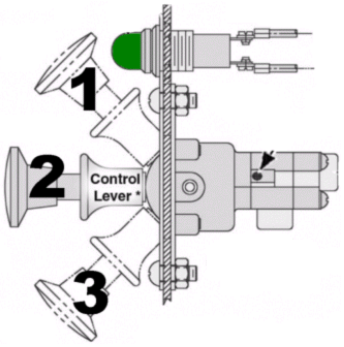
Label the positions:

1._____

2._____

3._____

Good ☐ Review ☐



Rule for transfer valves

If gpm **over** ½ the rated capacity of the pump set in _____

If gpm **under** ½ the rated capacity of the pump set in _____

Good ☐ Review ☐

You must throttle down below _____ psi before switching the transfer valve

Some examples of both type of friction loss are: Good ☐ Review ☐	
1.	**6.**
2.	**7.**
3.	**8.**
4.	**9.**
5.	**10.**

Rules of thumb friction loss Good ☐ Review ☐

Hose size	***FL per 100'***	***Standard GPM***
1"		
1½"		
1¾"		
2½"		
3"		
4"		

For every appliance in the hoselay add ____psi to the total friction loss amount. Good ☐ Review ☐

Calculate rules of thumb friction loss by _____ foot sections of hose, not by number of sections Good ☐ Review ☐

Basic requirements for nozzle pressures		
Any size fog nozzle requires *(unless a low pressure design)*	_____ psi	Good Review ☐ ☐
Handline solid bore nozzles require	_____ psi	
Master stream solid bore nozzles require *(deluge guns)*	_____ psi	
A foam educator requires	_____ psi	
Piercing & Cellar nozzles require	_____ psi	
The chimney nozzle requires	_____ psi	

R.O.T. 2½" **Stacktip**			***Actual 2½"*** **Stacktip**		
Tip	GPM	FL - 100'	Tip	GPM	FL - 100'
1"			1"		
1⅛"			1⅛"		
1¼"			1¼"		

Good Review ☐ ☐

Elevation Loss & Gain
Lose___psi per 10' above the pump
Gain ___psi per 10' below the pump
Good Review ☐ ☐

The _____ intake gauge tells the total PSI before it enters the impeller and the _____ discharge tells the total PSI of the water right after it exits the impeller.

Good Review ☐ ☐

Whatever line needs to operate at the _____ psi is what determines what the master discharge gauge will have to be at.

Good Review ☐ ☐

Pressure definitions:	
Static	
Flow	
Residual	

Good Review ☐ ☐

A _____ _____ is created when moving water is suddenly stopped and the momentum force is directed back through the system, possibly causing damage

Good Review ☐ ☐

Name 4 alternate water sources besides your booster tank on the truck	
1.	3.
2.	4.

Good Review ☐ ☐

Pump ratings and tank sizes		
Apparatus	***Capacity of pump***	***Tank size***
Engine 6	gpm	gallons
Engine 61	gpm	gallons
Engine 62	gpm	gallons
Squad 6	gpm	gallons
Ladder 6	gpm	gallons
Brush 6	gpm	gallons
Tanker 6	gpm	gallons

Good Review ☐ ☐

Opening the "_____ __ _____" valve and the "_____ _____" will allow water to go from the tank into the pump and back into the tank again, preventing either freezing or high temperatures by circulating.	Good Review ☐ ☐
The rule of thumb, when operating with only the booster tank as your supply, notify the Incident Commander when the water level reaches_____ tank capacity and also when there is a pump failure or other event that will affect safety and operations.	
No matter what size hose is being used for supply, the attack pumper should be receiving at least _____psi at it's intake.	

When using 2.5" hose for supply to another pumper, subtract ____ from the first two numbers of the gpm to find it's friction loss that needs to be accounted for.

Per 100 feet when supplying with 2½" hose		Good Review ☐ ☐
150gpm = ____psi friction loss	250gpm = ____psi friction loss	
200gpm = ____psi friction loss	300gpm = ____psi friction loss	

If supplying, add the total friction loss to a minimum of _____ to get your discharge psi Good Review ☐ ☐

Proper procedures for 4" hose	
1. Hook the "storz" or sexless coupling to the 4" intake and turn a ____ turn to lock. 2. Open the _____ valve. 3. Allow air to escape and wait till the bleeder flows a _____ stream of water. 4. Close the bleeder valve _____ tight. 5. Open valve on intake that allows water to flow into the pump. 6. When shutting down, assure the source of the supply is shut down. 7. Shut the valve leading into the pump. 8. Open the bleeder valve to relieve _____ The intake valve for 4" hose has it's own relief valve set at _____psi.	Good Review ☐ ☐

Hydrant basics			
Color	**Flow range**		_____caps = National Thread Silver caps = _____ Thread 3 required items that must be left at a hydrant _____ _____ _____
Blue		Good Review ☐ ☐	
Green			
Orange			
Red			
Black			

Good Review ☐ ☐

Good Review ☐ ☐

T/F A primer pump should never be operated for more than 30 seconds at a time. Good Review ☐ ☐

When supporting a sprinkler system, your desired discharge pressure is _____psi, not including elevation loss and not exceeding ____psi Good Review ☐ ☐

If you are driving a tanker for shuttle purposes, there are several tips that can make your mission effective.

1. Always drive _____.
2. Always have someone _____ you up to the dump tank.
3. You can leave the tank to pump and ___ _____ valves open between shuttles. This way all you have to do when you arrive back at the dump tank is put the pumps in gear and run the throttle up in the cab. You never get out of the cab and your dump time is decreased. Good Review ☐ ☐

I have completed all of the scenario layouts in the manual? ☐Yes □No

Driving Section

Some accidents occur because of the individual's lack of _____.

Some facts about emergency drivers (not good ones but typical)

1. Their mind is on the _____, not getting to it
2. They don't know what is going on ___ _____ their vehicle
3. They forget traffic signals "everyone sees me...they'll just stop to see what I do"
4. They want to push people out of the way, they forget their _____ _____
5. They want to 'beat the light"
6. They don't look at _____ sides of the intersection going through a green light
7. Their talking on the _____, pulling the air horn cord, wondering where that dang road is

Tips for calming and reducing adrenaline:

_____
_____
_____
_____
_____
_____
_____
_____

Always do a _____ ____ _____to check for open compartments, loose equipment, children and other objects

Use a _____ **or** _____ if one is available when backing

Gauge	Purpose	Consequences if over/under
Voltometer		
Amp Meter		
Engine Temp		
Oil Pressure		
Tachometer		
Air Pressure		

It is not acceptable to proceed across a _____ crossing with the gates down

Even bridges that have been designed properly and maintained can present problems. They _____ quicker than the road surface.

§20-_____. When speed limit is not applicable.

This exemption shall not, however, protect the driver of any such vehicle from the consequence of a _____ _____ of the safety of others.

§20-____. (Covers responsibilities of citizen drivers pulling over for emergency vehicles)

(A) States: ☞Citizen drivers must pull to the _____ of the curb when approached by an emergency vehicle that has activated their proper warning devices

☞Audible signal (siren) must be able to be heard from _____ feet

(C) States: ☞ That (out of city, town corporate limits) a driver may not follow or stop closer than ____ feet of a fire apparatus when responding to an alarm

(D) States: ☞ That a driver may not run over a ____ _____ or block the apparatus from it's water supply regardless of the distance from the fire

(E) States: ☞ They may not park with in _____ feet of fire trucks, ambulances or rescue squad vehicles when rendering aid

All _____ _____ are responsible for insuring that assigned apparatus are responding

When anapparatus is out of the station, personnel driving or riding _____ on the apparatus are required to wear seat belts. (State law)

Sirens should be operated on wail or yelp only. The ___-___o tone is to be used for emergency evacuation only.

Any time that a piece of apparatus is out of the station, the operator and any passengers must have full _____ _____ with them. (Except rescue 6)

☞The law says you may go over the speed limit when answering an alarm, basically, if you act in a _____ and _____ manner. Also note that even going the speed limit may not be legal if conditions (_____, _____, _____ etc.) exist, that causes the determination that a slower speed than the posted speed limit is the prudent and safe one.

☞You will be held liable for going through a red light if such an action causes an accident. You may proceed through a red light with emergency warning equipment on, but there must be _____% accountability that all other vehicles are stopped and continuing through will not cause an accident.

_____ Force does not occur in a straight line like when you are trying to stop a vehicle etc. It occurs when there is movement in a radius or an arc and is felt as a force towards the outside of the radius or arc.

CF also affects the water but since water flows in a "wave" motion it multiplies it's inertia towards the outside of the curve. To help lessen the total force of the wave, _____ are installed inside the tanks

Do not _____ **the pedal!** *(Air brakes will use more air than needed & ABS brakes will not work).* **Do not "slam" on the brakes!** Keep constant pressure just before the tires begin to lose their grip on the road surface

Essentially, _____ is when the tire on your vehicle is not able to "push" water out of it's way enough for the tire to contact the road.

Application of _____, at times, is the only way that these vehicles will even move. They can allow us traction and control but they are not a cure all.

- ❄ If the temperature is near 32 degrees, expect _____ somewhere
- ❄ Ice may be formed by melting snow and then re-freezing
- ❄ _____ freeze over easier
- ❄ _____ under the road may cause it to freeze quicker
- ❄ Areas that do not get much sunlight may freeze earlier/thaw later
  - ☞ Roadways shaded by _____
  - ☞ Areas _____ by hills and mountains

❄ Areas with _____ snow may turn to ice

When the vehicle returns to the bay use a hose to continually wash the _____ until all snow or ice is gone.

Issues for Automatic chains

1. Only use in snow that is ___" or less (deeper snow will not let the chain sling under the tire)
2. Only engage the chains when going under ___ MPH

3. Do not go over _____ MPH when driving with the chains activated
4. Do not operate the chains in _____ terrain
5. Disengage the chains _____ to arriving at a scene.

The _____ for an emergency response may be decided upon if there is belief or confirmation that it is directly related to the actual _____ of life or property.

What is the _____ of the vehicle you are responding?

If while responding emergency, you feel that “doubt of justification”, go _____.

When proceeding through an intersection, always use the _____ rule. That means that you are _____% sure that every other vehicle sees you, has yielded and it is allowing you the right of way.

Traffic congestion and other time and season related problems

✔Leaf-Lookers and tourist in the _____
✔_____ - Bus traffic, bus stops, picking and letting off kids, sports and other events
✔_____ is in session
✔Farm _____ on the road during season
✔Parades around _____ time
✔_____ season - Heavier traffic around the parks and practice fields
✔Halloween - More pedestrians. Use red lights and siren as normal for warning during this Holiday but use even more caution than normal

Times of Day

_____ changes at plants. 6-7am, 3pm, 11pm
Most people going to or from work. 6-9am, 4-6pm

_____
Road work and _____ crews out generally from 7am-5 or 6pm
Any Friday afternoon with more people around _____ areas

During emergency responses the siren could cause some problems with the _____ and put the rider at serious risk or even causes a horse to run in front of the vehicle. The best option would be to turn the _____ off as soon as you see them and leave your warning lights on, pass them very slowly and turn it back on when you have traveled a reasonable distance.

Can you position the apparatus to block _____ from running into the scene?

The closer we can get to the structure, the less hose will have to be used but it will also mean that we are closer to making the engine an _____ problem (the possibility of your engine absorbing radiant heat and damaging/disabling it) and may be placing in the “_____ _____” of the structure.

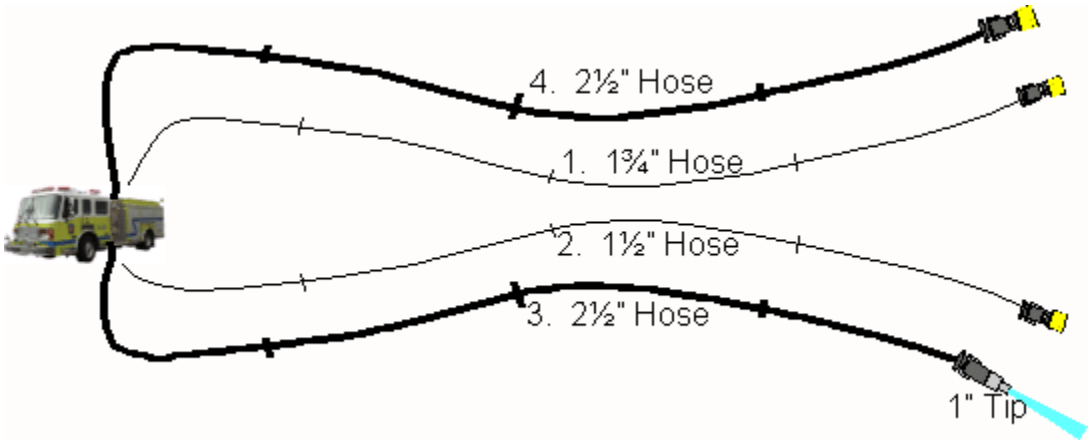
One method that can be used on approaching the structure is the _____-_____ size-up.
_____ Lay - from the hydrant to the fire/attack pumper
_____ Lay - From the fire/attack pumper to the hydrant

If you are using the vehicle as an attack vehicle on the fire or protecting a structure, here are a few things to consider.....

- ✔ Engine placement cannot block _____ route
- ✔ Remember all of the 10 standard firefighting orders and 18 watchout situations
- ✔ _____ the engine in from the last known turn-around
- ✔ Be prepared to disconnect/cut _____ quickly
- ✔ Keep _____ gallons of water in the tank for your protection
- ✔ Always start with a safe _____ point, cover your back
- ✔ Heavy smoke conditions may cause your vehicle to _____, stay upwind and out of smoke
- ✔Wear full protective clothing
- ✔Do not wet down ahead of the fire, _____ your water supply (Except when wetline and backfire strategies have been approved)
- ✔Have a protector line for your crew and engine
- ✔Use ____" hoselines if possible
- ✔Do not park under _____, next to propane tanks and other obvious hazards.
- ✔When protecting structures upslope from the head of the fire, _____ space must be present
- ✔Stay _____! Avoid the tendency to "dig-in"

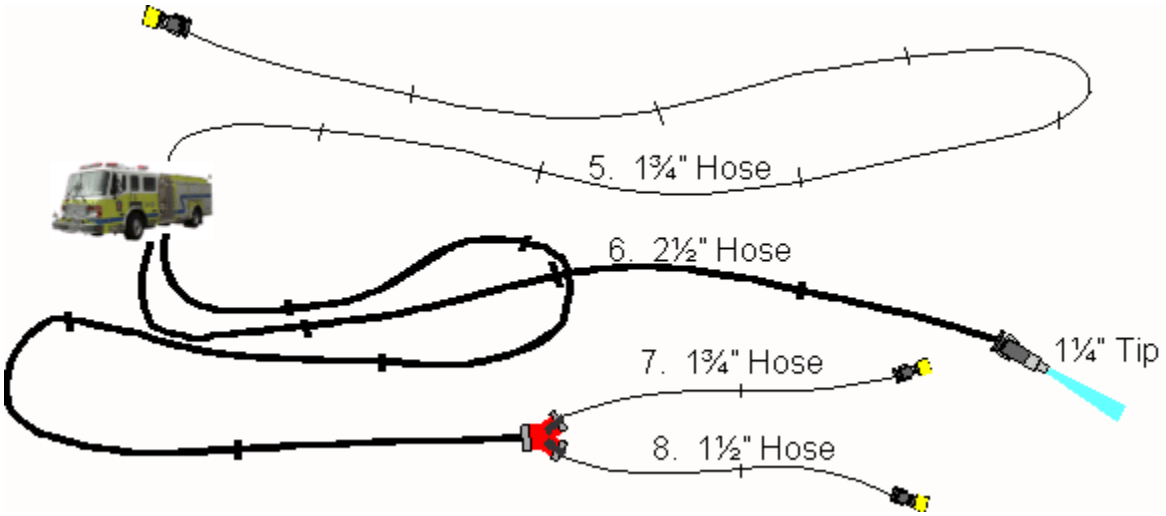
Consequences of an accident

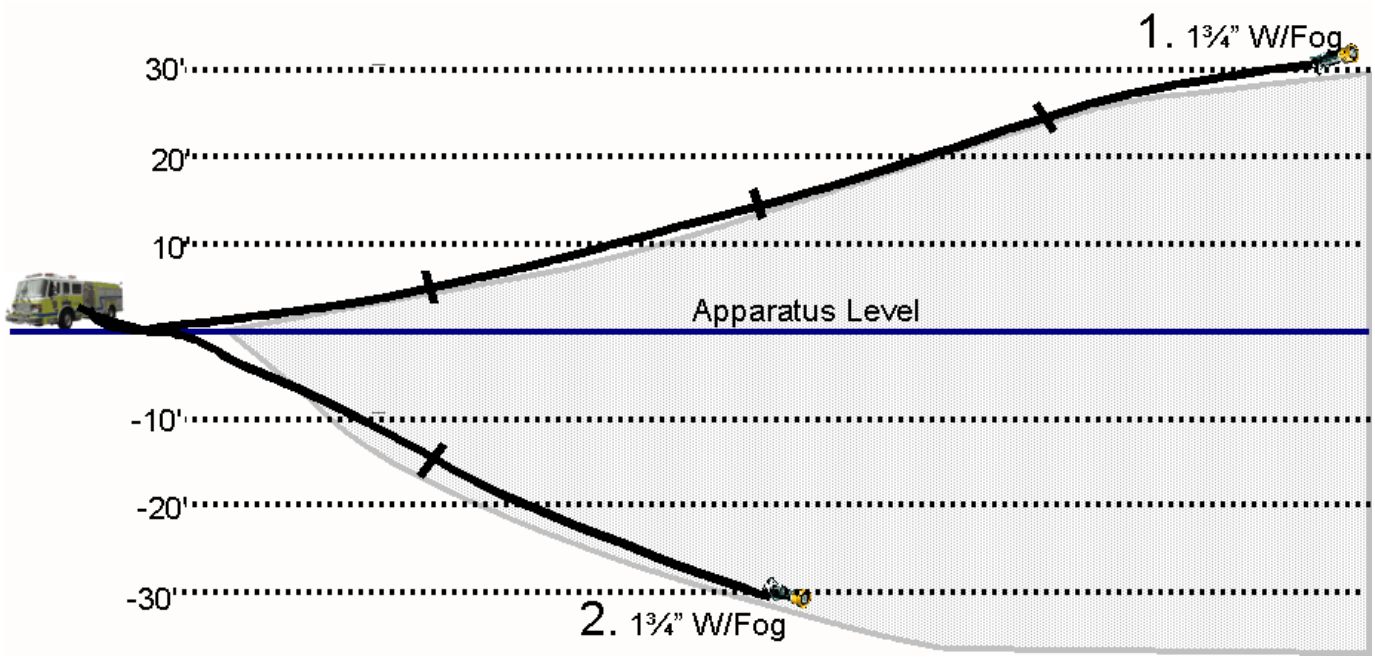
- ✔ _____ to you or your crew
- ✔ Injury to others
- ✔ _____ out of service from injury
- ✔ Disabilities for the _____ of their life
- ✔ Takes an apparatus away from 1st scene
- ✔ Takes personnel away from 1st scene
- ✔ Ties up other resources for your wreck and therefore taking more resources away from the 1st call
- ✔ _____ out of service until fixed
- ✔ Lawsuits, _____ costs
- ✔ _____ opinion / relations
- ✔ Critical Incident Stress, long term affects
- ✔ Loss of _____ life
- ✔ Your _____ _____ dealing with your loss/injury
- ✔ Loss of their life
- ✔ Their loved ones dealing with their loss/injury



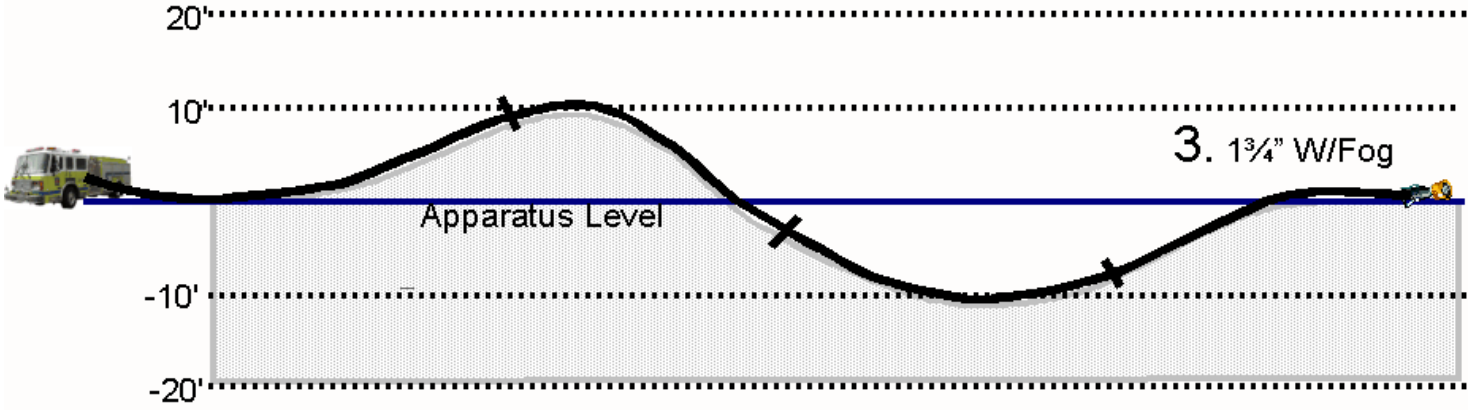
	1	2	3	4	5	6	7	8
How many sections of hose?								
PSI req. @ nozzle								
(Total line for 7&8) Total FL in line								
FL from appliances								
Elevation loss or gain								
Discharge pressure								
GPM on this line								
Time that line would last on E6's booster tank								

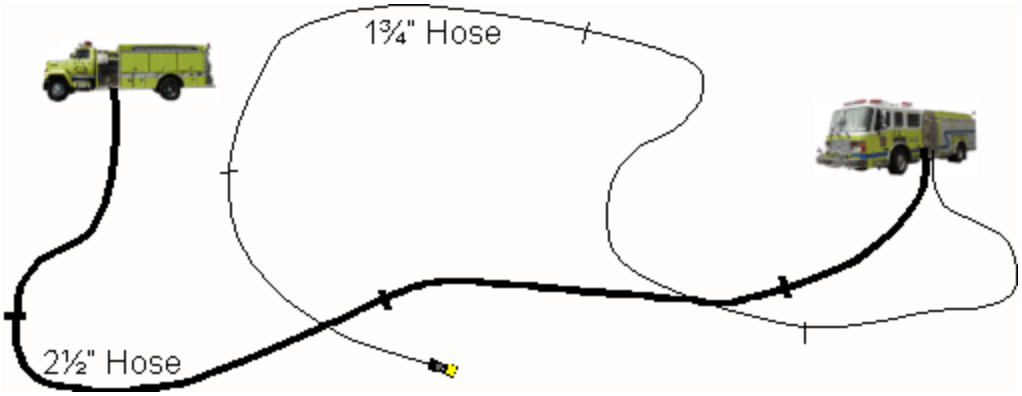
Master Discharge pressure if using all lines?	Top		Bottom	
What would the total GPM if all lines were flowing?	Top		Bottom	





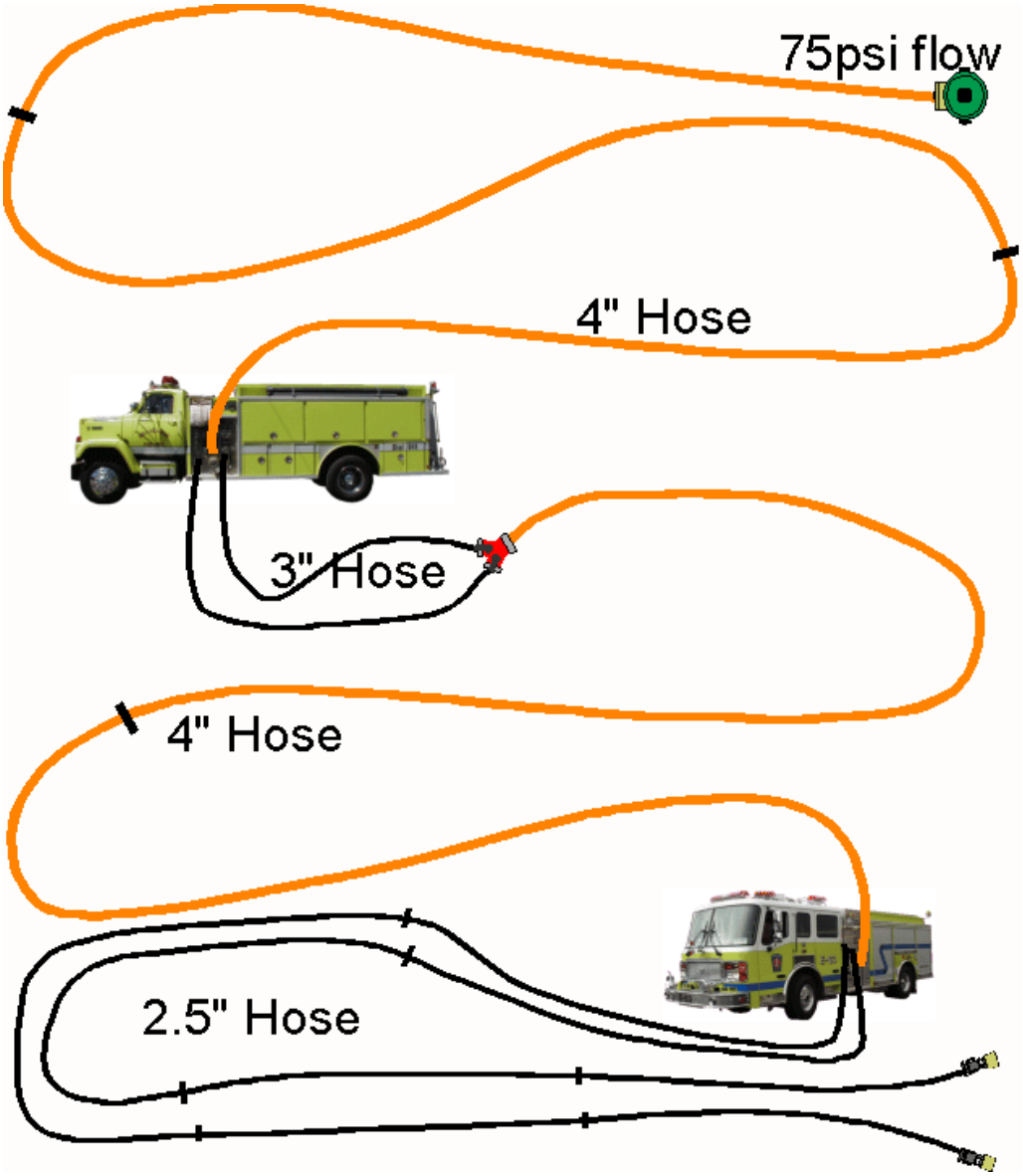
	1	2	3
How many sections of hose?			
PSI req. @ nozzle			
Total FL in Hose			
FL from appliances			
Elevation loss or gain			
Discharge pressure			
GPM on this line			





(Upper layout) GPM flowed by E6	
GPM you need to supply from E61	
FL per 100' in supply at this GPM	
Minimum intake PSI at E6	
Discharge PSI from E61	

(Lower layout) GPM flowed by E6	
Total FL between E61 & 6	
Minimum Discharge PSI from E61	
PSI intake @ E61	
Will this setup work?	



ANSWER KEY

	1	2	3	4	5	6	7	8
How many sections of hose?	4	4	4	4	8	4	8	8
PSI req. @ nozzle	100	100	50	100	100	50	100	100
(Total line for 7&8) Total FL For hose	50	50	20	30	100	50	70	70
FL from appliances	0	0	0	0	0	0	10	10
Elevation loss or gain	0	0	0	0	0	0	0	0
Discharge pressure	150	150	70	130	200	100	180	180
GPM on this line	150	125	209	250	150	326	150	125
Time that line would last on E63's booster tank	6:40	8:00	*4:45*	4:00	6:40	*3:04*	6:40	8:00

Master Discharge pressure if using all lines?	Top	150	Bottom	200
What would the total GPM if all lines were flowing?	Top	734	Bottom	751

3rd page of scenarios

(Upper layout) GPM flowed by E63	150
GPM you need to supply from E61	150
FL per 100' in supply at this GPM	5
Minimum intake PSI at E63	50
Discharge PSI from E61	60

(Lower layout) GPM flowed by E63	500
Total FL between E61 & 63	27.5
Minimum Discharge PSI from E61	77.5
PSI intake @ E61	60
Will this setup work?	Yes

** Notice that when you start using different size hose and lengths after a gated wye, you will be flowing different GPM through each and creating different friction losses but you are only able to supply one pressure to both since the gated wyes will cannot be locked and attempting to gate them down may end up creating a water hammer when the valve closes or moves from the flowing water.**

Notice that when there are hoselays that do not end in 100' increments (like the two lines coming into the siamese on the last layout) the FL numbers start ending up in digits like 7.5 but don't worry about decimals when your calculating, remember this is "Rule of Thumb"

**Notice in the last layout that you are flowing 500gpm. Since there are two lines coming into the siamese, the GPM are split between the two lines causing only 250GPM to flow through each. That is close to the flow used for the 15psi rule of thumb for 3" and since there is only 50', it is considered 7.5. You cannot add the FL from each of these lines together.

Elevation Scenarios	1	2	3
How many sections of	4	2	4
PSI req. @ nozzle	100	100	100
Total FL in Hose	50	25	50
FL from appliances	0	0	0
Elevation loss or gain	+15	-15	+10,-10 = 0
Discharge pressure	165	110	150
GPM on this line	150	150	150