



**Model Solution**

Part 1(a):

				Coil Blue (1-1)				AIR CORE		f = 1.000 KHz		
	R'	V <sub>A</sub>	V <sub>R'</sub>	V	V <sub>o</sub>	I <sub>1</sub>	Z <sub>1</sub>	R <sub>1</sub>	X <sub>1</sub>	ωM	M (mH)	L <sub>1</sub> (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 <sub>A</sub>	ΔV <sub>R'</sub>	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 <sub>A</sub>	V <sub>R'</sub>	V	V <sub>o</sub>	I <sub>2</sub>	Z <sub>2</sub>	R <sub>2</sub>	X <sub>2</sub>	ωM	M (mH)	L <sub>2</sub> (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 <sub>A</sub>	ΔV <sub>R'</sub>	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 <sub>A</sub>	V <sub>R'</sub>	V	V <sub>o</sub>	I* <sub>1</sub>	Z* <sub>1</sub>	R* <sub>1</sub>	X* <sub>1</sub>	ωM	M* (mH)	L* <sub>1</sub> (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 <sub>A</sub>	ΔV <sub>R'</sub>	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 <sub>A</sub>	V <sub>R'</sub>	V	V <sub>o</sub>	I* <sub>2</sub>	Z* <sub>2</sub>	R* <sub>2</sub>	X* <sub>2</sub>	ωM	M*(mH)	L* <sub>2</sub> (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 <sub>A</sub>	ΔV <sub>R'</sub>	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):

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



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

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

Part 2(g):

						AIR Core				$f = 1.000$ KHz $R' = 300\Omega$	
	Sr.	$R_L$	$V_A$	$V_{R'}$	V	$V_{RL}$	$I_p$	$Z_p$	$R_{PE}$	$X_{PE}$	$I_s$
	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					

**Experimental Competition**



**EXPERIMENT 2**

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



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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 <sub>2</sub>
1.23E+05		350.94 Ω



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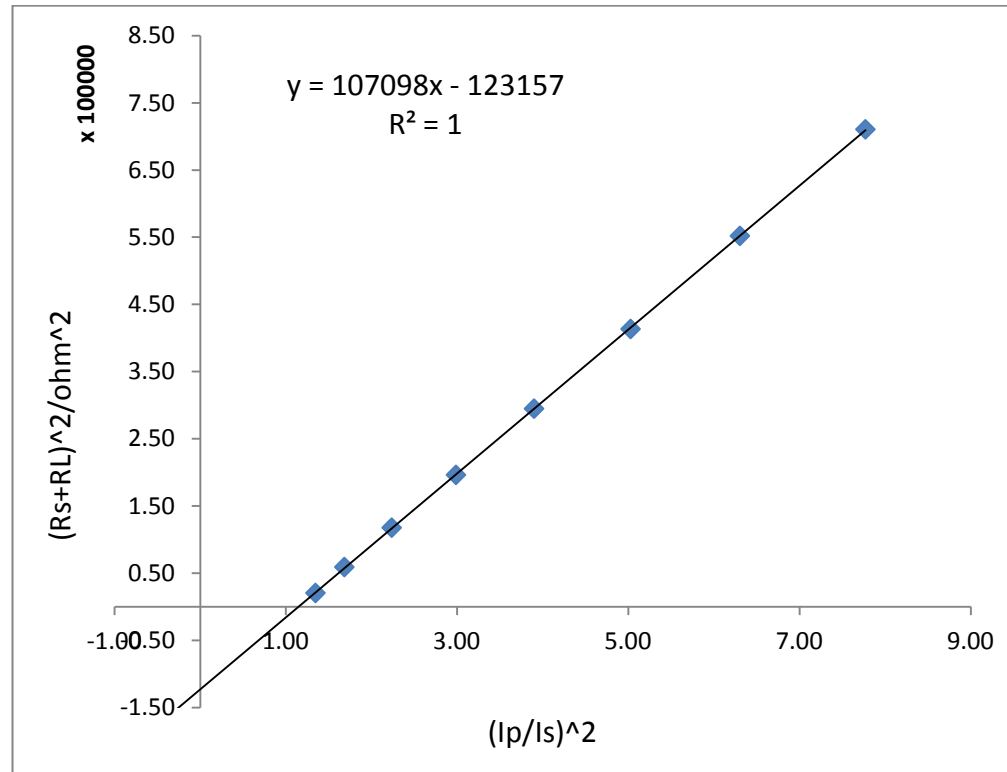
Part 2(i)

$(I_p/I_s)^2$	$(R_s+R_L)^2$
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):

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

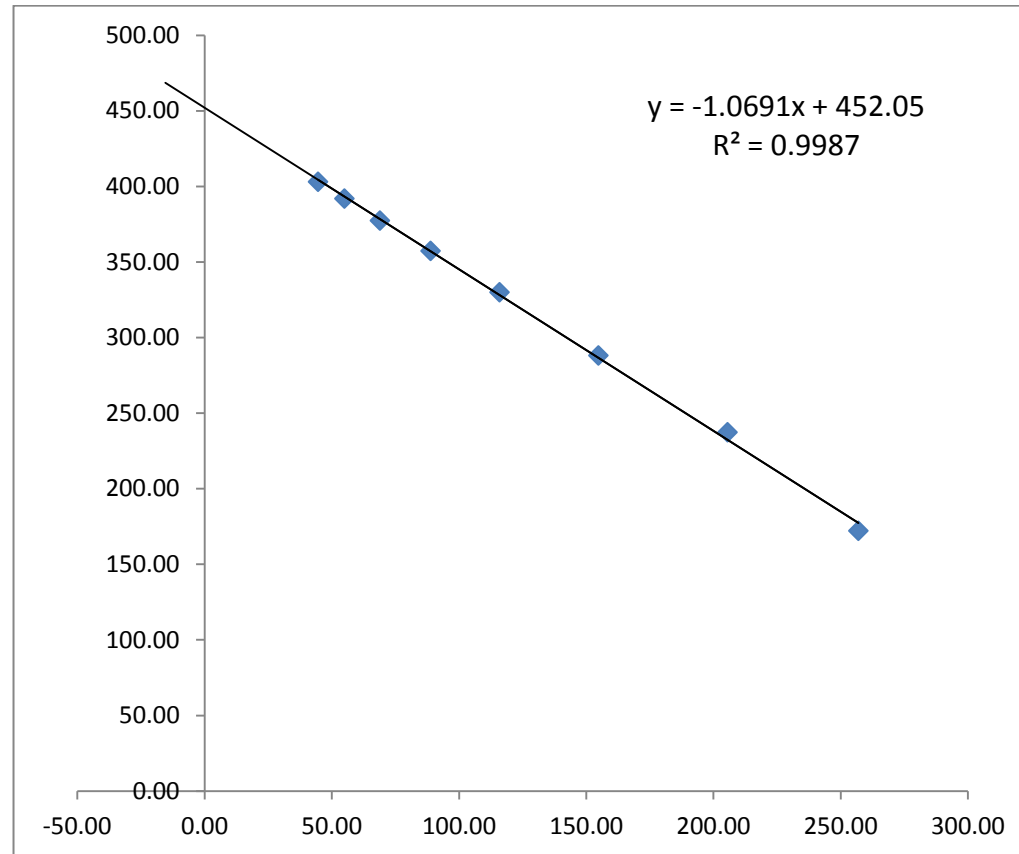


$$X_P = \left( \frac{I_S}{I_P} \right)^2 X_S$$

Sr.	R <sub>R</sub>	X <sub>R</sub>
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:

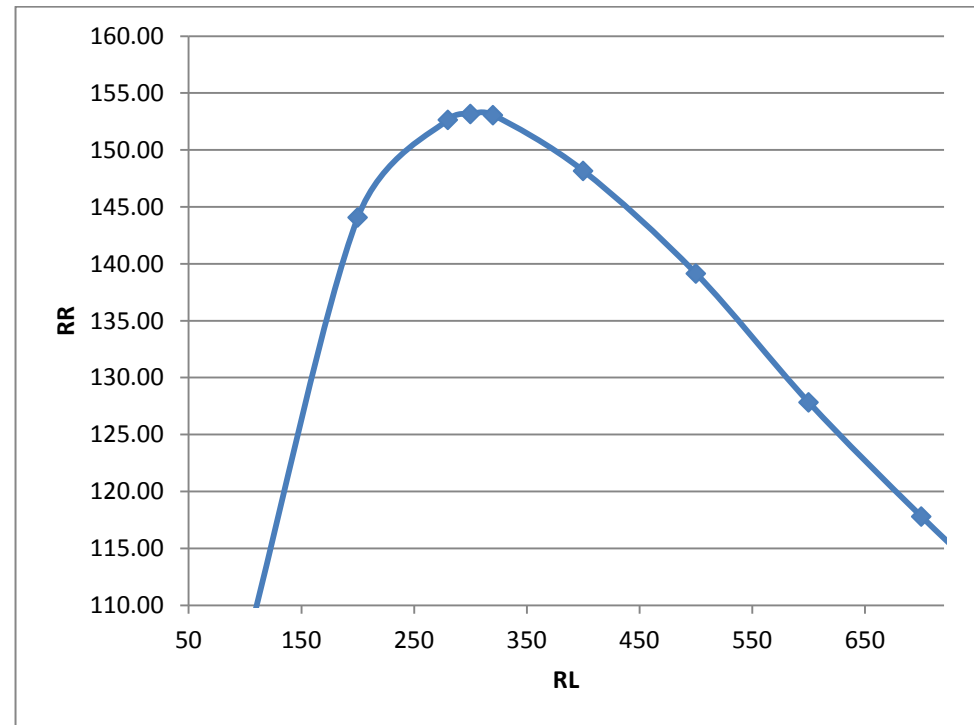
$$X_P - X_R = X_{PE}$$



Part 3(n):

Sr.	$R_L$	$V_A$	$V_{R'}$	V	$V_o$	$I_p$	$I_s$	$(I_p/I_s)^2$	$R_R$
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

$R_L$	$R_R$
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):

$$R_R = R^* - R_P$$

$$X_R = X_P - X^*$$

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



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

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

Part 4(p)

$$\Delta P = I_p^2(R_{PE} - R_P) - I_s^2(R_s + R_L)$$

		R <sub>L</sub>	V <sub>A</sub>	V <sub>R'</sub>	V	V <sub>o</sub>	I <sub>1</sub>	I <sub>2</sub>	R <sub>PE</sub>
		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					