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by Sara Vonk

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TIME SUBMITTED	16-JAN-2018 11:32PM (UTC+0000)	WORD COUNT	3122
SUBMISSION ID	81905380	CHARACTER COUNT	14789

RLC Series Circuit.

Resonance Frequency and “Q” Factor.

Sara Vonk

In this assignment we are going to look at an RLC circuit, what is it, what they are used for, resonance frequency and the “Q” Factor.

What is an RLC series circuit?

An RLC circuit is circuit that contains a resistor, an inductor and a capacitor.

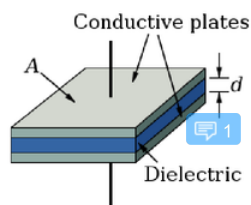
There are two types of RLC circuits. A series circuit and a parallel circuit.

In this assignment we are going to look at the RLC series circuit but I will briefly talk about what the RLC parallel circuit does.

If we want to fully understand what this circuit is doing we must first look at the two main components, the inductor and the capacitor.

What is a capacitor?

A capacitor is made up of two electrical conductors that are separated from each other by an insulator.



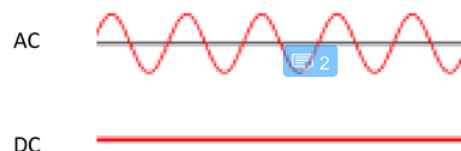
Capacitors can store electrical energy. They can charge and discharge in seconds.

They are similar to the battery as in you can charge them and discharge them, however, batteries normally rely on chemical reactions to release their electrical energy very slowly over a long period of time.

A capacitor stores energy because the two plates in a capacitor store opposite charges and the separation between them creates an electric field.

What could this be useful for?

Say you wanted to turn AC current into DC current?



As you can see here the AC current isn't giving out a consistent voltage and when it's on the purple line it's giving out 0V.

If you put the capacitor in parallel with the AC supply. Every time the AC supply was near 0V the capacitor would start the discharge and therefore would fill in the voltage gaps thus smoothing out the AC to DC.

What is an inductor?

An inductor is a component that temporarily stores energy in the form of a magnetic field.

Inductors are normally just coils of wire.



One of the most basic properties of electromagnetism is, if you have current flowing through a wire you will create a **weak** magnetic field around it.

This is why if you coil up lots of wire and put a current through it you will get a stronger magnetic field.

When you first put current through an inductor the magnetic field will expand until it reaches its limit, it will then stabilise.

When the current stops flowing through the inductor the magnetic field will turn back into electrical energy and its magnetic field will deplete until all the energy stored is released.

The current in an inductor cannot instantly change, it will always lag by a small amount of time.

Like capacitors they are temporary storage areas. Capacitors store energy in the form of static charge and resist sudden changes in voltage. Inductors store energy in the form of a magnetic field and resist sudden changes in current.

Current wave form with no inductor,



Current wave form with inductor,

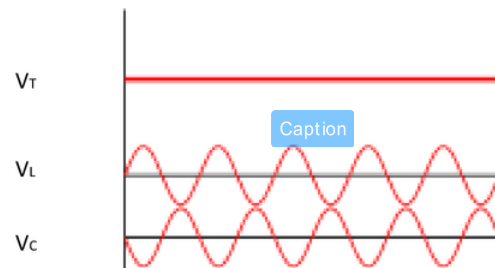


What is resonance?

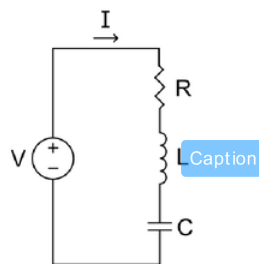
Resonance is when the capacitive reactance is equal to the inductive reactance.

$$X_L = X_C \Rightarrow \frac{2\pi f L}{1} = \frac{1}{2\pi f C}$$

This is also when they are out of Phase by 180 degrees.



As the Voltage flowing through the Inductor and the Capacitor are out of Phase by 180 degrees they cancel each other out. If you added them together they would be equal to 0 or very close to 0. This almost imitates/looks like a short circuit.

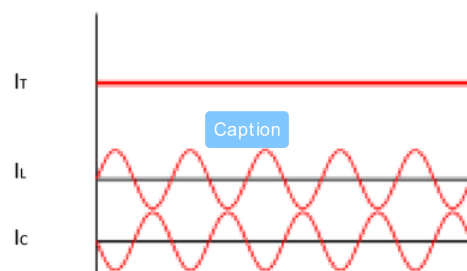


LC parallel circuit.

Voltage across the inductor and the capacitor are the same.

In a parallel RLC circuit the current is the sum of the current going through the capacitor and the inductor.

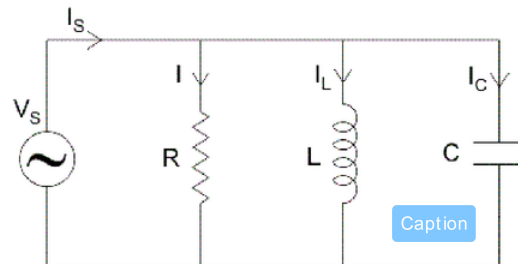
Current in the inductor and the capacitor out of phase by 180 degrees.



At resonance this circuit doesn't let any current to flow so it looks like an open circuit.

At low frequencies the circuit will be more inductive, and at higher frequencies the circuit will be more capacitive.

At resonance the voltage will peak in magnitude as it is essentially the open circuit voltage of a generator.



These Circuits lets you to create networks that will have a short circuit or an open circuit at a particular frequency.

Some of the things they are used as are;

- Low pass filter,
- High pass filter,
- Band pass filter,
- Band stop filter,
- Voltage multiplier,
- Oscillator circuit.

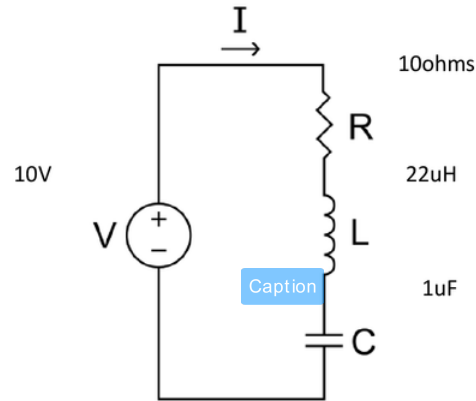
What is the "Q" Factor? Here is a quote of Wikipedia to help explain it.

"In an ideal series RLC circuit, and in a tuned radio frequency receiver (TRF) the Q factor is: where R, L and C are the resistance, inductance and capacitance of the tuned circuit, respectively. The larger the series resistance, the lower the circuit Q."

https://en.wikipedia.org/wiki/Q_factor#Definition

Main Body

Component values



Here you can see a circuit diagram of an RLC circuit. The component values being used are a ten ohm resistor, twenty two micro Henry inductor and a one micro farad capacitor. They will be linked in series with each other and the RMS and the Peak to Peak values will be measured across the inductor and the capacitor. The starting frequency will be five thousand hertz and it will be tested ever 2 thousand hertz up to forty nine thousand hertz.

To make sure the results taken are accurate three separate tests will be taken. The main one will be the practical test. This will best the practical abilities of the experiment conductor and it will test their problem solving skills as they will be ask to used machinery they have not used before. Test will be conducted used computer simulation software. Graphs and results will be taken from this and documented in this report. Note book maths will also be done and used in excel. From this we will be able to have three different production of the same test. It will test the Practical skills, the mathematical skills, the computer software skills and there analysing skills.

It would be very uncommon if all the results came out with the same results. You need to account for environmental factors, component tolerances and the machine accuracy.

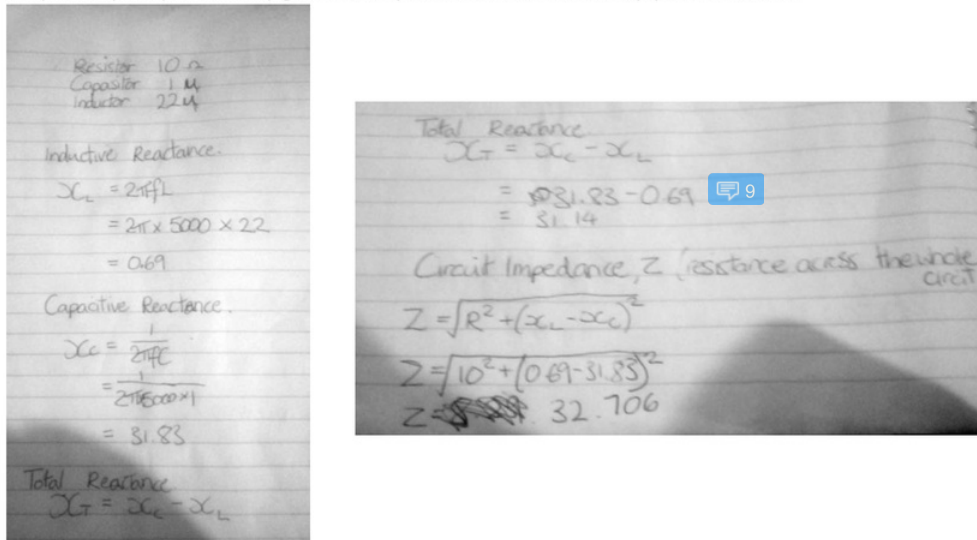
In this report there are plenty of images as a form of evidence to the work that has been done outside this report. However they were taken on a cheap phone camera so they are bad quality. If any extra better evidence is required for this report the original documents can be seen in person if necessary.

Before we do the practical experiment we are going to work out the values and the patterns we should be seeing. We are going to work out what the "Q" Factor is and we are going to work out what the resonance frequency is. We need to remember that even when we work it out mathematically its not going to be the same as the results we get from the practical as the maths doesn't account for tolerances.

Hand written calculations.

Below you can see the maths notes made in preparation for the rest of the experiments. The calculations for inductive reactance, capacitive reactance, total reactance and impedance were worked out for five thousand hertz frequency. This was done as a guide to base the rest of the work off.

The photo quality is not very good as they were taken with a cheap phone camera.



After the math's had been worked out and the answers were confirmed as correct and excel spread sheet was set up so it could do the same calculations for all of the different frequencies that were going to be tested.

Inductive reactance: $X_L = 2\pi fL$

Capacitive reactance: $X_C = \frac{1}{2\pi fC}$

When $X_L > X_C$ the circuit is Inductive

When $X_C > X_L$ the circuit is Capacitive

Total circuit reactance = $X_L - X_C$ or $X_C - X_L$

Total circuit impedance = $Z = \sqrt{R^2 + X^2} = R + jX$

phase = $\theta = \tan^{-1}[(X_L - X_C)/R]$

Frequency	X_L	X_C	X_T	Z	phase	Impedance for graph across cap/inductor
5000	0.69123	81.83088	81.13965	32.106	1.28007	32.106
5500	0.76035	74.54545	73.7851	28.177	1.22976	28.177
6000	0.82948	67.26092	66.43144	24.684	1.19967	24.684
6500	0.89861	60.00000	59.10139	21.642	1.18000	21.642
7000	0.96774	52.74545	51.77771	19.058	1.16118	19.058
7500	1.03687	45.49092	44.44905	16.839	1.14388	16.839
8000	1.10600	38.23639	37.13039	14.925	1.12798	14.925
8500	1.17513	31.00000	29.82513	13.267	1.11337	13.267
9000	1.24426	23.78545	22.54379	11.814	1.10000	11.814
9500	1.31339	16.58092	15.24947	10.544	1.08777	10.544
10000	1.38252	9.37639	8.04813	9.433	1.07667	9.433
10500	1.45165	6.17187	5.34478	8.444	1.06667	8.444
11000	1.52078	2.96735	2.55343	7.577	1.05778	7.577
11500	1.58991	0.76283	1.82708	6.822	1.04990	6.822
12000	1.65904	0.00000	1.65904	6.172	1.04303	6.172
12500	1.72817	-0.76283	1.99100	5.608	1.03718	5.608
13000	1.79730	-1.52566	2.32296	5.125	1.03228	5.125
13500	1.86643	-2.28850	2.65492	4.714	1.02828	4.714
14000	1.93556	-3.05133	2.98688	4.367	1.02500	4.367
14500	2.00469	-3.81417	3.31884	4.078	1.02238	4.078
15000	2.07382	-4.57700	3.65080	3.842	1.02040	3.842
15500	2.14295	-5.33984	3.98276	3.653	1.01900	3.653
16000	2.21208	-6.10267	4.31472	3.506	1.01818	3.506
16500	2.28121	-6.86551	4.64668	3.396	1.01782	3.396
17000	2.35034	-7.62835	4.97864	3.318	1.01782	3.318
17500	2.41947	-8.39118	5.31060	3.267	1.01818	3.267
18000	2.48860	-9.15402	5.64256	3.239	1.01878	3.239
18500	2.55773	-9.91686	5.97452	3.230	1.01950	3.230
19000	2.62686	-10.67969	6.30648	3.237	1.02033	3.237
19500	2.69599	-11.44253	6.63844	3.250	1.02128	3.250
20000	2.76512	-12.20537	6.97040	3.269	1.02233	3.269
20500	2.83425	-12.96821	7.30236	3.294	1.02348	3.294
21000	2.90338	-13.73105	7.63432	3.325	1.02473	3.325
21500	2.97251	-14.49389	7.96628	3.362	1.02608	3.362
22000	3.04164	-15.25673	8.29824	3.405	1.02753	3.405

For this excel spread sheet the frequency range was deliberately made large so that we could get a good view on what was happening in the circuit. The range starts at five thousand hertz and ends at one hundred and ten thousand hertz.

Below you can see the different formulas used in excel to work out the Inductive reactance, capacitive reactance, total reactance, impedance, phase and the impedance across the inductor and the capacitor.

X_L

frequency	X _L	X _C	Z	phase	impedance for graph across cap/inductor
5000	0.69115	31.8309886	31.1398	1.26007	31.1398
5500	0.76027	28.972624	28.177	1.22976	28.177
6000	0.82938	26.5258238	25.6964	1.19967	25.6964
6500	0.8985	24.485759	23.5869	1.1698	23.5869

Caption

X_C

frequency	X _L	X _C	Z	phase	impedance for graph across cap/inductor
5000	0.69115	31.8309886	31.1398	1.26007	31.1398
5500	0.76027	28.972624	28.177	1.22976	28.177
6000	0.82938	26.5258238	25.6964	1.19967	25.6964
6500	0.8985	24.485759	23.5869	1.1698	23.5869

X_T

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Z

frequency	X _L	X _C	X _T	Z	phase	impedance for graph across cap/inductor
5000	0.69115	31.8309886	31.1398	32.2061	1.26007	31.1398
5500	0.76027	28.972624	28.177	29.8989	1.22976	28.177
6000	0.82938	26.5258238	25.6964	27.5737	1.19967	25.6964
6500	0.8985	24.485759	23.5869	25.6192	1.1698	23.5869

Phase

frequency	X _L	X _C	X _T	Z	phase	impedance for graph across cap/inductor
5000	0.69115	31.8309886	31.1398	32.2061	1.26007	31.1398
5500	0.76027	28.972624	28.177	29.8989	1.22976	28.177
6000	0.82938	26.5258238	25.6964	27.5737	1.19967	25.6964
6500	0.8985	24.485759	23.5869	25.6192	1.1698	23.5869

Z across L and C

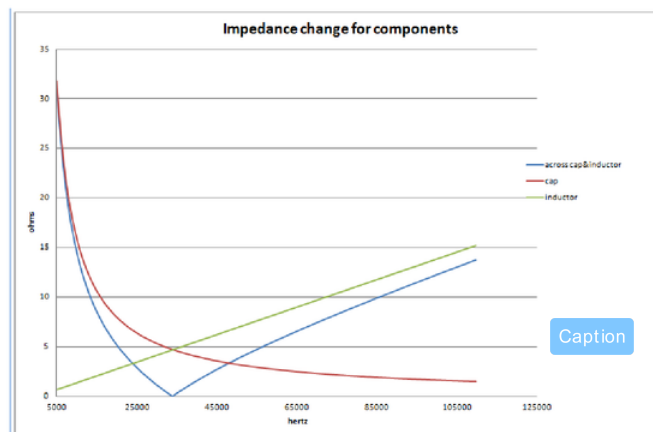
frequency	X_L	X_C	Z	phase	impedance for graph across cap/inductor
5000	0.69115	31.8309886	31.1398	32.7661	1.26807
5500	0.76027	28.972624	28.177	29.8989	1.22976
6000	0.82938	26.5258238	25.6964	27.5737	1.19967

After doing this maths on excel I've estimated that the 'q' factor should be round 34000Hz. However I'm not expecting it to be spot on as we need to account for the tolerance the components have and other environmental factors like temperature etc. Even though individually they wouldn't make a noticeable different added together they can be out by a noticeable amount sometimes.

32000	4.42336	4.97359197	0.55023	10.0151	0.05497	0.55023
32500	4.49248	4.89707517	0.4046	10.0082	0.04044	0.4046
33000	4.56159	4.82287706	0.26128	10.0034	0.02612	0.26128
33500	4.63071	4.75089382	0.12019	10.0007	0.01202	0.12019
34000	4.69982	4.68102774	-0.01879	10	-0.00188	0.01879
34500	4.76894	4.61318676	-0.15575	10.0012	-0.01557	0.15575
35000	4.83805	4.54728409	-0.29077	10.0042	-0.02907	0.29077

This is where the inductor and the capacitor are out of phase by 180 degrees. This means that in a 'puff of logic' they cancel each other out. If you look on the table you can see that the impedance is 10 ohms (the same as the 10 ohms resistor in the circuit).

This graph has been produced from the results that were achieved on excel.



From this we have a good base to start our experiment. We can see what the shape of the impedance graphs should look like. It is a good reference to come back to and compare the future findings to as we know that this graph has been mathematically proven and that all the future results should mirror this graph in some way.

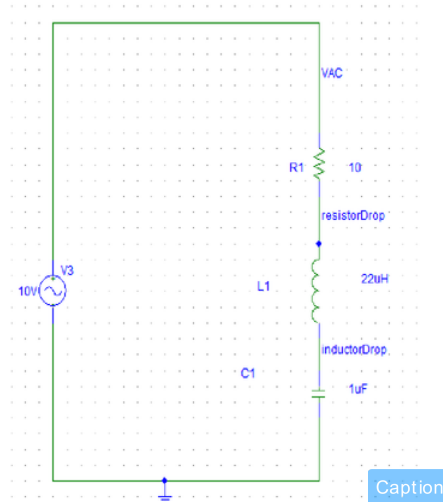
frequency	X_L	X_C	X_T	Z	AMP	V_R	V_L	V_C	Watts	Q factor
5000	0.69	31.83	31.14	32.71	0.31	3.06	0.21	9.73	3.057533	0.069115
5500	0.76	28.94	28.18	29.90	0.33	3.34	0.25	9.68	3.344607	0.076027
6000	0.83	26.53	25.70	27.57	0.36	3.63	0.30	9.62	3.626648	0.082938
6500	0.90	24.49	23.59	25.62	0.39	3.90	0.35	9.56	3.90333	0.08985
7000	0.97	22.74	21.77	23.96	0.42	4.17	0.40	9.49	4.174352	0.096761
7500	1.04	21.22	20.18	22.53	0.44	4.44	0.46	9.42	4.439444	0.103673
8000	1.11	19.89	18.79	21.28	0.47	4.70	0.52	9.35	4.698364	0.110584
8500	1.17	18.72	17.55	20.20	0.50	4.95	0.58	9.27	4.950902	0.117496
9000	1.24	17.68	16.44	19.24	0.52	5.20	0.65	9.19	5.196875	0.124407
9500	1.31	16.75	15.44	18.40	0.54	5.44	0.71	9.11	5.436127	0.131319
10000	1.38	15.92	14.53	17.64	0.57	5.67	0.78	9.02	5.668532	0.13823
10500	1.45	15.16	13.71	16.97	0.59	5.89	0.86	8.93	5.893991	0.145142
11000	1.52	14.47	12.95	16.36	0.61	6.11	0.93	8.84	6.112427	0.152053
11500	1.59	13.84	12.25	15.81	0.63	6.32	1.01	8.75	6.323791	0.158965
12000	1.66	13.26	11.60	15.32	0.65	6.53	1.08	8.66	6.528056	0.165876
12500	1.73	12.73	11.00	14.87	0.67	6.73	1.16	8.56	6.725215	0.172788
13000	1.80	12.24	10.45	14.46	0.69	6.92	1.24	8.47	6.915282	0.179699
13500	1.87	11.79	9.92	14.09	0.71	7.10	1.32	8.37	7.098291	0.186611
14000	1.94	11.37	9.43	13.75	0.73	7.27	1.41	8.27	7.27429	0.193522
14500	2.00	10.98	8.97	13.43	0.74	7.44	1.49	8.17	7.443345	0.200434
15000	2.07	10.61	8.54	13.15	0.76	7.61	1.58	8.07	7.605535	0.207345
15500	2.14	10.27	8.13	12.89	0.78	7.76	1.66	7.97	7.760952	0.214257
16000	2.21	9.95	7.74	12.64	0.79	7.91	1.75	7.87	7.909699	0.221168
16500	2.28	9.65	7.36	12.42	0.81	8.05	1.84	7.77	8.05189	0.22808
17000	2.35	9.36	7.01	12.21	0.82	8.19	1.92	7.67	8.187645	0.234991
17500	2.42	9.09	6.68	12.02	0.83	8.32	2.01	7.56	8.317095	0.241903
18000	2.49	8.84	6.35	11.85	0.84	8.44	2.10	7.46	8.440373	0.248814
18500	2.56	8.60	6.05	11.69	0.86	8.56	2.19	7.36	8.557622	0.255726
19000	2.63	8.38	5.75	11.54	0.87	8.67	2.28	7.26	8.668986	0.262637
19500	2.70	8.16	5.47	11.40	0.88	8.77	2.37	7.16	8.774614	0.269549
20000	2.76	7.96	5.19	11.27	0.89	8.87	2.45	7.06	8.874657	0.27646
20500	2.83	7.76	4.93	11.15	0.90	8.97	2.54	6.96	8.969266	0.283372
21000	2.90	7.58	4.68	11.04	0.91	9.06	2.63	6.87	9.058597	0.290283
21500	2.97	7.40	4.43	10.94	0.91	9.14	2.72	6.77	9.142804	0.297195
22000	3.04	7.23	4.19	10.84	0.92	9.22	2.80	6.67	9.222041	0.304106
22500	3.11	7.07	3.96	10.76	0.93	9.30	2.89	6.58	9.296461	0.311018
23000	3.18	6.92	3.74	10.68	0.94	9.37	2.98	6.48	9.366217	0.317929
23500	3.25	6.77	3.52	10.60	0.94	9.43	3.06	6.39	9.431462	0.324841
24000	3.32	6.63	3.31	10.53	0.95	9.49	3.15	6.29	9.492343	0.331752
24500	3.39	6.50	3.11	10.47	0.95	9.55	3.23	6.20	9.549009	0.338664
25000	3.46	6.37	2.91	10.41	0.96	9.60	3.32	6.11	9.601604	0.345575
25500	3.52	6.24	2.72	10.36	0.97	9.65	3.40	6.02	9.650272	0.352487
26000	3.59	6.12	2.53	10.31	0.97	9.70	3.48	5.93	9.695151	0.359398
26500	3.66	6.01	2.34	10.27	0.97	9.74	3.57	5.85	9.736379	0.36631
27000	3.73	5.89	2.16	10.23	0.98	9.77	3.65	5.76	9.774091	0.373221

27500	3.80	5.79	1.99	10.20	0.98	9.81	3.73	5.68	9.808415	0.380133
28000	3.87	5.68	1.81	10.16	0.98	9.84	3.81	5.59	9.839481	0.387044
28500	3.94	5.58	1.64	10.13	0.99	9.87	3.89	5.51	9.867412	0.393956
29000	4.01	5.49	1.48	10.11	0.99	9.89	3.97	5.43	9.892329	0.400867
29500	4.08	5.40	1.32	10.09	0.99	9.91	4.04	5.35	9.91435	0.407779
30000	4.15	5.31	1.16	10.07	0.99	9.93	4.12	5.27	9.933589	0.41469
30500	4.22	5.22	1.00	10.05	1.00	9.95	4.20	5.19	9.950157	0.421602
31000	4.29	5.13	0.85	10.04	1.00	9.96	4.27	5.12	9.964162	0.428513
31500	4.35	5.05	0.70	10.02	1.00	9.98	4.34	5.04	9.975708	0.435425
32000	4.42	4.97	0.55	10.02	1.00	9.98	4.42	4.97	9.984897	0.442336
32500	4.49	4.90	0.40	10.01	1.00	9.99	4.49	4.89	9.991825	0.449248
33000	4.56	4.82	0.26	10.00	1.00	10.00	4.56	4.82	9.996588	0.456159
33500	4.63	4.75	0.12	10.00	1.00	10.00	4.63	4.75	9.999278	0.463071
34000	4.70	4.68	-0.02	10.00	1.00	10.00	4.70	4.68	9.999982	0.469982
34500	4.77	4.61	-0.16	10.00	1.00	10.00	4.77	4.61	9.998787	0.476894
35000	4.84	4.55	-0.29	10.00	1.00	10.00	4.84	4.55	9.995775	0.483805
35500	4.91	4.48	-0.42	10.01	1.00	9.99	4.90	4.48	9.991026	0.490717
36000	4.98	4.42	-0.56	10.02	1.00	9.98	4.97	4.41	9.984617	0.497628
36500	5.05	4.36	-0.68	10.02	1.00	9.98	5.03	4.35	9.976622	0.50454
37000	5.11	4.30	-0.81	10.03	1.00	9.97	5.10	4.29	9.967112	0.511451
37500	5.18	4.24	-0.94	10.04	1.00	9.96	5.16	4.23	9.956157	0.518363
38000	5.25	4.19	-1.06	10.06	0.99	9.94	5.22	4.16	9.943824	0.525274
38500	5.32	4.13	-1.19	10.07	0.99	9.93	5.28	4.11	9.930175	0.532186
39000	5.39	4.08	-1.31	10.09	0.99	9.92	5.35	4.05	9.915274	0.539097
39500	5.46	4.03	-1.43	10.10	0.99	9.90	5.41	3.99	9.899179	0.546009
40000	5.53	3.98	-1.55	10.12	0.99	9.88	5.46	3.93	9.881948	0.55292
40500	5.60	3.93	-1.67	10.14	0.99	9.86	5.52	3.88	9.863635	0.559832
41000	5.67	3.88	-1.79	10.16	0.98	9.84	5.58	3.82	9.844294	0.566743
41500	5.74	3.84	-1.90	10.18	0.98	9.82	5.64	3.77	9.823976	0.573655
42000	5.81	3.79	-2.02	10.20	0.98	9.80	5.69	3.71	9.80273	0.580566
42500	5.87	3.74	-2.13	10.22	0.98	9.78	5.75	3.66	9.780602	0.587478
43000	5.94	3.70	-2.24	10.25	0.98	9.76	5.80	3.61	9.757638	0.594389
43500	6.01	3.66	-2.35	10.27	0.97	9.73	5.85	3.56	9.733882	0.601301
44000	6.08	3.62	-2.46	10.30	0.97	9.71	5.91	3.51	9.709376	0.608212
44500	6.15	3.58	-2.57	10.33	0.97	9.68	5.96	3.46	9.684159	0.615124

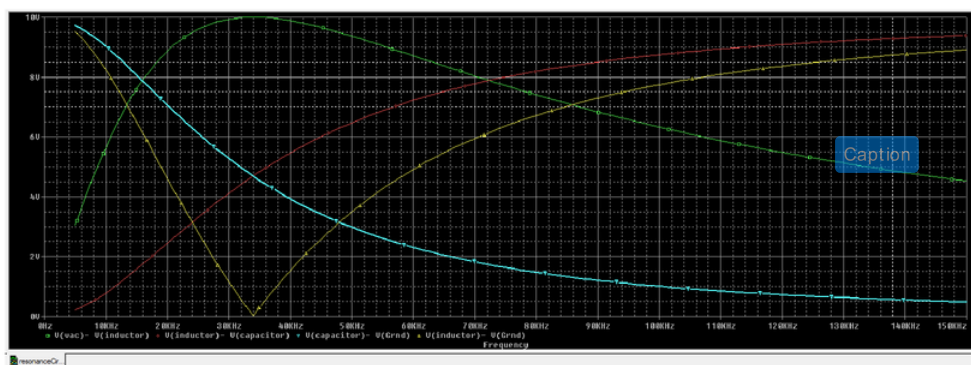
The "Q" Factor is = 0.469

Computer simulation

In the picture below you can see a screenshot of a schematic diagram made using PSpice Scamatics. It has been made to simulate the RLC series circuit so we can compare them the practical results and the Excel results.



This graph shows the results taken from the computer simulation software.



The above output shows voltage drop across resistor in green; across capacitor in blue; inductor in red and across both inductor and capacitor in yellow.

It can be seen that at lower frequencies the inductor has little influence and the capacitor a great influence on the circuit, this is reversed at high frequencies. Also, it clearly shows how the inductor and capacitor cancel one another due to opposing phase differences around 34kHz, meaning the voltage is dropped across the resistor at this frequency.

This graph is very similar the graph made using Excel. This shows that so far all the results have been correct.

Practical

On the 12th of December 2017, Electronics Engineering students were asked to build, test and record the results of a RLC series circuit. They were given breadboards, wires, an oscilloscope, function generator, a resistor, an inductor and a capacitor.

They were asked to find the resonance frequency and the “Q” Factor and compare them. They were given two hours in which to complete the practical aspect of the assignment. Below you can see some photos captured while mid way through the practical.

As you can see on the screen they were measuring forty nine kilo hertz at the time. They were using the reading on the oscilloscope screen to give them the RMS and the Peak to Peak voltage for the different frequencies.

The results were taken and documented within the time limit given.

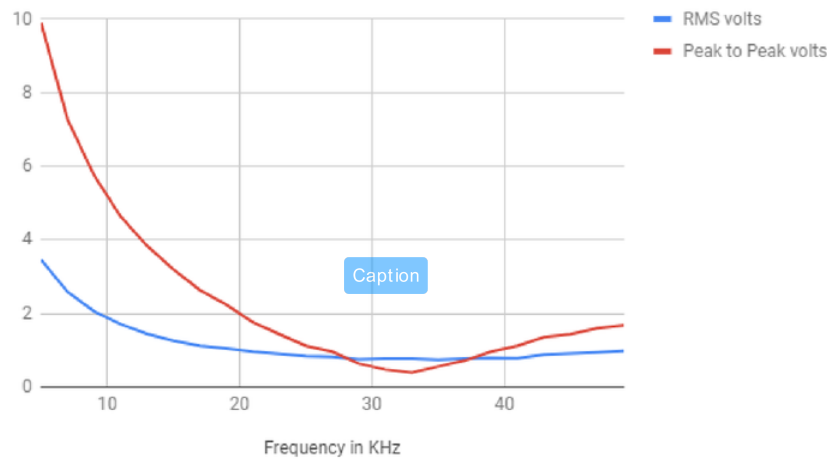


Below you can see the reading that was taken from the practical experiment. They show the frequency measured at, the RMS for that frequency and the peak to peak voltage.

Results from Practical.

Frequency in KHz	RMS volts	Peak to Peak volts
5	3.46	9.9
7	2.59	7.28
9	2.06	5.76
11	1.71	4.64
13	1.45	3.84
15	1.26	3.2
17	1.12	2.64
19	1.05	2.24
21	0.958	1.76
23	0.9	1.44
25	0.846	1.12
27	0.826	0.96
29	0.754	0.64
31	0.773	0.48
33	0.775	0.4
35	0.745	0.56
37	0.778	0.72
39	0.794	0.96
41	0.783	1.12
43	0.885	1.36
45	0.916	1.44
47	0.942	1.6
49	0.982	1.68

RMS volts and Peak to Peak volts



The above graph looks how it was expected to look there for the maths was right and the practical experiment was right.

In the practical the resonance frequency was at 33KHz and not 34KHz. Like I said earlier this is because of the tolerances in the components.

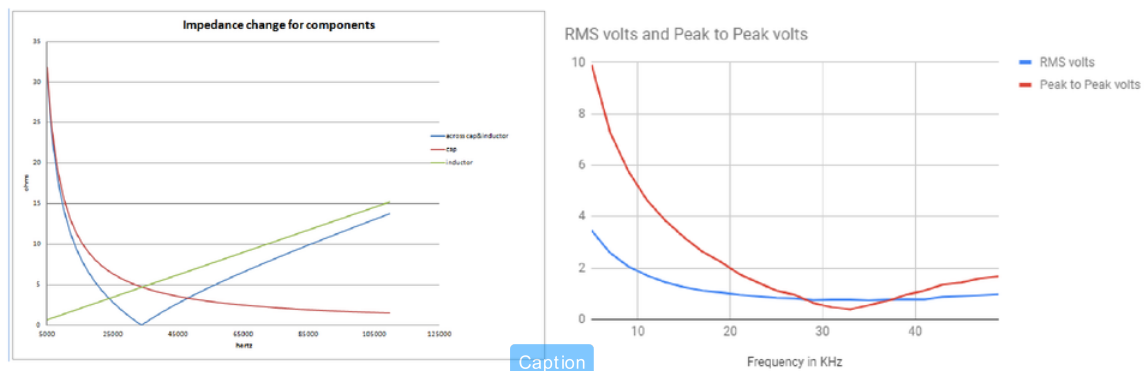
If I did the practical experiment again I would go up to 70KHz as I don't think I took enough reading to get a true representation of what is happening.

Graphs comparison,

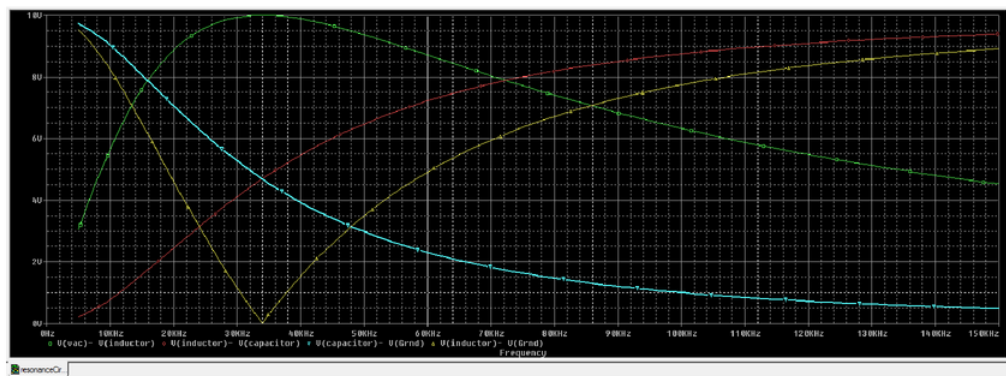
Compare them to the theory results and talk about how they compare
If they are out by quite a bit talk about the components and their tolerance

Below you can see all three graphs together. Even though they do all show small differences there is definitely a correlation between them. In all three graphs the resonance frequency is around 34KHz.

The Mathematical calculated graph and the practical one are the most **similar**. They both have very similar shapes to them as you can see before resonance both of the lines are convex and after resonance both of the lines are concave. In the computer simulation before resonance the line appears to be relatively straight after resonance it does agree with the other graphs though as it is also concave.



Caption



Conclusion

Looking at all the data we have collected over the course of the assignment we can see clearly that un-doubtable the resonance frequency is at 34KHz for an RLC series circuit containing a 10 ohm resistor, 22uH and 1uF components.

After doing two separate calculations we can comfortably say that the "Q" Factor is 0.469.

$$Q = \frac{1}{R} \sqrt{\frac{L}{C}} = \frac{\omega_0 L}{R},$$

$$Q = \frac{X_L}{R}$$

To conclude this we could say it is always important to do an experiment in as many different ways as possible as that is when you are most likely to notice pattern and problems if there are any.

FINAL GRADE

GENERAL COMMENTS

Instructor

53/100

PAGE 1

PAGE 2



Comment 1

Caption?



Comment 2

Caption?



Comment 3

supply

PAGE 3



Comment 4

Caption?



Comment 5

Not necessarily weak. Most of the strongest magnetic fields on the planet are created by passing current through a coil.



Comment 6

Caption?



Caption

Caption?

PAGE 4



Caption

Caption?

QM

Caption

Caption?

QM

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Caption?

QM

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Caption?

PAGE 5

QM

Caption

Caption?



Comment 7

Q Factor

PAGE 6

QM

Caption

Caption?



Comment 8

They should be close

PAGE 7



Comment 9

These images could have been typed up and inserted into your report as equations. I'm not sure why you have inserted them as photographs. The photos of writing make your report look untidy and unprofessional.



Comment 10

spreadsheet

QM

Caption

Caption?

PAGE 8



Comment 11

As a rule of thumb, whole numbers less than ten should be written as words, whole numbers larger than ten should use digits rather than words. Decimals should always be written using digits and not words.

QM

Caption

Caption?

PAGE 9



Comment 12

Q factor does not have any units as it is a ratio

QM

Caption

Caption?

QM

Caption

Caption?

PAGE 10

PAGE 11

PAGE 12

QM

Caption

Caption?

QM

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PAGE 13



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PAGE 14

QM

Caption

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PAGE 15



Comment 15

simmlar

QM

Caption

Caption?

PAGE 16

GRADING FORM: SMU GENERIC_GJ

SARA VONK

53.25

RESEARCH-INFORMED LITERATURE



References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions not applied consistently. Sources referenced should be listed at the end of your report in the References section and a citation made to them in your text. The school has adopted the use of the IEEE referencing format.

2.25

KNOWLEDGE AND UNDERSTANDING



Knowledge is accurate with a good understanding of the field of study.

13

ANALYSIS



Sound, logical, analytical thinking; synthesis and evaluation. Ability to devise and sustain persuasive arguments, and to review the reliability, validity & significance of evidence. Ability to communicate ideas and evidence accurately and convincingly. Sound, convincing conclusions / recommendations.

15.5

PRACTICAL APPLICATION AND DEP.



A good and appropriate application of standard methods, materials, tools and/or techniques. Good appreciation of the context of the application, with some use of examples, where relevant.

15.9

SKILLS FOR PROFESSIONAL PRAC.



Can communicate in a suitable format but with some room for improvement. For example, adding captions to your figures allows you to directly refer to them in the text. "..as shown in Figure 4." Work lacks coherence in places and could be better structured. Technical reports should always be written using the third person passive voice, e.g. instead of saying "..I connected the components and measured the voltages" you could say "... the components were connected as shown in figure 7 and the voltage drop across each component was measured."

6.6