Homework #10

1. You'd like to reform 10,000 bpd methyl-cyclohexane to toluene (100% conversion).
   - How many bbl/day toluene will result?
   - What is the change in boiling point between the methyl-cyclohexane and the toluene?
   - How much hydrogen will be produced (in both scf/bbl feed & scf/day)?

2. You'd like to convert 10,000 bpd of isobutylene to isooctane in an alkylation unit.
   - How much isobutane (in bpd) is needed for 100% conversion & no excess of either reactant?
   - How many bbl/day isooctane will be made?
   - How much hydrogen will be produced (in both scf/bbl feed & scf/day)?

3. You'd like to reform 10,000 bpd of the Heavy Naphtha from Hibernia to 97 RON clear.
   - How much crude oil must be processed to make this much reformer feed?
   - How many bbl/day C5+ gasoline will be made?
   - How much hydrogen will be produced (in both scf/bbl feed & scf/day)?

4. You'd like to do some calculations for the reforming of 10,000 bpd Heavy Naphtha from Hibernia based upon chemistry. Assume all of the reported naphthenes are methyl-cyclohexane. Further assume that the only reaction that occurs is to dehydrogenate the naphthenese to aromatics.
   - How much liquid will remain (in bpd)?
   - How much hydrogen will be produced (in both scf/bbl feed & scf/day)?

Hibernia Crude Oil – Summary of Major Cuts

	Whole Crude	Light Naphtha	Medium Naphtha	Heavy Naphtha	Kero	Atm Gas Oil	Light VGO	Heavy VGO	Vacuum Resid	Atm Resid
TBP Temp At Start, °C	Start	10	80	150	200	260	340	450	570	340
TBP Temp At End, °C	End	80	150	200	260	340	450	570	End	End
TBP Temp At Start, °F	Start	55	175	300	400	500	650	850	1050	650
TBP Temp At End, °F	End	175	300	400	500	650	850	1050	End	End
Yield at Start, vol%		1.6	7.3	21.3	30.9	41.6	56.7	74.3	86.6	56.7
Yield at End, vol%		7.3	21.3	30.9	41.6	56.7	74.3	86.6	100.0	100.0
Yield of Cut (wt% of Crude)		4.5	12.6	8.9	10.4	15.1	18.4	13.3	15.6	47.3
Yield of Cut (vol% of Crude)		5.7	14.0	9.6	10.7	15.1	17.6	12.3	13.4	43.3
Gravity, °API	35.9	81.0	53.9	48.6	40.7	35.2	28.1	22.8	13.0	21.6
Specific Gravity	0.8454	0.6660	0.7632	0.7857	0.8218	0.8489	0.8868	0.9168	0.9791	0.9240
Sulfur, wt%	0.34	0.00	0.00	0.01	0.02	0.15	0.40	0.53	1.07	0.66
Mercaptan Sulfur, ppm		1	2	2	3	3	3			
Nitrogen, ppm	1035		0	1	1	51	710	1837	4186	2170
Hydrogen, wt%		16.1	15.9	15.4	14.6	14.0	13.2	12.5		
Viscosity @ 40 °C (104 °F), cSt	5.09			1.07	1.74	4.06	16.9	168	69661	257
Viscosity @ 50 °C (122 °F), cSt	3.55			0.938	1.47	3.26	12.2	93.8	20100	141
Viscosity @ 100 °C (212 °F), cSt	1.04			0.563	0.797	1.46	3.84	13.6	465	19.1
Viscosity @ 135 °C (275 °F), cSt	0.610			0.438	0.591	0.994	2.27	6.03	110	8.21
Freeze Point, °C				-58.000	-31.000	2.00	45.0			
Freeze Point, °F				-72	-23	36	113			
Pour Point, °C	13		-87	-60	-34	-1	34	51	35	29
Pour Point, °F	55		-125	-76	-29	31	93	124	95	84
Smoke Point, mm (ASTM)				25	20	17	15			
Aniline Point, °C				52	60	71	86	98		
Aniline Point, °F				125	140	160	187	208		
Total Acid Number, mg KOH/g	0.11	0.0	0.0	0.0	0.0	0.0	0.1	0.2		
Cetane Index, ASTM D976				37	46	52				
Diesel Index				61	57	56	52	48		
Characterization Factor (K Factor)	11.6	12.7	11.6	11.8	11.8	11.9	12.0	12.2	12.0	12.0
Research Octane Number, Clear		64.8	56.4	34.2						
Motor Octane Number, Clear		63.0								
Paraffins, vol%		83.1	48.1	51.2	46.9	40.0	30.6			
Naphthenes, vol%		16.9	35.2	30.4	31.8	33.0	36.1			
Aromatics, vol%		0.0	16.7	18.4	21.2	27.0	33.3			
Thiophenes, vol%										
Molecular Weight	233	103	112	143	176	227	326	471	824	436
Gross Heating Value, MM BTU/bbl	5.81	4.86	5.38	5.52	5.71	5.85	6.03	6.18	6.42	6.20
Gross Heating Value, kcal/kg	10900	11580	11190	11140	11050	10940	10800	10690	10390	10660
Gross Heating Value, MJ/kg	45.6	48.5	46.8	46.6	46.2	45.8	45.2	44.7	43.5	44.6
Heptane Asphaltenes, wt%	0.9								5.6	1.9
Micro Carbon Residue, wt%	1.2								8.0	2.6
Ramsbottom Carbon, wt%	1.2								7.6	2.5
Vanadium, ppm	1								6	2
Nickel, ppm	1								6	2
Iron, ppm										