Model Solution

Part 1(a):

				Coil Blue (1-1)				AIR CORE		f = 1.000 KHz		
	R'	V_A	$V_{R'}$	V	Vo	I_1	Z_1	R_1	X_1	ωM	M (mH)	L_1(mH)
	450	10.090	6.760	6.770	4.940							
		10.060	6.700	6.740	4.910							
Avg	450	10.075	6.730	6.755	4.925	0.015	451.67	52.57	448.60	329.31	52.44	71.43

ΔV_A	ΔVR'	ΔV
0.14	0.11	0.11

us(z)	us(R)	ur(Z)	ur(R)	uc(R)	uc(Z)	uc(X)	uc(L)	U(R)	U(X)	U(L)
0.0057	1.1432	0.2747	0.4235	1.2191	0.2748	0.3114	0.000050	3.00	0.7	0.0002

Part 1b:

	Coil Green (2-2)					AIR CORE			f = 1.000 KHz		
	R'	V_A	$V_{R'}$	V	Vo	I_2	Z_2	R_2	X_2	ωM	M (mH)	L_2(mH)
	350	9.960	6.690	6.610	6.390							
		9.980	6.630	6.680	6.410							
Avg	350	9.970	6.660	6.645	6.400	0.019	349.21	42.96	346.56	336.34	53.56	55.18

ΔV_A	ΔVR'	ΔV
0.14	0.11	0.11

us(z)	us(R)	ur(Z)	ur(R)	uc(R)	uc(Z)	uc(X)	uc(L)	U(R)	U(X)	U(L)
0.0027	0.9057	0.2153	0.3335	0.9651	0.2153	0.2478	0.000039	2.00	0.5	0.0001

Part 1(c)

				Coil Blue (1-1)				Al CORE		f = 1.000 KHz		
	R'	V_A	$V_{R'}$	V	Vo	I^*_1	Z^*_1	R^*_1	X^*_1	ωM	M* (mH)	L^*_1(mH)
	290	9.900	5.940	6.010	4.450							
		9.880	5.890	6.050	4.410							
Avg	290	9.890	5.915	6.030	4.430	0.020	295.64	109.68	274.54	217.19	34.58	43.72

ΔV_A	ΔVR'	ΔV
0.14	0.10	0.10

us(z)	us(R)	ur(Z)	ur(R)	uc(R)	uc(Z)	uc(X)	uc(L)	U(R)	U(X)	U(L)
0.0220	1.2498	0.2030	0.3740	1.3046	0.2042	0.5657	0.000090	3.00	1.2	0.0002

Part 1(d):

	Coil Green (2-2)						Al CORE		f = 1.000 KHz		
	R'	V_A	$V_{R'}$	V	Vo	I^*_2	Z^*_2	R^*_2	X^*_2	ωM	M*(mH)	L^*_2(mH)
	280	9.860	6.280	6.170	4.840							
		9.830	6.230	6.130	4.860							
Avg	280	9.845	6.255	6.150	4.850	0.022	275.30	71.48	265.86	217.11	34.57	42.33

ΔV_A	ΔVR'	ΔV
0.14	0.10	0.10

us(z)	us(R)	ur(Z)	ur(R)	uc(R)	uc(Z)	uc(X)	uc(L)	U(R)	U(X)	U(L)
0.0173537	0.9509	0.1821	0.3106	1.000	0.1829	0.329	0.000052	3.00	0.7	0.0002

Part 2(f):

$$\omega M = R' \frac{V_O}{V_{R'}}$$

$$k = \frac{M}{\sqrt{L_1 L_2}}$$

M_{avg} (Air) =	53.00 mH		k =	0.844
M^*_{avg} (Al core) =	34.58 mH		k^* =	0.804

Part 2(g):

						AIR Core				f = 1.000 KHz R'=300Ω	
	Sr.	R_L	V_A	$V_{R'}$	V	V_{RL}	Ip	Zp	R_{PE}	X_{PE}	Is
	1	100	10.19	5.99	4.97	1.73					
			10.15	6.03	4.94	1.72					
Avg		100	10.17	6.01	4.96	1.73	0.0200	247.34	177.56	172.19	0.017
	2	200	10.12	5.39	5.67	2.77					
			10.09	5.44	5.70	2.79					
Avg		200	10.11	5.42	5.69	2.78	0.0181	314.96	207.03	237.36	0.014
	3	300	10.13	5.17	6.17	3.44					
			10.15	5.11	6.19	3.43					

Avg		300	10.14	5.14	6.18	3.44	0.0171	360.70	216.93	288.18	0.011
	4	400	10.11	5.00	6.51	3.88					
			10.14	5.05	6.53	3.87					
Avg		400	10.13	5.03	6.52	3.88	0.0168	389.25	206.46	329.99	0.010
	5	500	10.15	4.93	6.74	4.20					
			10.12	4.99	6.77	4.17					
Avg		500	10.14	4.96	6.76	4.19	0.0165	408.57	198.08	357.34	0.008
	6	600	10.10	4.98	6.91	4.42					
			10.13	4.91	6.93	4.40					
Avg		600	10.12	4.95	6.92	4.41	0.0165	419.82	183.87	377.41	0.007
	7	700	10.14	4.97	7.05	4.58					
			10.11	4.91	7.07	4.60					
Avg		700	10.13	4.94	7.06	4.59	0.0165	428.74	173.76	391.96	0.007
	8	800	10.09	4.91	7.17	4.74					
			10.12	4.98	7.15	4.72					
Avg		800	10.11	4.95	7.16	4.73	0.0165	434.38	161.90	403.08	0.006

Part 2(h)

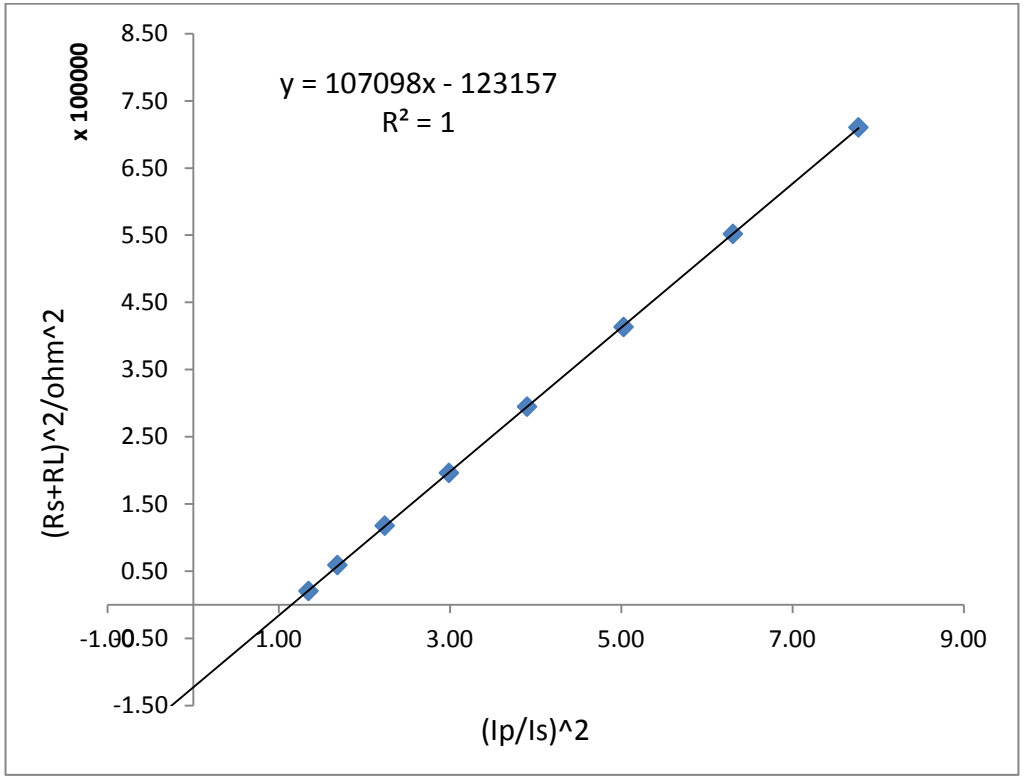
$$(R_S + R_L)^2 = (\omega M)^2 \left(\frac{I_P}{I_S}\right)^2 - X_S^2$$

Slope		M
1.07E+05		52.08 mH
Intercept		X_2
1.23E+05		350.94 Ω

Part 2(i)

$(Ip/Is)^2$	$(Rs+R_L)^2$
1.35	20438.25
1.69	59030.73
2.24	117623.21
2.99	196215.69
3.90	294808.17
5.03	413400.65
6.31	551993.13
7.77	710585.61

Part 2(j):



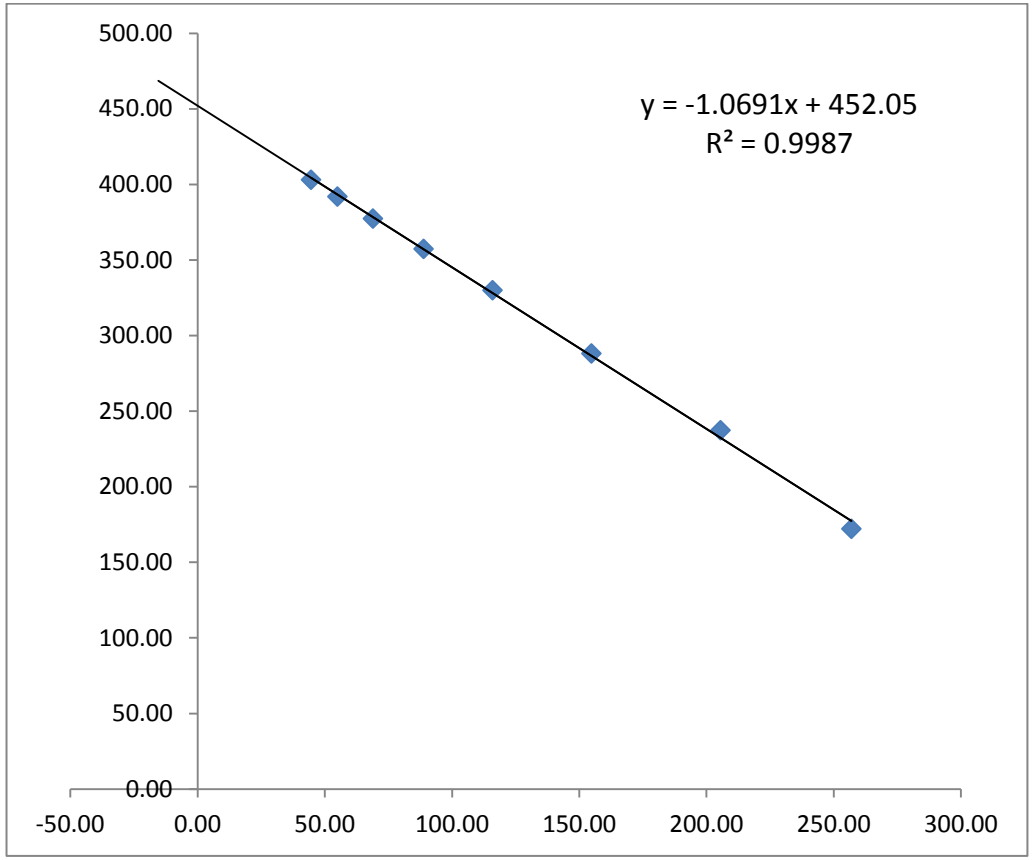
Part 3(k) and 3(l):

$$R_R = \left(\frac{I_S}{I_P}\right)^2 \left(R_S + R_L\right)$$

$$X_P = \left(\frac{I_S}{I_P}\right)^2 X_S$$

Sr.	R_R	X_R
1	106.00	256.95
2	144.08	205.52
3	153.17	154.78
4	148.17	115.92
5	139.16	88.82
6	127.84	68.91
7	117.81	54.95
8	108.46	44.59

Part 3(m)



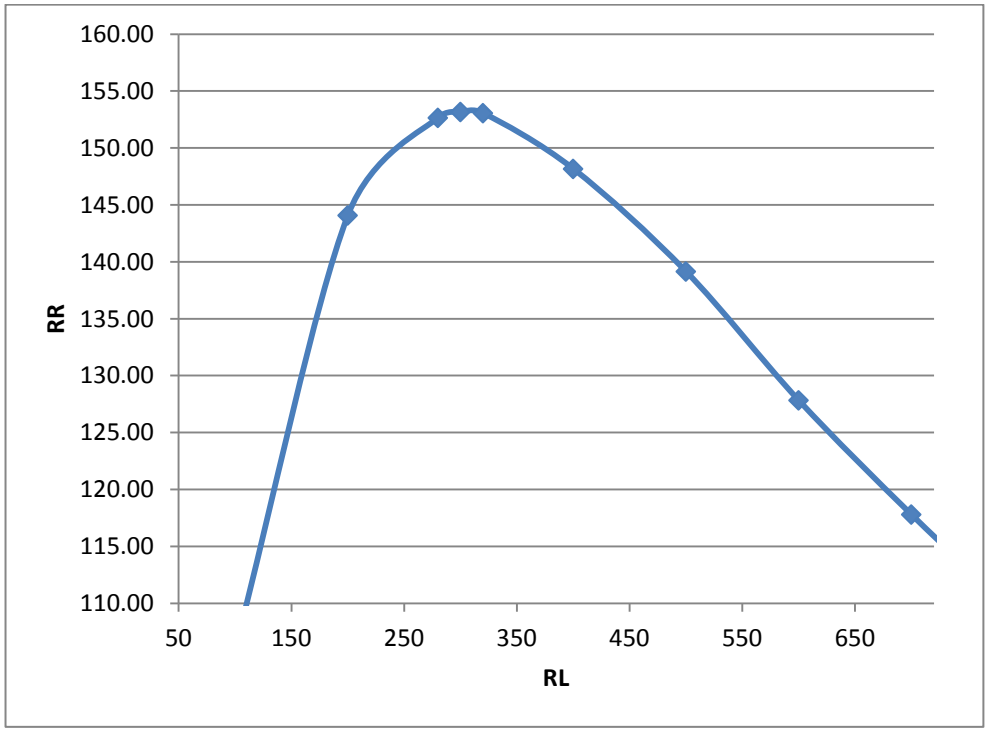
Inference:

$$X_P - X_R = X_{PE}$$

Part 3(n):

Sr.	R_L	V_A	$V_{R'}$	V	Vo	Ip	Is	$(Ip/Is)^2$	R_R
1	280	10.06	5.11	6.05	3.29				
		10.03	5.16	6.03	3.30				
	280	10.05	5.14	6.04	3.30	0.0171	0.01	2.12	152.65
2	320	10.02	5.09	6.19	3.51				
		10.05	5.03	6.21	3.50				
	320	10.04	5.06	6.20	3.51	0.0169	0.01	2.37	153.07

R_L	RR
100	106.00
200	144.08
280	152.65
300	153.17
320	153.07
400	148.17
500	139.16
600	127.84
700	117.81
800	108.45771



Part 4(o):

$$R_R = R^* - R_P$$

$$X_R = X_P - X^*$$

$$\frac{X_{core}}{R_{core}} = \frac{X_R}{R_R}$$

$$\frac{L_{core}}{R_{core}} = \frac{1}{2\pi f}\frac{\left(X_P - X^*\right)}{\left(R^* - R_P\right)}$$

Blue Coil	Green Coil
Lc/Rc	Lc/Rc
4.85E-04	4.50E-04

Part 4(p)

$$\Delta P = I_p^2\left(R_{PE} - R_P\right) - I_S^2\left(R_S + R_L\right)$$

		R_L	V_A	$V_{R'}$	V	Vo	I_1	I_2	R_{PE}
		1000	9.00	5.32	5.08	3.45			
			9.01	5.27	5.10	3.43			
Avg		1000	9.01	5.30	5.09	3.44	0.0177	0.003	145.23
			Δ P =	1.65E-02 W					