

**SP04A**

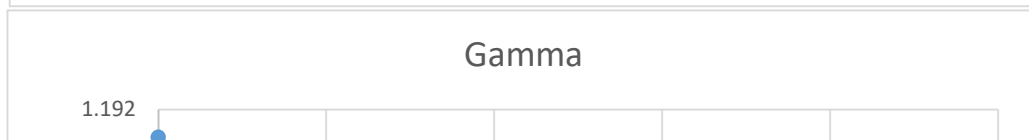
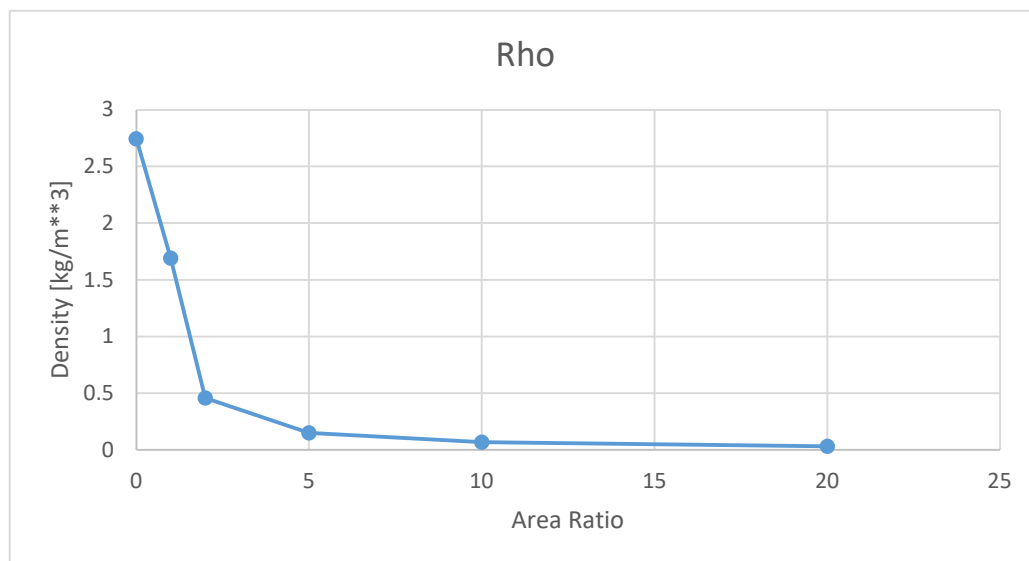
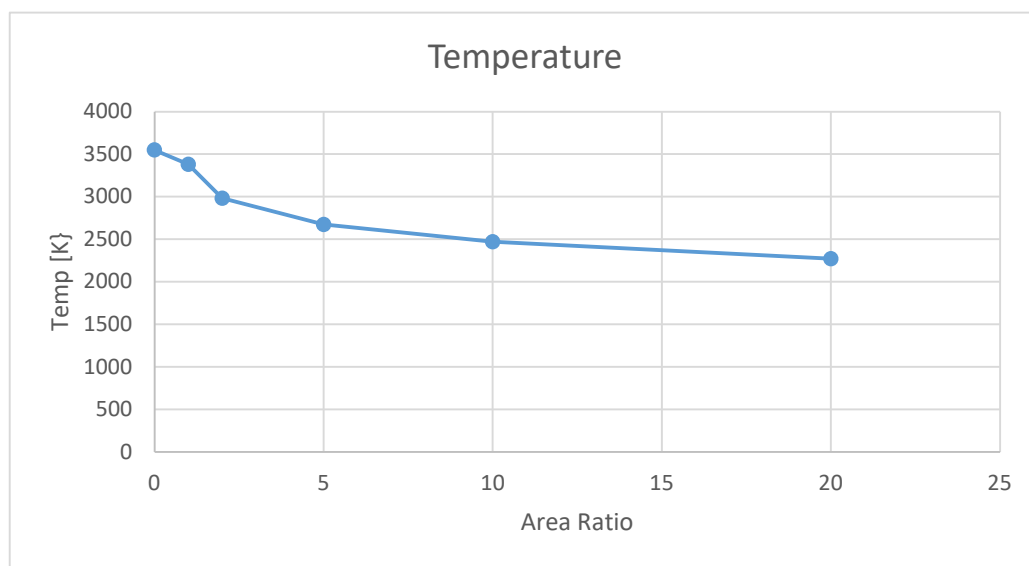
**Name** Veronica Loomis  
**Given:** O/F = 7.934  
Pc = 50 atm  
Equilibrium Flow  
Nozzle Area Ratios: 0, 1, 2, 5, 10, 20  
**Find:** Plots of values as a function of the nozzle area ratio  
**Analysis:** CEQUEL

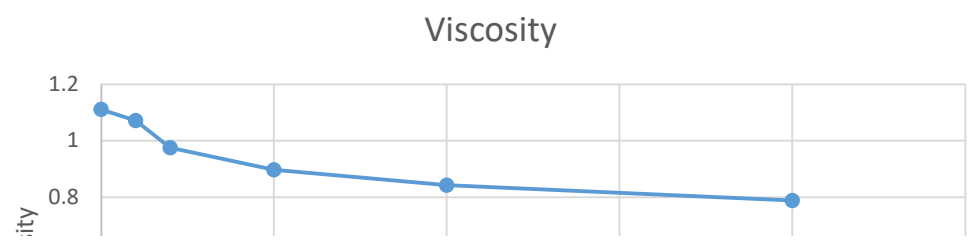
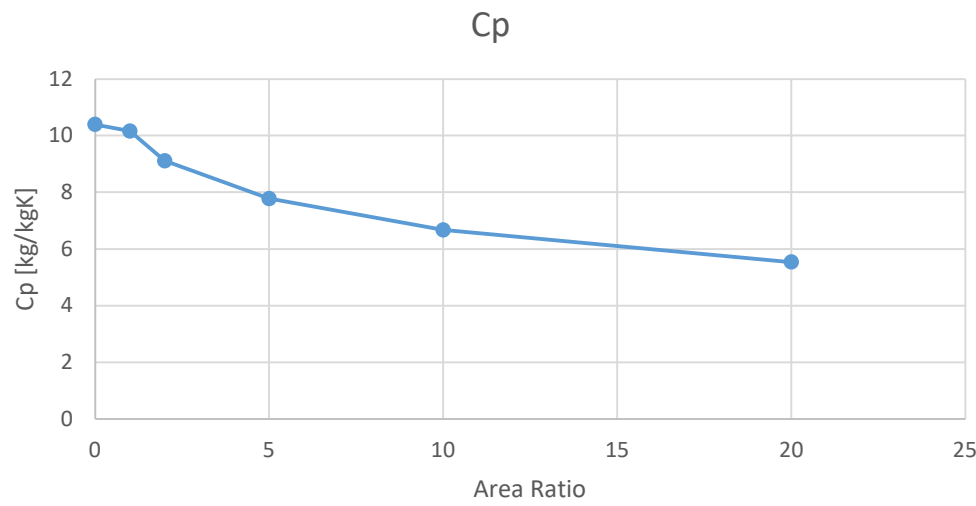
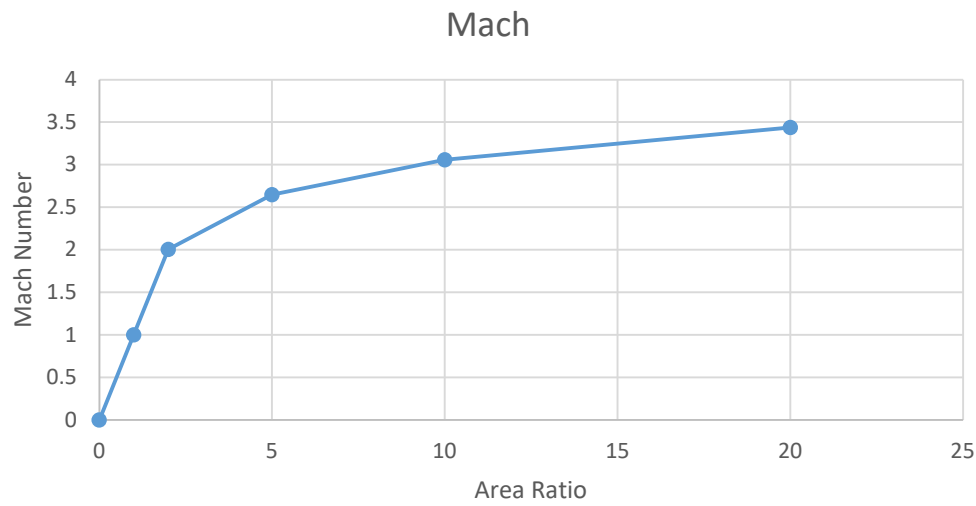
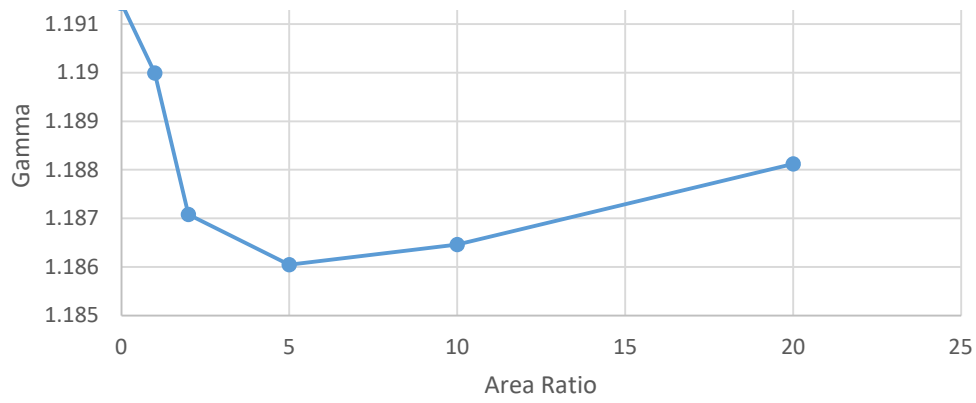
O/F 7.934  
Pc (atm) 50  
Pc (bar) 50.6625

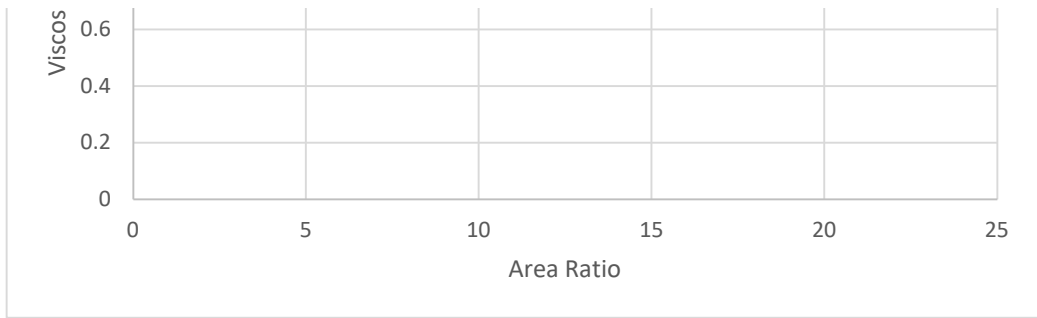
Area Ratios	0	1	2	5	10	20	
OF	7.934	7.934	7.934	7.934	7.934	7.934	DIMENSIONLESS
FPCT	11.19319	11.19319	11.19319	11.19319	11.19319	11.19319	DIMENSIONLESS
ERATIO	1.000338	1.000338	1.000338	1.000338	1.000338	1.000338	DIMENSIONLESS
Phi	1.000338	1.000338	1.000338	1.000338	1.000338	1.000338	DIMENSIONLESS
AR	0	1	2	5	10	20	DIMENSIONLESS
P	50.6625	29.35713	6.780241	1.920466	0.791986	0.334503	BAR
T	3548.422	3381.747	2980.844	2673.461	2468.599	2270.965	DEG K
RHO	2.744301	1.691015	0.458145	0.148395	0.067298	0.031285	KG/M^3
H	-860.601	-1837.49	-4187.76	-5934.71	-7028.45	-7996.04	KJ/KG
U	-2706.7	-3573.56	-5667.7	-7228.86	-8205.28	-9065.27	KJ/KG
GFE	-57163.8	-55496.1	-51485.2	-48354.8	-46198	-44029.7	KJ/KG
S	15.86712	15.86712	15.86712	15.86712	15.86712	15.86712	KJ/(KG K)
Z	1	1	1	1	1	1	DIMENSIONLESS
MW	15.98148	16.19614	16.74688	17.17609	17.44107	17.65943	MOL WT
CP	10.39491	10.16045	9.115419	7.783356	6.67492	5.540151	KJ/(KG K)
CPG	3.238026	3.215358	3.150319	3.085956	3.033401	2.973607	KJ/(KG K)
GammaG	1.191429	1.189994	1.187081	1.186048	1.186461	1.188121	DIMENSIONLESS
Gamma	1.128506	1.12541	1.119764	1.119001	1.121974	1.12928	DIMENSIONLESS
C	1443.376	1397.779	1287.313	1203.395	1149.075	1098.844	M/S
MW_MIX	15.98148	16.19614	16.74688	17.17609	17.44107	17.65943	MOL WT
Viscosity	1.110518	1.071734	0.975276	0.897615	0.843612	0.789487	milliPOISE
Specific_Heat	10.39516	10.16055	9.114248	7.782729	6.674583	5.54	KJ/(KG K)
Conductivity_	22.1023	20.77815	16.62412	12.60708	9.756744	7.160257	milliW/(CM K)
Prandtl_Eq	0.522299	0.52408	0.5347	0.554125	0.577114	0.610839	DIMENSIONLESS
Specific_Heat	3.238087	3.215396	3.150436	3.085993	3.033415	2.973612	KJ/(KG K)
Conductivity_	4.909735	4.663019	4.058006	3.582104	3.259603	2.945546	milliWATTS/(CM K)
Prandtl_FR	0.732413	0.739017	0.757157	0.773298	0.785073	0.79701	DIMENSIONLESS
PINJ_P	-999.999	-999.999	-999.999	-999.999	-999.999	-999.999	N/A
PC_P	1	1.725731	7.472079	26.38032	63.96894	151.456	DIMENSIONLESS
MACH	0	0.999998	2.003862	2.647198	3.056562	3.437869	DIMENSIONLESS
AR	0	1	2	5	10	20	DIMENSIONLESS
CSTAR	0	2143	2143	2143	2143	2143	M/S
CF		0.652133	1.203513	1.486255	1.638628	1.762479	DIMENSIONLESS

ISPV	2639.796	3153.305	3591.874	3847.288	4060.72	M/S
ISP	1397.776	2579.598	3185.626	3512.22	3777.682	M/S
ISPVRHO	0	0	0	0	0	KG/(M^2 S)
AR	0	1	2	5	10	20 DIMENSIONLESS
H	0.001984	0.001678	0.000978	0.000524	0.000292	0.000137 MASS
H2	0.014558	0.013224	0.0097	0.00679	0.004873	0.003184 MASS
H2O	0.797388	0.819032	0.87361	0.915653	0.941706	0.963468 MASS
H2O2	6.93E-05	4.37E-05	1.18E-05	0	0	0 MASS
HO2	0.000375	0.000252	8.02E-05	2.58E-05	1.03E-05	0 MASS
O	0.014359	0.011811	0.006307	0.003074	0.001579	0.000672 MASS
O2	0.067528	0.063332	0.050333	0.037525	0.028067	0.019038 MASS
OH	0.103738	0.090627	0.058981	0.036405	0.023471	0.013497 MASS

Answer:







**Comment:** The tempeartures are lower for liquid than they are for gaseous propellants  
This makes sense since gases usually exist at higher temperatures, so  
not as much work has to be done compared to converting them from  
liquid to gas.