CEE 3804 HW 2 Solutions

PROBLEM 1

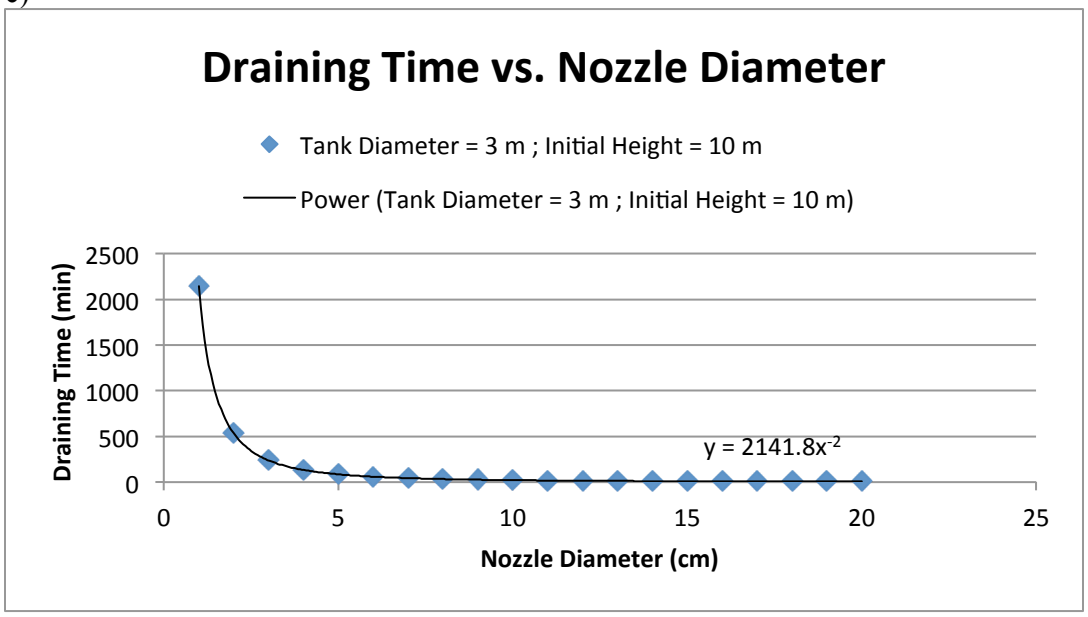
a)

```
'FUNCTION: drainingtime

'Calculates the time it takes for the water level
'in a cylindrical tank with cylindrical nozzle at
'bottom to drain from an initial height to a final height

'programmer: R. Powers
'date: 9/3/2013

'Inputs:
'   tank diameter (m)
'   nozzle diameter (m)
'   initial height (m)
'   final (drained) height (m)

Public Function drainingtime(tankdiameter, nozzlediameter, initialheight, drainedheight)

'Define Pi because Pi is not a built-in constant
Pi = 3.1416

'Define gravitational constant
g = 9.81                                'm/s/s

'Define tank area At and nozzle area An
At = 0.25 * Pi * (tankdiameter) ^ 2      'm^2
An = 0.25 * Pi * (nozzlediameter) ^ 2    'm^2

'Define function for draining time (s)
drainingtime = ((2 * (At / An)) / Sqr(2 * g)) * (Sqr(initialheight) - Sqr(drainedheight))

End Function
```

b)

Nozzle Diameter		Δt (Draining Time)		
cm	m	s	min	hr
1	0.01	128505.9	2141.765	35.69608
2	0.02	32126.47	535.4412	8.92402
3	0.03	14278.43	237.9739	3.966231
4	0.04	8031.618	133.8603	2.231005
5	0.05	5140.235	85.67059	1.427843
6	0.06	3569.608	59.49346	0.991558
7	0.07	2622.569	43.70948	0.728491
8	0.08	2007.904	33.46507	0.557751
9	0.09	1586.492	26.44154	0.440692
10	0.1	1285.059	21.41765	0.356961
11	0.11	1062.032	17.70053	0.295009
12	0.12	892.402	14.87337	0.247889
13	0.13	760.3898	12.67316	0.211219
14	0.14	655.6423	10.92737	0.182123
15	0.15	571.1372	9.518954	0.158649
16	0.16	501.9761	8.366268	0.139438
17	0.17	444.657	7.41095	0.123516
18	0.18	396.6231	6.610385	0.110173
19	0.19	355.972	5.932866	0.098881
20	0.2	321.2647	5.354412	0.08924

c)



The function is a power function—more specifically, an inverse second degree polynomial. That is, draining time and nozzle diameter have a nonlinear relationship.

PROBLEM 2

a)

```
'FUNCTION: watervelocity

'Calculates the velocity of water flowing through a pipe
'as a function of the physical properties of the pipe

'programmer: R. Powers
'date: 9/4/2013

'Inputs:
'   pipe diameter (m)
'   head loss per unit length (m/m)
'   friction factor

Public Function watervelocity(pipediameter, headloss, frictionfactor)
'Define dimensionless constants
k = 0.85
a = 0.63
B = 0.54

'Define function for water velocity (m/s)
watervelocity = k * frictionfactor * ((pipediameter / 4) ^ a) * ((headloss) ^ B)

End Function
```

b)

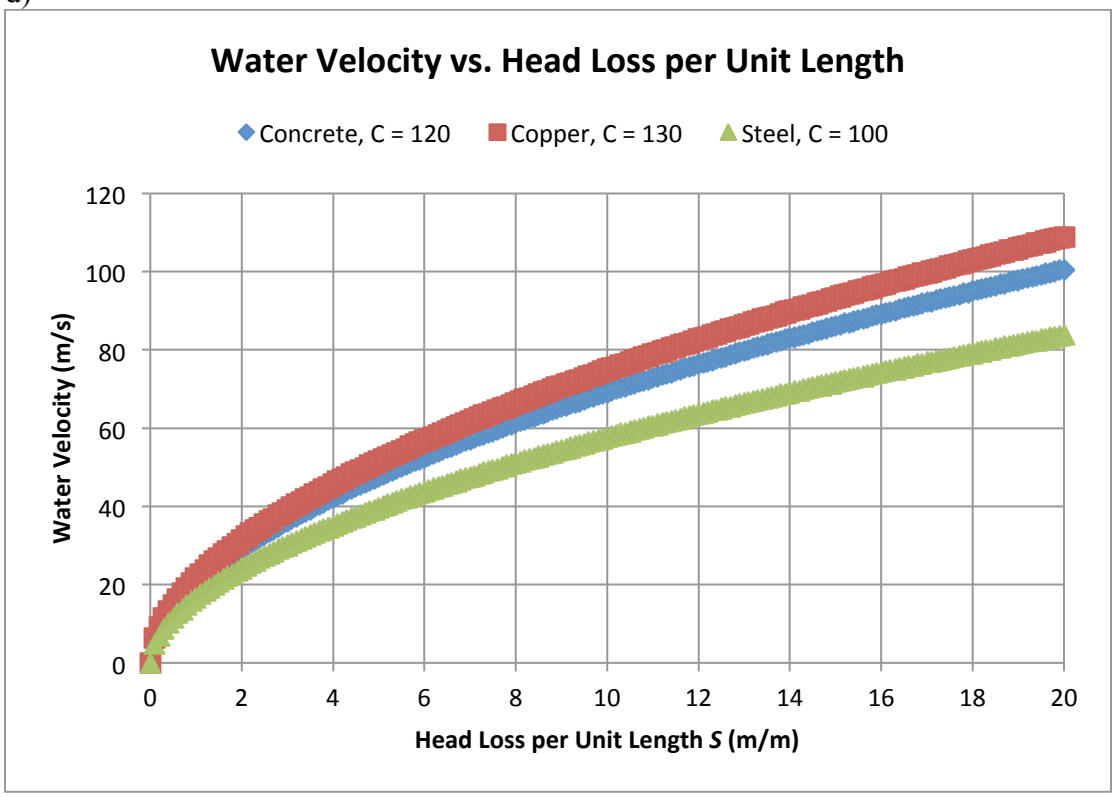
Friction factor		120	
Diameter		0.3	m
S		10	m/m
v		69.16538	m/s

c)

v		
Copper	74.92916	m/s
Steel	57.63782	m/s

Steel has higher friction than concrete, while copper has lower friction than concrete.

d)


Water Velocity vs. Head Loss per Unit Length
Concrete, C = 120
Copper, C = 130
Steel, C = 100
Water Velocity (m/s)
120
100
80
60
40
20
0
0
2
4
6
8
10
12
14
16
18
20
Head Loss per Unit Length S (m/m)

PROBLEM 3

Value ($)	(All)

a)

		Data	
Construction Site	Vehicle	Average of Value	Average of Miles
Greensboro	Cat 160H	151617.4429	127704.9172
	Cat 725	142389.2214	117181.2451
	Cat 775F	135575.0903	111698.734
Greensboro Total		141952.2386	117518.2872
Raleigh	Cat 160H	157876.3631	131967.3058
	Cat 725	154143.5901	128909.3752
	Cat 775F	163687.3946	133973.4255
Raleigh Total		158702.9582	131603.932
Richmond	Cat 160H	129649.8714	107278.9778
	Cat 725	145092.6328	120367.0494
	Cat 775F	153686.8314	127900.9925
Richmond Total		144901.0995	120294.948
Grand Total		148742.5142	123359.9623

b)

c)

Row Labels	Sum of Miles
Cat 160H	7612370.296
Cat 725	13559808.32
Cat 775F	12751811.02
Grand Total	**33923989.63**

d)

Status	Active

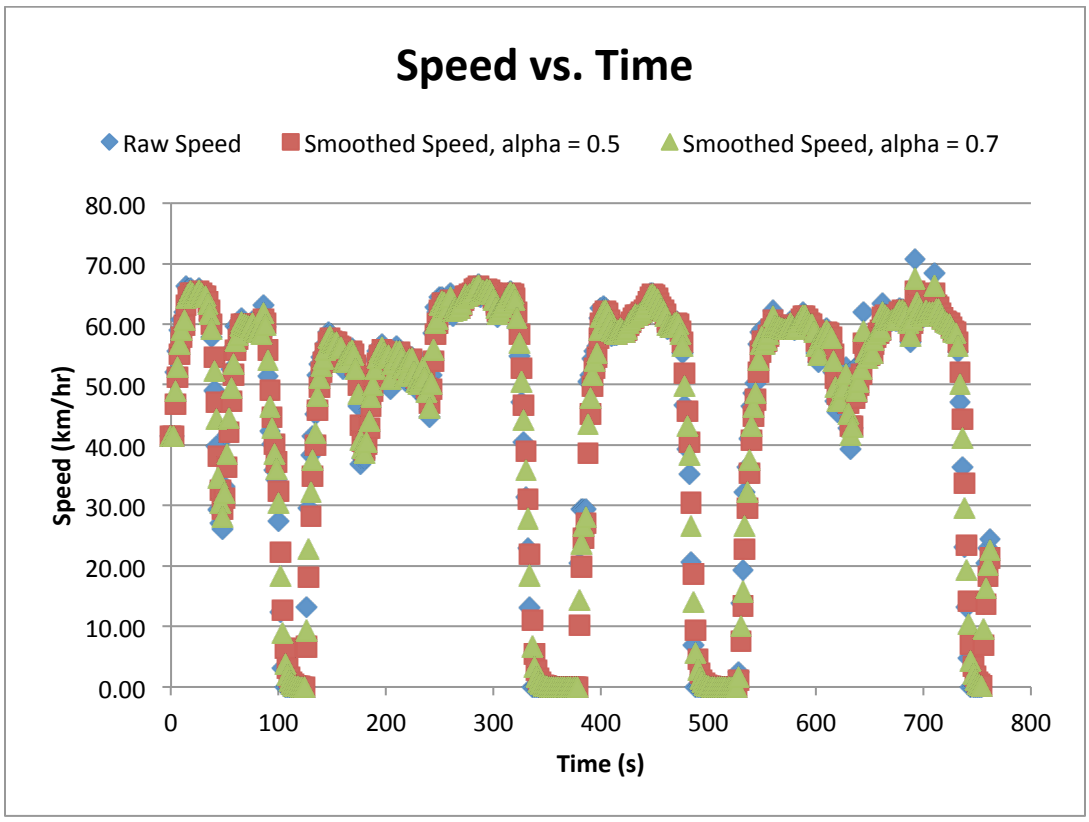
Row Labels	Count of Status
Cat 160H	**61**
Greensboro	13
Raleigh	22
Richmond	26
Cat 725	**107**
Greensboro	25
Raleigh	32
Richmond	50
Cat 775F	**95**
Greensboro	23
Raleigh	33
Richmond	39
Grand Total	**263**

PROBLEM 4

a) See attached Excel file.

	A	B	C	D	E	F
1	**Transportation Analysis**					
2						
3			alpha:	0.5		
4						
5	**Time (s)**	**Speed (km/h)**	**Speed (m/s)**	**Smoothed Speed (km/hr)**	**Smoothed Speed (m/s)**	**Acceleration (m/s^2)**
6	0	41.43	11.51	41.43	11.51	0.00
7	2	41.43	11.51	41.43	11.51	0.00
8	4	52.11	14.48	46.77	12.99	1.48
9	6	55.60	15.44	51.19	14.22	0.48
10	8	58.92	16.37	55.05	15.29	0.46
11	10	60.76	16.88	57.91	16.09	0.26
12	12	61.86	17.18	59.88	16.63	0.15
13	14	66.28	18.41	63.08	17.52	0.61
14	16	65.73	18.26	64.41	17.89	-0.08

d)



PROBLEM 5

	A	B	C	D
1			Formula	
2	Loan amount	1200000000		USD
3	Number of years	20		
4	Number of Periods	240		
5	Interest	5.00%		percent
6				
7	Monthly Payment	($7,919,468.87)	=PMT(B5/12,B4,B2)	
8	Yearly Payment	($95,033,626.45)	=B7*12	
9				
10	Paid by landing fees	($38,013,450.58)	=0.4*B8	USD/yr
11	Landings per year	470000		
12	Average Landing Fee	($80.88)	=B10/B11	USD/yr