

2420823 ACDA4006 Resonance Charles H assignment

by Charles H

Submission date: 03-Apr-2025 09:01PM (UTC+0100)

Submission ID: 254719526

File name:

59347_Charles_H_2420823_ACDA4006_Resonance_Charles_H_assignment_658780_37027447.docx (268.07K)

Word count: 7017

Character count: 49783

Resonance

By Charles H, 2420823

For L4 – mputer System
Fundamentals (ACCA4028)

Embedded Electronic Systems

Contents page:

Section 1: Abstract

Section 2: Introduction

Section 3: Simulated circuit setup

Section 4: Simulated circuit results

Section 5: Physical circuit setup

Section 6: Physical circuit results

Section 7: Results analysis

Section 8: Conclusion

Section 9: References

Section 1: Abstract

TANK, RCL or resonance circuits use the relationship between the electric field and magnetic field of the capacitor and inductor and their interactions with the environment to resonate at the intended frequency. The circuit used had a signal generator of varying frequencies going into a series resistor with a value of 1K. The circuit then split into a capacitor with a value of 1µF and an inductor of 1mH in parallel with each other before going to ground. It was created in a simulation software and on breadboard with the results getting compared between each other. The results showed that exporting simulation data was closer to an ideal circuit than using the tools in simulation, however the breadboard circuit returned a response much worse than either of the other. It's expected as the simulations used generic components of perfect value. The breadboard has **problems** such as additional, unused connections which cause interference, imperfect values which change the reactance of the circuit. It also has joints **made from contact** which increase the attenuation of a circuit when compared to permanent joins such as solder.

Section 2: Introduction

Resonance circuits are also commonly called RCL circuits or **TANK** circuits [1]. They are commonly used to either generate or receive specific frequencies which is achieved by having the circuit resonate at the intended frequency. They **have used** as a starting point of development for non-invasive monitoring of biological lifeforms [2] and measuring wear of mechanical components [3].

Attenuation is a measure of the degradation of a signal through a system [1]. An attenuation of 0dB means there is no signal loss throughout the circuit.

Resonance is the ability for a circuit to oscillate between states, with the resonant frequency being the most efficient frequency at which it occurs [1]. A perfect resonance would continue forever and never change frequency.

Reactance is the resistance induced from charge holding components to the flow of charge within a circuit. [4] The oscillations are at their most effective when the reactance of the circuit total to zero, implying there is no resistance to current flow.

$$Attenuation = 20 * \log_{10} \left(\frac{V_{out}}{V_{in}} \right)$$

Caption required - ation Needed

$$Inductive reactance: X_L = 2\pi FL$$

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

Resonance occurs when the reactance of the circuit is minimal. Inductive reactance is minimal when there's no frequency and linearly increases tending towards infinite

reactance at an infinite frequency. Capacitive reactance tends towards infinity at no frequency and decreases exponentially towards 0 reactance at an infinite frequency. The resonant frequency of the circuit will occur when the reactance's are equal. The resonant frequency can be calculated by equating the equations for X_L and X_C and then rearranged for F to be the subject of the equation.

$$2\pi FL = \frac{1}{2\pi FC}$$

$$4\pi^2 F^2 CL = 1$$

$$F^2 = \frac{1}{4\pi^2 CL}$$

$$F = \frac{1}{2\pi\sqrt{CL}}$$

Caption required

RCL circuits are any circuit which contain a resistor, capacitor and inductor in any configuration. The circuit that will be investigated will have a resistor in series, with an inductor and capacitor in parallel. It is a second order circuit, as there are 2 charge storage components [1], the capacitor in an electrical field and the inductor in a magnetic field. The circuit operates by having a potential difference across the capacitor. This causes current to flow through the inductor in parallel to the capacitor. The flowing current induces a magnetic field. The strength of the magnetic field increases in strength as the capacitor drains, which reduces the electrical field strength causing more current to flow through the inductor.

Once the capacitor is drained the electric field has no energy and the magnetic field begins to collapse, inducing a current in opposition to the original direction and re-creating the original electrical field. The circuit then oscillates between the magnetic and electric fields as one weakens and the other strengthens between the peaks. If there were no losses in the circuit, it would continue to oscillate forever with no additional current from an outside source.



Internal resistances of the circuit reduce the peak field strength of each oscillation, so for the circuit to continue oscillating there needs to be an external power source. The resistor in the circuit acts as a current limit to prevent the circuit from receiving more current than needed to re-cooperate the losses, otherwise there would be no reverse current as the source would be overpowering and prevent the magnetic field from decreasing in strength.

The circuit will be created in a simulation software first with data collected on the expected response of the circuit. It will then be created on a breadboard, with the same data collected and compared to the simulated results.

The ⁷circuits output voltage can be measured on an oscilloscope from between the resistor, and the charge holding components. The attenuation can be calculated to find how well the system oscillates at varying frequencies. By finding the frequencies where the attenuation has dropped 3dB from the peak, the bandwidth of the system can be found using those frequencies and the Q factor calculated.⁸

The intended values for the components within the circuit are a 1K resistor, a 1μF capacitor and a 1mH inductor. By substituting the values into the equation for resonant frequency, the expected frequency is

$$F = \frac{1}{2\pi\sqrt{(10^{-3})(10^{-6})}} = 5030\text{Hz}$$

Caption required

Section 3: Simulated Circuit setup.

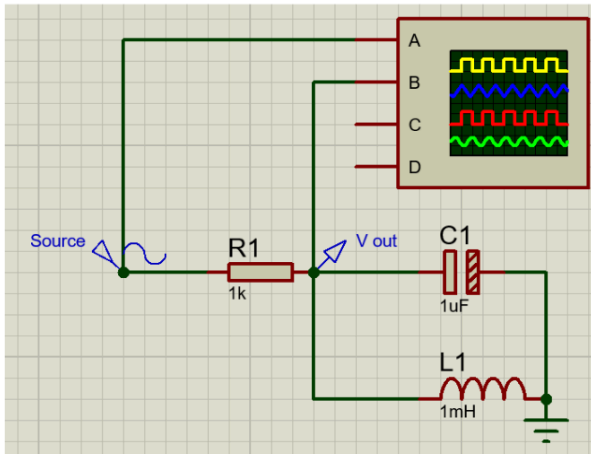


Fig 1: Circuit diagram created within Proteus.

The circuit was created in Proteus Professional 8.17, shown in Figure 1 above. The circuit utilises the generic components library to avoid any behaviours caused by specific components. A signal generator labelled source which can be used during simulation to change the frequency generated and an oscilloscope to record the input and output voltages manually, to ensure the attenuation is measured from the voltage across the circuit and not the target voltage. The oscilloscope was connected across the resistor to measure the voltage both coming into the circuit from the

signal generator, and the voltage at output between the resistor, capacitor and inductor.

Section 4: Simulated Circuit results:

Table I

Simulated results

Frequency (Hz)	V in	V out	Gain (dB)
100	1	0.00065	-63.74173
200	1	0.00130	-57.72113
500	1	0.00320	-49.89700
1000	1	0.00650	-43.74173
2000	1	0.01515	-36.39175
4500	1	0.15781	-16.03731
4600	1	0.20003	-13.97810
4700	1	0.27075	-11.34863
4800	1	0.40026	-7.95316
4900	1	0.64084	-3.86501
5000	1	0.7	-3.09804
5100	1	0.45592	-6.82223
5200	1	0.30669	-10.26601
5300	1	0.22745	-12.86228
5400	1	0.18106	-14.84355
5500	1	0.15026	-16.46313
10000	1	0.02750	-31.21335
20000	1	0.00830	-41.61844

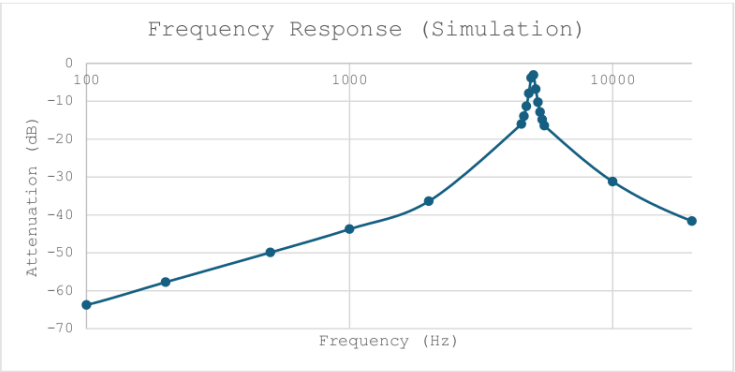


Figure 2: A graph showing the frequency response of the simulated circuit.

A problem encountered with the simulation, is that the resolution of the frequency that can be created from the signal generator is 2.S.F. As a result, the peak from the simulation can't be accurately determined from nearby data points during testing but instead needs to be inferred from drawing the curve. A solution to the problem is by using the data export function within proteus.

Table II

Extract of exported data

Frequency	Gain (dB)
4808.393	-9.91986
4819.478	-9.53984
4830.588	-9.14592
4841.724	-8.73746
4852.885	-8.3139
4864.072	-7.87475
4875.285	-7.41973
4886.524	-6.94883
4897.788	-6.46246
4909.079	-5.96169
4920.395	-5.4485
4931.738	-4.92615
4943.107	-4.39976
4954.502	-3.87682
4965.923	-3.36789
4977.371	-2.88717
4988.845	-2.45258
5000.345	-2.08515
5011.872	-1.80701
5023.426	-1.63805
5035.006	-1.59188
5046.613	-1.6724
5058.247	-1.87284
5069.907	-2.17749
5081.594	-2.56544
5093.309	-3.0146
5105.05	-3.50465
5116.818	-4.01865
5128.614	-4.54344
5140.437	-5.06936
5152.286	-5.58963
5164.164	-6.0997
5176.068	-6.59669
5188	-7.07891

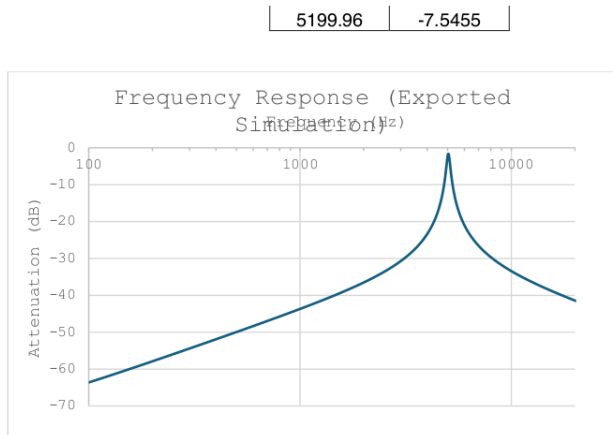


Figure 3: A graph showing the frequency response for exported simulation data.

The exported data in full can be viewed in extract A. The data has many more data points with much smaller resolution than what's possible with manually measuring the data. By having more data points, later calculations can be more accurate.

Although the exported data has come from the same circuit and file, it doesn't align with the manually measured data, which were both checked to be correct. This is an example of how different simulations and methods of simulation will return different values.

Section 5: Physical Circuit setup

The circuit was then created on a breadboard to compare against the simulated results. The input wave amplitude was set to 2V pk-pk, with frequency being variable. The oscilloscope probes were hooked onto additional wires, as the legs of the components were not long enough to hook onto. The distances between components were kept small to reduce losses within the circuit.

The actual values of the components were a 981Ω resistor, a 1.029μF capacitor and a 0.992mH inductor. This means the capacitive reactance and inductive reactances are both going to be slightly lower. The expected resonant frequency of the circuit is

$$F = \frac{1}{2\pi\sqrt{(982^{-6})(1029^{-9})}} = 4980 \text{ Hz}$$

Section 6: Physical Circuit results:

Table III

Physical Circuit results

Frequency	V in	vout	attenuation (dB)
100	1.9	0.0144	-42.40782218
200	1.92	0.0152	-42.02915282
500	1.92	0.016	-41.58362492
1000	1.92	0.02	-39.64542466
1500	1.92	0.0254	-37.56935024
2000	1.92	0.0328	-35.3485477
2500	1.92	0.0436	-32.87629479
3500	1.92	0.0808	-27.51779736
3600	1.92	0.088	-26.77637113
3700	1.92	0.092	-26.39026803
3800	1.92	0.1	-25.66602457
3900	1.92	0.108	-24.99754946
4000	1.92	0.116	-24.37686479
4100	1.92	0.126	-23.65861367
4200	1.92	0.138	-22.86844285
4300	1.92	0.148	-22.26079027
4400	1.92	0.162	-21.47572428
4500	1.94	0.1744	-20.92510499
4600	1.94	0.188	-20.27287761
4700	1.94	0.202	-19.64900721
4800	1.94	0.212	-19.22931738
4900	1.94	0.22	-18.90758098
5000	1.94	0.224	-18.75107423
5050	1.94	0.224	-18.75107423
5100	1.94	0.224	-18.75107423
5200	1.94	0.22	-18.90758098
5300	1.94	0.212	-19.22931738
5400	1.94	0.202	-19.64900721
5500	1.94	0.1912	-20.12627684
5600	1.92	0.18	-20.56057447
5700	1.92	0.168	-21.15983894
5800	1.92	0.158	-21.69288283
5900	1.92	0.15	-22.14419939
6000	1.92	0.142	-22.62025769
6100	1.92	0.132	-23.25454595
6200	1.92	0.126	-23.65861367
6300	1.92	0.12	-24.08239965
6400	1.92	0.112	-24.68166412
6500	1.92	0.108	-24.99754946
7500	1.92	0.074	-28.28139018
8500	1.92	0.056	-30.70226403
9500	1.92	0.048	-32.04119983
10000	1.9	0.042	-33.11008621
20000	1.9	0.0172	-40.86450308
50000	1.9	0.007	-48.67311122
100000	1.84	0.0036	-54.17030644

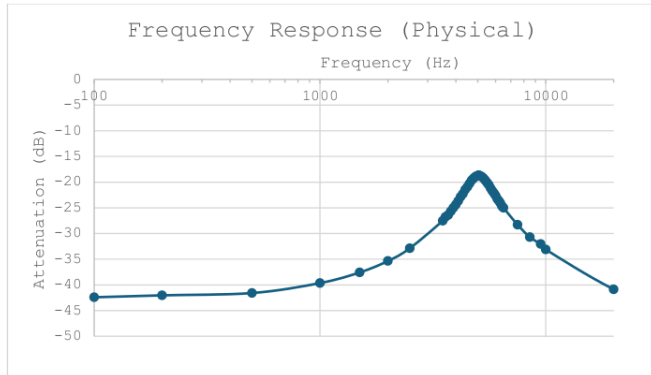


Figure 4: Graph of the frequency response of the physical circuit on a graph.

The graph in Figure 4, although following the general pattern of the simulations, does not have the same gradients of curves as the others. It has a lower peak and retains more attenuation at the lower and higher ends of the frequencies tested.

Results analysis:

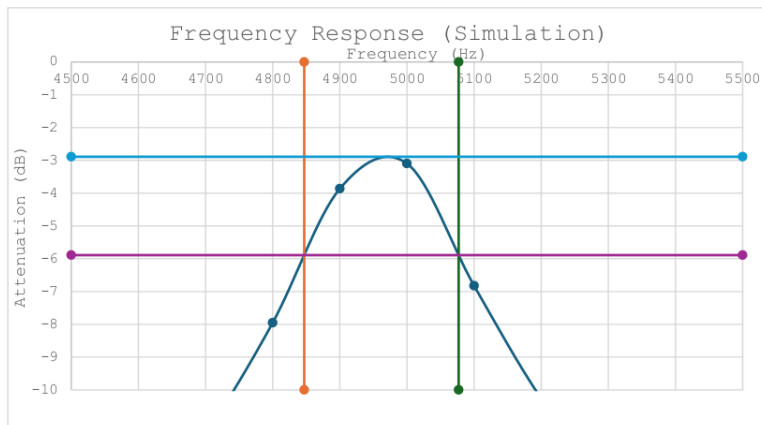


Figure 5: Peak analysis of the measured simulation data.

When the peak of the measured simulation is analysed, it becomes clear that there are only 4 points around the bandwidth and peak. A quick analysis shows estimates of a peak that should be around -2.9dB. The bandwidth limits would be at -5.9dB

which estimate at 4847Hz and 5077Hz, resulting in a bandwidth of 230Hz and a central frequency of 4962Hz.

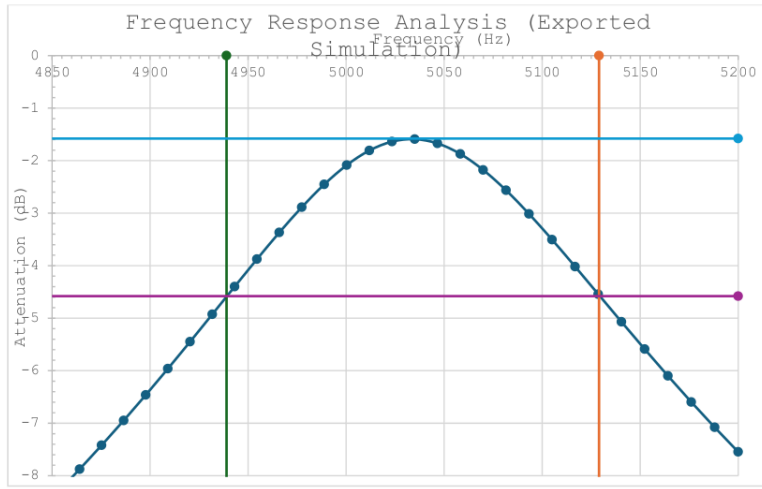


Figure 6: Peak analysis of the exported data.

The exported data has many more points throughout the peak of the frequency response. Its peak has an attenuation of -1.58dB and the bandwidth limits can be found at an attenuation of -4.58dB, making the lower bandwidth limit 4939Hz and the higher bandwidth limit 5129Hz. This results in a bandwidth of 190Hz and a central frequency of 5034Hz with a calculated Q factor as 26.49.

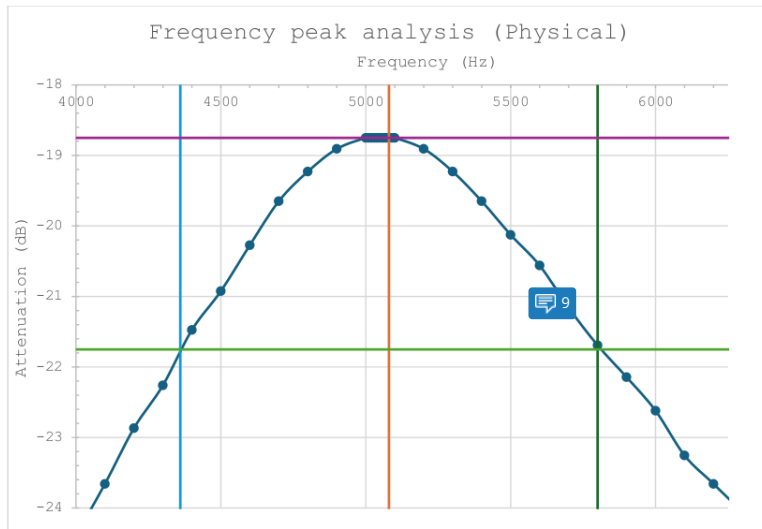


Figure 7: Peak analysis on the physical circuit data to calculate Bandwidth.

The peak attenuation of the physical circuit was -18.75dB, making the -3dB point for finding the bandwidth limits at -21.75dB. The lower bandwidth limit was at 4360Hz, and the upper bandwidth limit was 5800Hz, making the bandwidth 1440Hz and the central frequency 5080Hz. The Q factor was 3.5.

One characteristic that will have a large effect on the resonance is the resistance of the inductor. The one used in the breadboard had a resistance of 6.0Ω in a circuit where the target is resonance it is proportionally high for these kind of circuits.

As the physical circuit was created on breadboard, there are likely to be lots of interference and losses from the additional connections within the board, as well as the connections on components being caused by physical contact and not a solder connection, which is likely to be a reason why the results are so much lower compared to the simulation results.

The measured simulation had a central frequency of 4962Hz, below the mathematically calculated perfect value. The exported circuit was 1Hz higher than the target at 5054Hz and the breadboard circuit had a central frequency of 5080Hz.

Conclusion:

Table IV:
Summary of calculated results

Characteristic	Simulated circuit	Exported circuit	Physical circuit
Maximum attenuation (dB)	-2.89	-1.58	-18.75
Lower bandwidth Limit (Hz)	4847	4939	4360
Upper bandwidth limit (Hz)	5077	5129	5800
Central Frequency (Hz)	4962	5034	5080
Bandwidth	230	140	1440
Q Factor	21.57391	26.49	3.52778

The first noticeable effect from the data is that the exported circuit data is closer to an ideal circuit for the q factor, bandwidth and attenuation than the others. It's also not extremely close to the simulated circuit data, which shows the discrepancies between the methods.

From the information that was calculated, its clear that the physical circuit had a much lower attenuation that the simulated data, so at its resonant frequency, it is not as efficient as the simulations were projecting. It has a much larger bandwidth than expected which also increases the range that the circuit will be producing frequencies, while also having a higher central frequency. If the circuit was needed in a high precision environment, then it would not be very suitable for that use, however it could be used in low precision environments where an efficiency loss is not too important.

References

- [K. Webb, "SECOND-ORDER FILTERS," College of Engineering, Oregon
1 University, [Online]. Available:
] https://web.engr.oregonstate.edu/~webbk/ENGR202_files/SECTION%203%20Secon%20Order%20Filters.pdf. [Accessed 13 03 2025].
- [T.-L. L. S. C. P. N. K. M. J. L. Yan Dong, "A "Two-Part" Resonance Circuit based
2 Detachable Sweat Patch for Noninvasive Biochemical and Biophysical Sensing,"
] 28 11 2022. [Online]. Available:
<https://advanced.onlinelibrary.wiley.com/doi/full/10.1002/adfm.202210136>.
[Accessed 20 03 2025].
- [Z. Liu, S. Wu, K. R. Mahmud, D. Zhu and K. Yu, "The Optimization of Parallel
3 Resonance Circuit for Wear Debris Detection by Adjusting Capacitance," 10 2022.
] [Online]. Available:
<https://www.proquest.com/docview/2724236631?accountid=130472&parentSessionId=YcJR3LAWUaKkv4y8QPzVdNqATSq6I%2FnIBKBgRPtfAns%3D&pq-origsite=primo&sourcetype=Scholarly%20Journals>. [Accessed 20 03 2025].
- ["Difference Between Resistance and Reactance," Circuit Globe, [Online].
4 Ref Qual re: [https://circuitglobe.com/difference-between-resistance-and-](https://circuitglobe.com/difference-between-resistance-and-reactance.html)
] [reactance.html](https://circuitglobe.com/difference-between-resistance-and-reactance.html). [Accessed 14 03 2025].
- [K. B. I. M. S. E. H. John Hiley, "Hughes electrical & electronic technology,"
5 Pearson, 2016, pp. 313-314.
]

Appendix:

A: Exported data

Frequency (Hz)	Attenuation (dB)	Frequency (Hz)	Attenuation (dB)	Frequency (Hz)	Attenuation (dB)
100	-63.6156	586.1382	-48.5468	3427.678	-27.9354
100.2305	-63.5974	587.4894	-48.5264	3435.579	-27.8808
100.4616	-63.5792	588.8437	-48.5059	3443.499	-27.8259
100.6932	-63.561	590.2011	-48.4854	3451.437	-27.7707
100.9253	-63.5428	591.5616	-48.4649	3459.394	-27.7151
101.1579	-63.5246	592.9253	-48.4444	3467.369	-27.6593
101.3911	-63.5064	594.2922	-48.4239	3475.362	-27.6032
101.6249	-63.4882	595.6621	-48.4033	3483.373	-27.5467
101.8591	-63.4699	597.0353	-48.3828	3491.403	-27.4899
102.0939	-63.4517	598.4116	-48.3623	3499.452	-27.4328
102.3293	-63.4334	599.7911	-48.3418	3507.519	-27.3754
102.5652	-63.4152	601.1737	-48.3213	3515.604	-27.3176
102.8016	-63.3969	602.5596	-48.3008	3523.709	-27.2595
103.0386	-63.3786	603.9486	-48.2802	3531.832	-27.201
103.2761	-63.3604	605.3409	-48.2597	3539.973	-27.1422
103.5142	-63.3421	606.7363	-48.2392	3548.134	-27.0831
103.7528	-63.3238	608.135	-48.2186	3556.313	-27.0236
103.992	-63.3055	609.5369	-48.1981	3564.511	-26.9637
104.2317	-63.2872	610.942	-48.1775	3572.728	-26.9034
104.472	-63.2689	612.3504	-48.157	3580.964	-26.8428
104.7129	-63.2505	613.762	-48.1365	3589.219	-26.7818
104.9542	-63.2322	615.1769	-48.1159	3597.493	-26.7204
105.1962	-63.2139	616.595	-48.0953	3605.786	-26.6586
105.4387	-63.1955	618.0164	-48.0748	3614.099	-26.5965
105.6818	-63.1772	619.4411	-48.0542	3622.43	-26.5339
105.9254	-63.1588	620.869	-48.0337	3630.781	-26.4709
106.1696	-63.1405	622.3003	-48.0131	3639.15	-26.4075
106.4143	-63.1221	623.7348	-47.9925	3647.539	-26.3437
106.6596	-63.1037	625.1727	-47.972	3655.948	-26.2795
106.9055	-63.0853	626.6139	-47.9514	3664.376	-26.2148
107.1519	-63.0669	628.0584	-47.9308	3672.823	-26.1497
107.3989	-63.0485	629.5062	-47.9102	3681.29	-26.0842
107.6465	-63.0301	630.9573	-47.8896	3689.776	-26.0182
107.8947	-63.0117	632.4119	-47.869	3698.282	-25.9518
108.1434	-62.9933	633.8697	-47.8485	3706.807	-25.8848
108.3927	-62.9749	635.3309	-47.8279	3715.352	-25.8175
108.6426	-62.9564	636.7955	-47.8073	3723.917	-25.7496
108.893	-62.938	638.2635	-47.7867	3732.502	-25.6812
109.144	-62.9195	639.7348	-47.7661	3741.106	-25.6124
109.3956	-62.9011	641.2096	-47.7454	3749.73	-25.543
109.6478	-62.8826	642.6877	-47.7248	3758.374	-25.4732

109.9006	-62.8642	644.1693	-47.7042	3767.038	-25.4028
110.1539	-62.8457	645.6542	-47.6836	3775.722	-25.3319
110.4079	-62.8272	647.1426	-47.663	3784.426	-25.2605
110.6624	-62.8087	648.6344	-47.6424	3793.15	-25.1885
110.9175	-62.7902	650.1297	-47.6217	3801.894	-25.116
111.1732	-62.7717	651.6284	-47.6011	3810.658	-25.0429
111.4295	-62.7532	653.1306	-47.5805	3819.443	-24.9692
111.6863	-62.7347	654.6362	-47.5598	3828.247	-24.895
111.9438	-62.7162	656.1453	-47.5392	3837.072	-24.8201
112.2018	-62.6977	657.6578	-47.5185	3845.918	-24.7447
112.4605	-62.6791	659.1739	-47.4979	3854.784	-24.6686
112.7197	-62.6606	660.6934	-47.4772	3863.67	-24.592
112.9796	-62.642	662.2165	-47.4566	3872.576	-24.5147
113.24	-62.6235	663.7431	-47.4359	3881.504	-24.4367
113.5011	-62.6049	665.2732	-47.4152	3890.451	-24.3581
113.7627	-62.5864	666.8068	-47.3946	3899.42	-24.2789
114.025	-62.5678	668.3439	-47.3739	3908.409	-24.1989
114.2878	-62.5492	669.8846	-47.3532	3917.419	-24.1183
114.5513	-62.5306	671.4289	-47.3326	3926.449	-24.0369
114.8154	-62.512	672.9767	-47.3119	3935.501	-23.9548
115.08	-62.4934	674.528	-47.2912	3944.573	-23.872
115.3453	-62.4748	676.083	-47.2705	3953.666	-23.7885
115.6112	-62.4562	677.6415	-47.2498	3962.78	-23.7042
115.8777	-62.4376	679.2036	-47.2291	3971.915	-23.6191
116.1449	-62.419	680.7694	-47.2084	3981.072	-23.5332
116.4126	-62.4004	682.3387	-47.1877	3990.249	-23.4466
116.681	-62.3817	683.9116	-47.167	3999.447	-23.3591
116.9499	-62.3631	685.4882	-47.1463	4008.667	-23.2707
117.2195	-62.3444	687.0684	-47.1256	4017.908	-23.1815
117.4898	-62.3258	688.6523	-47.1049	4027.17	-23.0915
117.7606	-62.3071	690.2398	-47.0841	4036.454	-23.0005
118.0321	-62.2885	691.831	-47.0634	4045.759	-22.9086
118.3042	-62.2698	693.4258	-47.0427	4055.085	-22.8159
118.5769	-62.2511	695.0243	-47.022	4064.433	-22.7221
118.8502	-62.2324	696.6265	-47.0012	4073.803	-22.6274
119.1242	-62.2138	698.2324	-46.9805	4083.194	-22.5317
119.3988	-62.1951	699.842	-46.9597	4092.607	-22.435
119.6741	-62.1764	701.4553	-46.939	4102.041	-22.3372
119.9499	-62.1577	703.0723	-46.9182	4111.497	-22.2384
120.2264	-62.139	704.6931	-46.8975	4120.975	-22.1386
120.5036	-62.1202	706.3176	-46.8767	4130.475	-22.0376
120.7814	-62.1015	707.9458	-46.856	4139.997	-21.9355
121.0598	-62.0828	709.5778	-46.8352	4149.54	-21.8322
121.3389	-62.0641	711.2135	-46.8144	4159.106	-21.7277
121.6186	-62.0453	712.853	-46.7936	4168.694	-21.6221
121.899	-62.0266	714.4963	-46.7729	4178.304	-21.5151

122.18	-62.0078	716.1434	-46.7521	4187.936	-21.4069
122.4616	-61.9891	717.7943	-46.7313	4197.59	-21.2975
122.7439	-61.9703	719.449	-46.7105	4207.266	-21.1866
123.0269	-61.9515	721.1075	-46.6897	4216.965	-21.0744
123.3105	-61.9328	722.7698	-46.6689	4226.686	-20.9608
123.5947	-61.914	724.436	-46.6481	4236.43	-20.8458
123.8797	-61.8952	726.106	-46.6273	4246.196	-20.7293
124.1652	-61.8764	727.7798	-46.6065	4255.984	-20.6112
124.4515	-61.8576	729.4575	-46.5856	4265.795	-20.4916
124.7384	-61.8388	731.1391	-46.5648	4275.629	-20.3704
125.0259	-61.82	732.8245	-46.544	4285.485	-20.2476
125.3141	-61.8012	734.5139	-46.5232	4295.364	-20.123
125.603	-61.7824	736.2071	-46.5023	4305.266	-19.9967
125.8925	-61.7636	737.9042	-46.4815	4315.191	-19.8687
126.1828	-61.7448	739.6053	-46.4607	4325.138	-19.7388
126.4736	-61.7259	741.3102	-46.4398	4335.109	-19.607
126.7652	-61.7071	743.0191	-46.419	4345.102	-19.4732
127.0574	-61.6882	744.732	-46.3981	4355.119	-19.3374
127.3503	-61.6694	746.4488	-46.3772	4365.158	-19.1996
127.6439	-61.6505	748.1695	-46.3564	4375.221	-19.0596
127.9381	-61.6317	749.8942	-46.3355	4385.307	-18.9174
128.2331	-61.6128	751.6229	-46.3146	4395.416	-18.773
128.5287	-61.594	753.3556	-46.2938	4405.549	-18.6262
128.825	-61.5751	755.0922	-46.2729	4415.704	-18.4769
129.1219	-61.5562	756.8329	-46.252	4425.884	-18.3252
129.4196	-61.5373	758.5776	-46.2311	4436.086	-18.1708
129.7179	-61.5184	760.3263	-46.2102	4446.313	-18.0138
130.017	-61.4995	762.079	-46.1893	4456.562	-17.854
130.3167	-61.4806	763.8358	-46.1684	4466.836	-17.6914
130.6171	-61.4617	765.5966	-46.1475	4477.133	-17.5257
130.9182	-61.4428	767.3615	-46.1266	4487.454	-17.357
131.22	-61.4239	769.1304	-46.1056	4497.799	-17.185
131.5225	-61.405	770.9035	-46.0847	4508.167	-17.0098
131.8257	-61.3861	772.6806	-46.0638	4518.559	-16.831
132.1296	-61.3672	774.4618	-46.0429	4528.976	-16.6487
132.4342	-61.3482	776.2471	-46.0219	4539.416	-16.4627
132.7394	-61.3293	778.0366	-46.001	4549.881	-16.2727
133.0454	-61.3103	779.8301	-45.98	4560.369	-16.0788
133.3521	-61.2914	781.6278	-45.9591	4570.882	-15.8806
133.6596	-61.2724	783.4296	-45.9381	4581.419	-15.678
133.9677	-61.2535	785.2356	-45.9172	4591.98	-15.4708
134.2765	-61.2345	787.0458	-45.8962	4602.566	-15.2588
134.586	-61.2156	788.8601	-45.8752	4613.176	-15.0418
134.8963	-61.1966	790.6786	-45.8543	4623.81	-14.8195
135.2073	-61.1776	792.5013	-45.8333	4634.469	-14.5918
135.5189	-61.1586	794.3282	-45.8123	4645.153	-14.3583

135.8313	-61.1396	796.1594	-45.7913	4655.861	-14.1187
136.1445	-61.1206	797.9947	-45.7703	4666.594	-13.8728
136.4583	-61.1017	799.8343	-45.7493	4677.351	-13.6203
136.7729	-61.0827	801.6781	-45.7283	4688.134	-13.3608
137.0882	-61.0636	803.5261	-45.7073	4698.941	-13.0939
137.4042	-61.0446	805.3784	-45.6863	4709.773	-12.8192
137.7209	-61.0256	807.235	-45.6652	4720.63	-12.5364
138.0384	-61.0066	809.0959	-45.6442	4731.513	-12.245
138.3566	-60.9876	810.9611	-45.6232	4742.42	-11.9445
138.6756	-60.9686	812.8305	-45.6021	4753.352	-11.6343
138.9953	-60.9495	814.7043	-45.5811	4764.31	-11.3141
139.3157	-60.9305	816.5824	-45.5601	4775.293	-10.9831
139.6368	-60.9115	818.4648	-45.539	4786.301	-10.6408
139.9587	-60.8924	820.3515	-45.5179	4797.334	-10.2866
140.2814	-60.8734	822.2426	-45.4969	4808.393	-9.91986
140.6048	-60.8543	824.1381	-45.4758	4819.478	-9.53984
140.9289	-60.8352	826.0379	-45.4547	4830.588	-9.14592
141.2538	-60.8162	827.9422	-45.4337	4841.724	-8.73746
141.5794	-60.7971	829.8508	-45.4126	4852.885	-8.3139
141.9058	-60.778	831.7638	-45.3915	4864.072	-7.87475
142.2329	-60.759	833.6812	-45.3704	4875.285	-7.41973
142.5608	-60.7399	835.603	-45.3493	4886.524	-6.94883
142.8894	-60.7208	837.5293	-45.3282	4897.788	-6.46246
143.2188	-60.7017	839.46	-45.3071	4909.079	-5.96169
143.5489	-60.6826	841.3951	-45.286	4920.395	-5.4485
143.8799	-60.6635	843.3348	-45.2648	4931.738	-4.92615
144.2115	-60.6444	845.2788	-45.2437	4943.107	-4.39976
144.544	-60.6253	847.2274	-45.2226	4954.502	-3.87682
144.8772	-60.6062	849.1805	-45.2014	4965.923	-3.36789
145.2112	-60.5871	851.138	-45.1803	4977.371	-2.88717
145.5459	-60.568	853.1001	-45.1591	4988.845	-2.45258
145.8814	-60.5489	855.0667	-45.138	5000.345	-2.08515
146.2177	-60.5297	857.0378	-45.1168	5011.872	-1.80701
146.5548	-60.5106	859.0135	-45.0956	5023.426	-1.63805
146.8926	-60.4915	860.9938	-45.0745	5035.006	-1.59188
147.2313	-60.4723	862.9785	-45.0533	5046.613	-1.6724
147.5707	-60.4532	864.9679	-45.0321	5058.247	-1.87284
147.9108	-60.434	866.9619	-45.0109	5069.907	-2.17749
148.2518	-60.4149	868.9604	-44.9897	5081.594	-2.56544
148.5936	-60.3957	870.9636	-44.9685	5093.309	-3.0146
148.9361	-60.3766	872.9714	-44.9473	5105.05	-3.50465
149.2794	-60.3574	874.9838	-44.9261	5116.818	-4.01865
149.6236	-60.3382	877.0008	-44.9049	5128.614	-4.54344
149.9685	-60.3191	879.0225	-44.8836	5140.437	-5.06936
150.3142	-60.2999	881.0489	-44.8624	5152.286	-5.58963
150.6607	-60.2807	883.0799	-44.8412	5164.164	-6.0997

151.008	-60.2615	885.1156	-44.8199	5176.068	-6.59669
151.3561	-60.2423	887.156	-44.7987	5188	-7.07891
151.705	-60.2231	889.2011	-44.7774	5199.96	-7.5455
152.0548	-60.2039	891.2509	-44.7561	5211.947	-7.99618
152.4053	-60.1848	893.3055	-44.7349	5223.962	-8.43104
152.7566	-60.1655	895.3648	-44.7136	5236.004	-8.85043
153.1087	-60.1463	897.4288	-44.6923	5248.075	-9.25486
153.4617	-60.1271	899.4976	-44.671	5260.173	-9.64493
153.8155	-60.1079	901.5711	-44.6497	5272.299	-10.0213
154.17	-60.0887	903.6495	-44.6284	5284.453	-10.3846
154.5254	-60.0695	905.7326	-44.6071	5296.634	-10.7354
154.8817	-60.0503	907.8205	-44.5858	5308.844	-11.0746
155.2387	-60.031	909.9133	-44.5645	5321.083	-11.4026
155.5966	-60.0118	912.0108	-44.5431	5333.349	-11.72
155.9553	-59.9926	914.1132	-44.5218	5345.644	-12.0275
156.3148	-59.9733	916.2205	-44.5005	5357.967	-12.3255
156.6751	-59.9541	918.3326	-44.4791	5370.318	-12.6145
157.0363	-59.9348	920.4496	-44.4577	5382.698	-12.895
157.3983	-59.9156	922.5714	-44.4364	5395.106	-13.1675
157.7611	-59.8963	924.6982	-44.415	5407.543	-13.4324
158.1248	-59.8771	926.8298	-44.3936	5420.009	-13.69
158.4893	-59.8578	928.9664	-44.3723	5432.503	-13.9406
158.8547	-59.8385	931.1079	-44.3509	5445.027	-14.1848
159.2209	-59.8193	933.2543	-44.3295	5457.579	-14.4226
159.5879	-59.8	935.4057	-44.3081	5470.16	-14.6545
159.9558	-59.7807	937.562	-44.2867	5482.77	-14.8808
160.3245	-59.7614	939.7233	-44.2652	5495.409	-15.1016
160.6941	-59.7421	941.8896	-44.2438	5508.077	-15.3172
161.0646	-59.7229	944.0609	-44.2224	5520.774	-15.5278
161.4359	-59.7036	946.2372	-44.2009	5533.501	-15.7338
161.808	-59.6843	948.4185	-44.1795	5546.257	-15.9351
162.181	-59.665	950.6048	-44.1581	5559.043	-16.1322
162.5549	-59.6457	952.7962	-44.1366	5571.857	-16.325
162.9296	-59.6264	954.9926	-44.1151	5584.702	-16.5139
163.3052	-59.6071	957.1941	-44.0937	5597.576	-16.6989
163.6817	-59.5877	959.4006	-44.0722	5610.48	-16.8802
164.059	-59.5684	961.6123	-44.0507	5623.413	-17.058
164.4372	-59.5491	963.829	-44.0292	5636.377	-17.2324
164.8162	-59.5298	966.0509	-44.0077	5649.37	-17.4034
165.1962	-59.5105	968.2779	-43.9862	5662.393	-17.5713
165.577	-59.4911	970.51	-43.9647	5675.446	-17.7361
165.9587	-59.4718	972.7472	-43.9431	5688.529	-17.898
166.3413	-59.4525	974.9896	-43.9216	5701.643	-18.057
166.7247	-59.4331	977.2372	-43.9001	5714.786	-18.2133
167.1091	-59.4138	979.49	-43.8785	5727.96	-18.3669
167.4943	-59.3944	981.7479	-43.857	5741.165	-18.518

167.8804	-59.3751	984.0111	-43.8354	5754.399	-18.6665
168.2674	-59.3557	986.2795	-43.8138	5767.665	-18.8127
168.6553	-59.3364	988.5531	-43.7922	5780.96	-18.9565
169.0441	-59.317	990.8319	-43.7707	5794.287	-19.0981
169.4338	-59.2977	993.116	-43.7491	5807.644	-19.2375
169.8244	-59.2783	995.4054	-43.7275	5821.032	-19.3748
170.2159	-59.2589	997.7001	-43.7058	5834.451	-19.51
170.6082	-59.2396	1000	-43.6842	5847.901	-19.6432
171.0015	-59.2202	1002.305	-43.6626	5861.382	-19.7745
171.3957	-59.2008	1004.616	-43.641	5874.894	-19.9039
171.7908	-59.1814	1006.932	-43.6193	5888.437	-20.0315
172.1869	-59.162	1009.253	-43.5977	5902.011	-20.1573
172.5838	-59.1427	1011.579	-43.576	5915.616	-20.2814
172.9816	-59.1233	1013.911	-43.5543	5929.253	-20.4038
173.3804	-59.1039	1016.249	-43.5327	5942.922	-20.5245
173.7801	-59.0845	1018.591	-43.511	5956.621	-20.6437
174.1807	-59.0651	1020.939	-43.4893	5970.353	-20.7613
174.5822	-59.0457	1023.293	-43.4676	5984.116	-20.8774
174.9847	-59.0263	1025.652	-43.4459	5997.911	-20.9921
175.3881	-59.0069	1028.016	-43.4242	6011.737	-21.1053
175.7924	-58.9874	1030.386	-43.4024	6025.596	-21.2171
176.1976	-58.968	1032.761	-43.3807	6039.486	-21.3276
176.6038	-58.9486	1035.142	-43.359	6053.409	-21.4367
177.0109	-58.9292	1037.528	-43.3372	6067.363	-21.5446
177.4189	-58.9098	1039.92	-43.3155	6081.35	-21.6511
177.8279	-58.8903	1042.317	-43.2937	6095.369	-21.7565
178.2379	-58.8709	1044.72	-43.2719	6109.42	-21.8606
178.6488	-58.8515	1047.129	-43.2501	6123.504	-21.9636
179.0606	-58.832	1049.542	-43.2283	6137.62	-22.0654
179.4734	-58.8126	1051.962	-43.2065	6151.769	-22.1661
179.8871	-58.7932	1054.387	-43.1847	6165.95	-22.2657
180.3018	-58.7737	1056.818	-43.1629	6180.164	-22.3642
180.7174	-58.7543	1059.254	-43.1411	6194.411	-22.4616
181.134	-58.7348	1061.696	-43.1192	6208.69	-22.5581
181.5516	-58.7154	1064.143	-43.0974	6223.003	-22.6535
181.9701	-58.6959	1066.596	-43.0755	6237.348	-22.7479
182.3896	-58.6764	1069.055	-43.0537	6251.727	-22.8414
182.81	-58.657	1071.519	-43.0318	6266.139	-22.934
183.2314	-58.6375	1073.989	-43.0099	6280.584	-23.0256
183.6538	-58.618	1076.465	-42.988	6295.062	-23.1163
184.0772	-58.5986	1078.947	-42.9661	6309.573	-23.2061
184.5015	-58.5791	1081.434	-42.9442	6324.119	-23.2951
184.9269	-58.5596	1083.927	-42.9223	6338.697	-23.3832
185.3532	-58.5401	1086.426	-42.9003	6353.309	-23.4705
185.7804	-58.5207	1088.93	-42.8784	6367.955	-23.5569
186.2087	-58.5012	1091.44	-42.8565	6382.635	-23.6426

186.638	-58.4817	1093.956	-42.8345	6397.348	-23.7274
187.0682	-58.4622	1096.478	-42.8125	6412.096	-23.8115
187.4995	-58.4427	1099.006	-42.7906	6426.877	-23.8949
187.9317	-58.4232	1101.539	-42.7686	6441.693	-23.9775
188.3649	-58.4037	1104.079	-42.7466	6456.542	-24.0594
188.7991	-58.3842	1106.624	-42.7246	6471.426	-24.1405
189.2344	-58.3647	1109.175	-42.7025	6486.344	-24.221
189.6706	-58.3452	1111.732	-42.6805	6501.297	-24.3007
190.1078	-58.3257	1114.295	-42.6585	6516.284	-24.3798
190.5461	-58.3062	1116.863	-42.6364	6531.306	-24.4583
190.9853	-58.2866	1119.438	-42.6144	6546.362	-24.536
191.4256	-58.2671	1122.018	-42.5923	6561.453	-24.6132
191.8669	-58.2476	1124.605	-42.5702	6576.578	-24.6897
192.3092	-58.2281	1127.197	-42.5481	6591.739	-24.7655
192.7525	-58.2086	1129.796	-42.526	6606.934	-24.8408
193.1968	-58.189	1132.4	-42.5039	6622.165	-24.9155
193.6422	-58.1695	1135.011	-42.4818	6637.431	-24.9896
194.0886	-58.15	1137.627	-42.4597	6652.732	-25.0631
194.536	-58.1304	1140.25	-42.4375	6668.068	-25.136
194.9845	-58.1109	1142.878	-42.4154	6683.439	-25.2084
195.4339	-58.0913	1145.513	-42.3932	6698.846	-25.2802
195.8845	-58.0718	1148.154	-42.371	6714.289	-25.3515
196.336	-58.0522	1150.8	-42.3489	6729.767	-25.4223
196.7886	-58.0327	1153.453	-42.3267	6745.28	-25.4925
197.2423	-58.0131	1156.112	-42.3045	6760.83	-25.5622
197.697	-57.9936	1158.777	-42.2822	6776.415	-25.6314
198.1527	-57.974	1161.449	-42.26	6792.036	-25.7002
198.6095	-57.9545	1164.126	-42.2378	6807.694	-25.7684
199.0673	-57.9349	1166.81	-42.2155	6823.387	-25.8361
199.5262	-57.9153	1169.499	-42.1933	6839.116	-25.9034
199.9862	-57.8958	1172.195	-42.171	6854.882	-25.9702
200.4472	-57.8762	1174.898	-42.1487	6870.684	-26.0365
200.9093	-57.8566	1177.606	-42.1264	6886.523	-26.1024
201.3724	-57.8371	1180.321	-42.1041	6902.398	-26.1678
201.8366	-57.8175	1183.042	-42.0818	6918.31	-26.2328
202.3019	-57.7979	1185.769	-42.0595	6934.258	-26.2973
202.7683	-57.7783	1188.502	-42.0371	6950.243	-26.3614
203.2357	-57.7587	1191.242	-42.0148	6966.265	-26.4251
203.7042	-57.7391	1193.988	-41.9924	6982.324	-26.4884
204.1738	-57.7196	1196.741	-41.97	6998.42	-26.5513
204.6445	-57.7	1199.499	-41.9477	7014.553	-26.6137
205.1162	-57.6804	1202.264	-41.9253	7030.723	-26.6758
205.5891	-57.6608	1205.036	-41.9028	7046.931	-26.7375
206.063	-57.6412	1207.814	-41.8804	7063.176	-26.7987
206.538	-57.6216	1210.598	-41.858	7079.458	-26.8596
207.0141	-57.602	1213.389	-41.8355	7095.778	-26.9202

207.4914	-57.5824	1216.186	-41.8131	7112.135	-26.9803
207.9697	-57.5627	1218.99	-41.7906	7128.53	-27.0401
208.4491	-57.5431	1221.8	-41.7681	7144.963	-27.0995
208.9296	-57.5235	1224.616	-41.7456	7161.434	-27.1586
209.4112	-57.5039	1227.439	-41.7231	7177.943	-27.2173
209.894	-57.4843	1230.269	-41.7006	7194.49	-27.2757
210.3778	-57.4647	1233.105	-41.6781	7211.075	-27.3337
210.8628	-57.445	1235.947	-41.6555	7227.698	-27.3914
211.3489	-57.4254	1238.797	-41.633	7244.36	-27.4487
211.8361	-57.4058	1241.652	-41.6104	7261.06	-27.5057
212.3244	-57.3862	1244.515	-41.5878	7277.798	-27.5624
212.8139	-57.3665	1247.384	-41.5652	7294.575	-27.6188
213.3045	-57.3469	1250.259	-41.5426	7311.391	-27.6749
213.7962	-57.3273	1253.141	-41.52	7328.245	-27.7306
214.2891	-57.3076	1256.03	-41.4974	7345.139	-27.786
214.783	-57.288	1258.925	-41.4747	7362.071	-27.8412
215.2782	-57.2683	1261.828	-41.4521	7379.042	-27.896
215.7744	-57.2487	1264.736	-41.4294	7396.053	-27.9505
216.2719	-57.229	1267.652	-41.4067	7413.102	-28.0048
216.7704	-57.2094	1270.574	-41.384	7430.191	-28.0587
217.2701	-57.1897	1273.503	-41.3613	7447.32	-28.1124
217.771	-57.1701	1276.439	-41.3385	7464.488	-28.1658
218.273	-57.1504	1279.381	-41.3158	7481.695	-28.2189
218.7762	-57.1308	1282.331	-41.2931	7498.942	-28.2717
219.2805	-57.1111	1285.287	-41.2703	7516.229	-28.3242
219.786	-57.0914	1288.25	-41.2475	7533.556	-28.3765
220.2926	-57.0718	1291.219	-41.2247	7550.922	-28.4285
220.8005	-57.0521	1294.196	-41.2019	7568.329	-28.4803
221.3095	-57.0324	1297.179	-41.1791	7585.776	-28.5318
221.8196	-57.0127	1300.17	-41.1562	7603.263	-28.583
222.331	-56.9931	1303.167	-41.1334	7620.79	-28.634
222.8435	-56.9734	1306.171	-41.1105	7638.358	-28.6847
223.3572	-56.9537	1309.182	-41.0876	7655.966	-28.7352
223.8721	-56.934	1312.2	-41.0647	7673.615	-28.7854
224.3882	-56.9143	1315.225	-41.0418	7691.304	-28.8354
224.9055	-56.8947	1318.257	-41.0189	7709.035	-28.8852
225.4239	-56.875	1321.296	-40.996	7726.806	-28.9347
225.9436	-56.8553	1324.342	-40.973	7744.618	-28.9839
226.4644	-56.8356	1327.394	-40.95	7762.471	-29.033
226.9865	-56.8159	1330.454	-40.9271	7780.366	-29.0818
227.5097	-56.7962	1333.521	-40.9041	7798.301	-29.1304
228.0342	-56.7765	1336.596	-40.8811	7816.278	-29.1788
228.5599	-56.7568	1339.677	-40.858	7834.296	-29.2269
229.0868	-56.7371	1342.765	-40.835	7852.356	-29.2748
229.6149	-56.7174	1345.86	-40.8119	7870.458	-29.3226
230.1442	-56.6977	1348.963	-40.7888	7888.601	-29.37

230.6747	-56.678	1352.073	-40.7658	7906.786	-29.4173
231.2065	-56.6583	1355.189	-40.7427	7925.013	-29.4644
231.7395	-56.6385	1358.313	-40.7195	7943.282	-29.5113
232.2737	-56.6188	1361.445	-40.6964	7961.594	-29.5579
232.8091	-56.5991	1364.583	-40.6732	7979.947	-29.6044
233.3458	-56.5794	1367.729	-40.6501	7998.343	-29.6506
233.8837	-56.5597	1370.882	-40.6269	8016.781	-29.6967
234.4229	-56.54	1374.042	-40.6037	8035.261	-29.7426
234.9633	-56.5202	1377.209	-40.5805	8053.784	-29.7882
235.5049	-56.5005	1380.384	-40.5573	8072.35	-29.8337
236.0478	-56.4808	1383.566	-40.534	8090.959	-29.879
236.592	-56.461	1386.756	-40.5107	8109.611	-29.9241
237.1374	-56.4413	1389.953	-40.4875	8128.305	-29.969
237.684	-56.4216	1393.157	-40.4642	8147.043	-30.0137
238.2319	-56.4018	1396.368	-40.4408	8165.824	-30.0582
238.7811	-56.3821	1399.587	-40.4175	8184.648	-30.1026
239.3316	-56.3623	1402.814	-40.3942	8203.515	-30.1468
239.8833	-56.3426	1406.048	-40.3708	8222.426	-30.1908
240.4363	-56.3229	1409.289	-40.3474	8241.381	-30.2346
240.9905	-56.3031	1412.538	-40.324	8260.379	-30.2783
241.5461	-56.2834	1415.794	-40.3006	8279.422	-30.3217
242.1029	-56.2636	1419.058	-40.2772	8298.508	-30.365
242.661	-56.2439	1422.329	-40.2537	8317.638	-30.4082
243.2204	-56.2241	1425.608	-40.2303	8336.812	-30.4512
243.7811	-56.2043	1428.894	-40.2068	8356.03	-30.494
244.3431	-56.1846	1432.188	-40.1833	8375.293	-30.5366
244.9063	-56.1648	1435.489	-40.1598	8394.6	-30.5791
245.4709	-56.1451	1438.799	-40.1362	8413.951	-30.6214
246.0368	-56.1253	1442.115	-40.1127	8433.348	-30.6636
246.6039	-56.1055	1445.44	-40.0891	8452.788	-30.7056
247.1724	-56.0858	1448.772	-40.0655	8472.274	-30.7474
247.7422	-56.066	1452.112	-40.0419	8491.805	-30.7891
248.3133	-56.0462	1455.459	-40.0183	8511.38	-30.8307
248.8857	-56.0264	1458.814	-39.9946	8531.001	-30.872
249.4595	-56.0067	1462.177	-39.971	8550.667	-30.9133
250.0345	-55.9869	1465.548	-39.9473	8570.378	-30.9544
250.6109	-55.9671	1468.926	-39.9236	8590.135	-30.9953
251.1886	-55.9473	1472.313	-39.8999	8609.938	-31.0361
251.7677	-55.9275	1475.707	-39.8761	8629.785	-31.0768
252.3481	-55.9077	1479.108	-39.8524	8649.679	-31.1173
252.9298	-55.888	1482.518	-39.8286	8669.619	-31.1576
253.5129	-55.8682	1485.936	-39.8048	8689.604	-31.1978
254.0973	-55.8484	1489.361	-39.781	8709.636	-31.2379
254.683	-55.8286	1492.794	-39.7571	8729.714	-31.2779
255.2701	-55.8088	1496.236	-39.7333	8749.838	-31.3177
255.8586	-55.789	1499.685	-39.7094	8770.008	-31.3574

256.4484	-55.7692	1503.142	-39.6855	8790.225	-31.3969
257.0396	-55.7494	1506.607	-39.6616	8810.489	-31.4363
257.6321	-55.7296	1510.08	-39.6377	8830.799	-31.4756
258.226	-55.7098	1513.561	-39.6137	8851.156	-31.5147
258.8213	-55.69	1517.05	-39.5897	8871.56	-31.5537
259.4179	-55.6702	1520.548	-39.5657	8892.011	-31.5926
260.016	-55.6503	1524.053	-39.5417	8912.509	-31.6314
260.6154	-55.6305	1527.566	-39.5177	8933.055	-31.67
261.2161	-55.6107	1531.087	-39.4936	8953.648	-31.7085
261.8183	-55.5909	1534.617	-39.4696	8974.288	-31.7469
262.4219	-55.5711	1538.155	-39.4455	8994.976	-31.7852
263.0268	-55.5513	1541.7	-39.4213	9015.711	-31.8233
263.6331	-55.5314	1545.254	-39.3972	9036.495	-31.8613
264.2409	-55.5116	1548.817	-39.373	9057.326	-31.8992
264.85	-55.4918	1552.387	-39.3489	9078.205	-31.937
265.4606	-55.472	1555.966	-39.3247	9099.133	-31.9747
266.0725	-55.4521	1559.553	-39.3004	9120.108	-32.0122
266.6859	-55.4323	1563.148	-39.2762	9141.132	-32.0496
267.3006	-55.4125	1566.751	-39.2519	9162.205	-32.087
267.9168	-55.3926	1570.363	-39.2276	9183.326	-32.1242
268.5344	-55.3728	1573.983	-39.2033	9204.496	-32.1612
269.1535	-55.353	1577.611	-39.179	9225.714	-32.1982
269.7739	-55.3331	1581.248	-39.1546	9246.982	-32.2351
270.3958	-55.3133	1584.893	-39.1302	9268.298	-32.2718
271.0192	-55.2934	1588.547	-39.1058	9289.664	-32.3085
271.6439	-55.2736	1592.209	-39.0814	9311.079	-32.345
272.2701	-55.2538	1595.879	-39.057	9332.543	-32.3815
272.8978	-55.2339	1599.558	-39.0325	9354.057	-32.4178
273.5269	-55.2141	1603.245	-39.008	9375.62	-32.454
274.1574	-55.1942	1606.941	-38.9835	9397.233	-32.4901
274.7894	-55.1743	1610.646	-38.959	9418.896	-32.5261
275.4229	-55.1545	1614.359	-38.9344	9440.609	-32.562
276.0578	-55.1346	1618.08	-38.9098	9462.372	-32.5978
276.6942	-55.1148	1621.81	-38.8852	9484.185	-32.6336
277.332	-55.0949	1625.549	-38.8606	9506.048	-32.6692
277.9713	-55.0751	1629.296	-38.8359	9527.962	-32.7047
278.6121	-55.0552	1633.052	-38.8112	9549.926	-32.7401
279.2544	-55.0353	1636.817	-38.7865	9571.941	-32.7754
279.8981	-55.0155	1640.59	-38.7618	9594.006	-32.8106
280.5434	-54.9956	1644.372	-38.737	9616.123	-32.8457
281.1901	-54.9757	1648.162	-38.7123	9638.29	-32.8807
281.8383	-54.9558	1651.962	-38.6875	9660.509	-32.9157
282.488	-54.936	1655.77	-38.6626	9682.779	-32.9505
283.1392	-54.9161	1659.587	-38.6378	9705.1	-32.9852
283.7919	-54.8962	1663.413	-38.6129	9727.472	-33.0199
284.4461	-54.8763	1667.247	-38.588	9749.896	-33.0544

285.1018	-54.8564	1671.091	-38.5631	9772.372	-33.0889
285.7591	-54.8366	1674.943	-38.5381	9794.9	-33.1233
286.4178	-54.8167	1678.804	-38.5131	9817.479	-33.1576
287.0781	-54.7968	1682.674	-38.4881	9840.111	-33.1918
287.7398	-54.7769	1686.553	-38.4631	9862.795	-33.2259
288.4032	-54.757	1690.441	-38.438	9885.531	-33.2599
289.068	-54.7371	1694.338	-38.4129	9908.319	-33.2938
289.7344	-54.7172	1698.244	-38.3878	9931.16	-33.3277
290.4023	-54.6973	1702.159	-38.3627	9954.054	-33.3614
291.0717	-54.6774	1706.082	-38.3375	9977.001	-33.3951
291.7427	-54.6575	1710.015	-38.3123	10000	-33.4287
292.4152	-54.6376	1713.957	-38.2871	10023.05	-33.4622
293.0893	-54.6177	1717.908	-38.2619	10046.16	-33.4956
293.765	-54.5978	1721.869	-38.2366	10069.32	-33.529
294.4422	-54.5779	1725.838	-38.2113	10092.53	-33.5622
295.1209	-54.558	1729.816	-38.1859	10115.79	-33.5954
295.8012	-54.5381	1733.804	-38.1606	10139.11	-33.6285
296.4831	-54.5182	1737.801	-38.1352	10162.49	-33.6615
297.1666	-54.4983	1741.807	-38.1098	10185.91	-33.6945
297.8516	-54.4784	1745.822	-38.0843	10209.39	-33.7274
298.5383	-54.4585	1749.847	-38.0589	10232.93	-33.7601
299.2265	-54.4385	1753.881	-38.0334	10256.52	-33.7928
299.9163	-54.4186	1757.924	-38.0078	10280.16	-33.8255
300.6076	-54.3987	1761.976	-37.9823	10303.86	-33.858
301.3006	-54.3788	1766.038	-37.9567	10327.61	-33.8905
301.9952	-54.3589	1770.109	-37.9311	10351.42	-33.9229
302.6913	-54.3389	1774.189	-37.9054	10375.28	-33.9553
303.3891	-54.319	1778.279	-37.8798	10399.2	-33.9875
304.0885	-54.2991	1782.379	-37.854	10423.17	-34.0197
304.7895	-54.2791	1786.488	-37.8283	10447.2	-34.0518
305.4921	-54.2592	1790.606	-37.8025	10471.29	-34.0838
306.1963	-54.2393	1794.734	-37.7767	10495.42	-34.1158
306.9022	-54.2193	1798.871	-37.7509	10519.62	-34.1477
307.6097	-54.1994	1803.018	-37.7251	10543.87	-34.1795
308.3188	-54.1795	1807.174	-37.6992	10568.18	-34.2113
309.0295	-54.1595	1811.34	-37.6732	10592.54	-34.243
309.7419	-54.1396	1815.516	-37.6473	10616.96	-34.2746
310.456	-54.1196	1819.701	-37.6213	10641.43	-34.3061
311.1716	-54.0997	1823.896	-37.5953	10665.96	-34.3376
311.889	-54.0798	1828.1	-37.5692	10690.55	-34.369
312.6079	-54.0598	1832.314	-37.5431	10715.19	-34.4004
313.3286	-54.0399	1836.538	-37.517	10739.89	-34.4316
314.0509	-54.0199	1840.772	-37.4909	10764.65	-34.4628
314.7748	-53.9999	1845.015	-37.4647	10789.47	-34.494
315.5005	-53.98	1849.269	-37.4385	10814.34	-34.5251
316.2278	-53.96	1853.532	-37.4123	10839.27	-34.5561

316.9567	-53.9401	1857.804	-37.386	10864.26	-34.587
317.6874	-53.9201	1862.087	-37.3597	10889.3	-34.6179
318.4198	-53.9002	1866.38	-37.3333	10914.4	-34.6487
319.1538	-53.8802	1870.682	-37.3069	10939.56	-34.6795
319.8895	-53.8602	1874.995	-37.2805	10964.78	-34.7102
320.6269	-53.8403	1879.317	-37.2541	10990.06	-34.7408
321.3661	-53.8203	1883.649	-37.2276	11015.39	-34.7714
322.1069	-53.8003	1887.991	-37.2011	11040.79	-34.8019
322.8494	-53.7803	1892.344	-37.1745	11066.24	-34.8324
323.5937	-53.7604	1896.706	-37.1479	11091.75	-34.8627
324.3396	-53.7404	1901.078	-37.1213	11117.32	-34.8931
325.0873	-53.7204	1905.461	-37.0946	11142.95	-34.9233
325.8367	-53.7004	1909.853	-37.0679	11168.63	-34.9536
326.5878	-53.6805	1914.256	-37.0412	11194.38	-34.9837
327.3407	-53.6605	1918.669	-37.0144	11220.18	-35.0138
328.0953	-53.6405	1923.092	-36.9876	11246.05	-35.0438
328.8516	-53.6205	1927.525	-36.9608	11271.97	-35.0738
329.6097	-53.6005	1931.968	-36.9339	11297.96	-35.1037
330.3695	-53.5805	1936.422	-36.907	11324	-35.1336
331.1311	-53.5605	1940.886	-36.88	11350.11	-35.1634
331.8945	-53.5406	1945.36	-36.8531	11376.27	-35.1932
332.6596	-53.5206	1949.845	-36.826	11402.5	-35.2229
333.4264	-53.5006	1954.339	-36.799	11428.78	-35.2525
334.195	-53.4806	1958.845	-36.7718	11455.13	-35.2821
334.9654	-53.4606	1963.36	-36.7447	11481.54	-35.3116
335.7376	-53.4406	1967.886	-36.7175	11508	-35.3411
336.5116	-53.4206	1972.423	-36.6903	11534.53	-35.3705
337.2873	-53.4006	1976.97	-36.663	11561.12	-35.3999
338.0648	-53.3806	1981.527	-36.6357	11587.77	-35.4292
338.8442	-53.3606	1986.095	-36.6084	11614.49	-35.4585
339.6253	-53.3406	1990.673	-36.581	11641.26	-35.4877
340.4082	-53.3205	1995.262	-36.5536	11668.1	-35.5168
341.1929	-53.3005	1999.862	-36.5261	11694.99	-35.5459
341.9794	-53.2805	2004.472	-36.4986	11721.95	-35.575
342.7678	-53.2605	2009.093	-36.4711	11748.98	-35.604
343.5579	-53.2405	2013.724	-36.4435	11776.06	-35.633
344.3499	-53.2205	2018.366	-36.4159	11803.21	-35.6619
345.1437	-53.2005	2023.019	-36.3882	11830.42	-35.6907
345.9394	-53.1804	2027.683	-36.3605	11857.69	-35.7195
346.7369	-53.1604	2032.357	-36.3327	11885.02	-35.7483
347.5362	-53.1404	2037.042	-36.3049	11912.42	-35.777
348.3373	-53.1204	2041.738	-36.2771	11939.88	-35.8056
349.1403	-53.1003	2046.445	-36.2492	11967.41	-35.8343
349.9452	-53.0803	2051.162	-36.2213	11994.99	-35.8628
350.7519	-53.0603	2055.891	-36.1933	12022.64	-35.8913
351.5604	-53.0402	2060.63	-36.1653	12050.36	-35.9198

352.3709	-53.0202	2065.38	-36.1372	12078.14	-35.9482
353.1832	-53.0002	2070.141	-36.1091	12105.98	-35.9766
353.9973	-52.9801	2074.914	-36.0809	12133.89	-36.0049
354.8134	-52.9601	2079.697	-36.0527	12161.86	-36.0332
355.6313	-52.9401	2084.491	-36.0245	12189.9	-36.0614
356.4511	-52.92	2089.296	-35.9962	12218	-36.0896
357.2728	-52.9	2094.112	-35.9679	12246.16	-36.1178
358.0964	-52.8799	2098.94	-35.9395	12274.39	-36.1459
358.9219	-52.8599	2103.778	-35.9111	12302.69	-36.1739
359.7493	-52.8398	2108.628	-35.8826	12331.05	-36.2019
360.5786	-52.8198	2113.489	-35.8541	12359.47	-36.2299
361.4099	-52.7997	2118.361	-35.8255	12387.97	-36.2578
362.243	-52.7797	2123.244	-35.7969	12416.52	-36.2857
363.0781	-52.7596	2128.139	-35.7682	12445.15	-36.3135
363.915	-52.7396	2133.045	-35.7395	12473.84	-36.3413
364.7539	-52.7195	2137.962	-35.7107	12502.59	-36.3691
365.5948	-52.6994	2142.891	-35.6819	12531.41	-36.3968
366.4376	-52.6794	2147.83	-35.6531	12560.3	-36.4244
367.2823	-52.6593	2152.782	-35.6241	12589.25	-36.4521
368.129	-52.6392	2157.744	-35.5952	12618.28	-36.4797
368.9776	-52.6192	2162.719	-35.5662	12647.36	-36.5072
369.8282	-52.5991	2167.704	-35.5371	12676.52	-36.5347
370.6807	-52.579	2172.701	-35.508	12705.74	-36.5621
371.5352	-52.559	2177.71	-35.4788	12735.03	-36.5896
372.3917	-52.5389	2182.73	-35.4496	12764.39	-36.6169
373.2502	-52.5188	2187.762	-35.4203	12793.81	-36.6443
374.1106	-52.4987	2192.805	-35.391	12823.31	-36.6716
374.973	-52.4787	2197.86	-35.3616	12852.87	-36.6988
375.8374	-52.4586	2202.926	-35.3322	12882.5	-36.7261
376.7038	-52.4385	2208.005	-35.3027	12912.19	-36.7532
377.5722	-52.4184	2213.095	-35.2731	12941.96	-36.7804
378.4426	-52.3983	2218.196	-35.2436	12971.79	-36.8075
379.315	-52.3782	2223.31	-35.2139	13001.7	-36.8345
380.1894	-52.3581	2228.435	-35.1842	13031.67	-36.8616
381.0658	-52.3381	2233.572	-35.1544	13061.71	-36.8885
381.9443	-52.318	2238.721	-35.1246	13091.82	-36.9155
382.8247	-52.2979	2243.882	-35.0947	13122	-36.9424
383.7072	-52.2778	2249.055	-35.0648	13152.25	-36.9693
384.5918	-52.2577	2254.239	-35.0348	13182.57	-36.9961
385.4784	-52.2376	2259.436	-35.0048	13212.96	-37.0229
386.367	-52.2175	2264.644	-34.9747	13243.42	-37.0497
387.2576	-52.1974	2269.865	-34.9445	13273.94	-37.0764
388.1504	-52.1773	2275.097	-34.9143	13304.54	-37.1031
389.0451	-52.1572	2280.342	-34.884	13335.21	-37.1298
389.942	-52.137	2285.599	-34.8537	13365.96	-37.1564
390.8409	-52.1169	2290.868	-34.8232	13396.77	-37.183

391.7419	-52.0968	2296.149	-34.7928	13427.65	-37.2095
392.6449	-52.0767	2301.442	-34.7623	13458.6	-37.236
393.5501	-52.0566	2306.747	-34.7317	13489.63	-37.2625
394.4573	-52.0365	2312.065	-34.701	13520.73	-37.289
395.3666	-52.0164	2317.395	-34.6703	13551.89	-37.3154
396.278	-51.9962	2322.737	-34.6396	13583.13	-37.3417
397.1915	-51.9761	2328.091	-34.6087	13614.45	-37.3681
398.1072	-51.956	2333.458	-34.5778	13645.83	-37.3944
399.0249	-51.9359	2338.837	-34.5469	13677.29	-37.4207
399.9447	-51.9157	2344.229	-34.5158	13708.82	-37.4469
400.8667	-51.8956	2349.633	-34.4847	13740.42	-37.4731
401.7908	-51.8755	2355.049	-34.4536	13772.09	-37.4993
402.717	-51.8554	2360.478	-34.4224	13803.84	-37.5254
403.6454	-51.8352	2365.92	-34.3911	13835.66	-37.5516
404.5759	-51.8151	2371.374	-34.3597	13867.56	-37.5776
405.5085	-51.7949	2376.84	-34.3283	13899.53	-37.6037
406.4433	-51.7748	2382.319	-34.2968	13931.57	-37.6297
407.3803	-51.7547	2387.811	-34.2652	13963.68	-37.6557
408.3194	-51.7345	2393.316	-34.2336	13995.87	-37.6816
409.2607	-51.7144	2398.833	-34.2019	14028.14	-37.7076
410.2041	-51.6942	2404.363	-34.1701	14060.48	-37.7334
411.1497	-51.6741	2409.905	-34.1383	14092.89	-37.7593
412.0975	-51.6539	2415.461	-34.1064	14125.38	-37.7851
413.0475	-51.6338	2421.029	-34.0744	14157.94	-37.8109
413.9997	-51.6136	2426.61	-34.0423	14190.58	-37.8367
414.954	-51.5935	2432.204	-34.0102	14223.29	-37.8624
415.9106	-51.5733	2437.811	-33.978	14256.08	-37.8881
416.8694	-51.5532	2443.431	-33.9457	14288.94	-37.9138
417.8304	-51.533	2449.063	-33.9134	14321.88	-37.9395
418.7936	-51.5128	2454.709	-33.881	14354.89	-37.9651
419.759	-51.4927	2460.368	-33.8485	14387.99	-37.9907
420.7266	-51.4725	2466.039	-33.8159	14421.15	-38.0162
421.6965	-51.4523	2471.724	-33.7833	14454.4	-38.0417
422.6686	-51.4322	2477.422	-33.7505	14487.72	-38.0672
423.643	-51.412	2483.133	-33.7177	14521.12	-38.0927
424.6196	-51.3918	2488.857	-33.6848	14554.59	-38.1182
425.5984	-51.3716	2494.595	-33.6519	14588.14	-38.1436
426.5795	-51.3515	2500.345	-33.6188	14621.77	-38.169
427.5629	-51.3313	2506.109	-33.5857	14655.48	-38.1943
428.5485	-51.3111	2511.886	-33.5525	14689.26	-38.2196
429.5364	-51.2909	2517.677	-33.5192	14723.13	-38.2449
430.5266	-51.2707	2523.481	-33.4859	14757.07	-38.2702
431.5191	-51.2505	2529.298	-33.4524	14791.08	-38.2955
432.5138	-51.2304	2535.129	-33.4189	14825.18	-38.3207
433.5109	-51.2102	2540.973	-33.3853	14859.36	-38.3459
434.5102	-51.19	2546.83	-33.3516	14893.61	-38.371

435.5119	-51.1698	2552.701	-33.3178	14927.94	-38.3962
436.5158	-51.1496	2558.586	-33.2839	14962.36	-38.4213
437.5221	-51.1294	2564.484	-33.25	14996.85	-38.4464
438.5307	-51.1092	2570.396	-33.2159	15031.42	-38.4714
439.5416	-51.089	2576.321	-33.1818	15066.07	-38.4965
440.5549	-51.0688	2582.26	-33.1476	15100.8	-38.5215
441.5704	-51.0486	2588.213	-33.1133	15135.61	-38.5465
442.5884	-51.0284	2594.179	-33.0789	15170.5	-38.5714
443.6086	-51.0082	2600.16	-33.0444	15205.48	-38.5964
444.6313	-50.9879	2606.154	-33.0098	15240.53	-38.6213
445.6562	-50.9677	2612.161	-32.9752	15275.66	-38.6461
446.6836	-50.9475	2618.183	-32.9404	15310.87	-38.671
447.7133	-50.9273	2624.219	-32.9056	15346.17	-38.6958
448.7454	-50.9071	2630.268	-32.8706	15381.55	-38.7206
449.7799	-50.8869	2636.331	-32.8356	15417	-38.7454
450.8167	-50.8666	2642.409	-32.8004	15452.54	-38.7702
451.8559	-50.8464	2648.5	-32.7652	15488.17	-38.7949
452.8976	-50.8262	2654.606	-32.7298	15523.87	-38.8196
453.9416	-50.806	2660.725	-32.6944	15559.66	-38.8443
454.9881	-50.7857	2666.859	-32.6589	15595.53	-38.8689
456.0369	-50.7655	2673.006	-32.6233	15631.48	-38.8936
457.0882	-50.7453	2679.168	-32.5875	15667.51	-38.9182
458.1419	-50.725	2685.344	-32.5517	15703.63	-38.9428
459.198	-50.7048	2691.535	-32.5158	15739.83	-38.9673
460.2566	-50.6845	2697.739	-32.4797	15776.11	-38.9919
461.3176	-50.6643	2703.958	-32.4436	15812.48	-39.0164
462.381	-50.6441	2710.192	-32.4073	15848.93	-39.0409
463.4469	-50.6238	2716.439	-32.371	15885.47	-39.0654
464.5153	-50.6036	2722.701	-32.3345	15922.09	-39.0898
465.5861	-50.5833	2728.978	-32.298	15958.79	-39.1142
466.6594	-50.5631	2735.269	-32.2613	15995.58	-39.1386
467.7351	-50.5428	2741.574	-32.2245	16032.45	-39.163
468.8134	-50.5225	2747.894	-32.1876	16069.41	-39.1874
469.8941	-50.5023	2754.229	-32.1506	16106.46	-39.2117
470.9773	-50.482	2760.578	-32.1135	16143.59	-39.236
472.063	-50.4618	2766.942	-32.0763	16180.8	-39.2603
473.1513	-50.4415	2773.32	-32.0389	16218.1	-39.2846
474.242	-50.4212	2779.713	-32.0015	16255.49	-39.3088
475.3352	-50.401	2786.121	-31.9639	16292.96	-39.3331
476.431	-50.3807	2792.544	-31.9262	16330.52	-39.3573
477.5293	-50.3604	2798.981	-31.8884	16368.17	-39.3815
478.6301	-50.3401	2805.434	-31.8505	16405.9	-39.4056
479.7334	-50.3199	2811.901	-31.8124	16443.72	-39.4298
480.8393	-50.2996	2818.383	-31.7742	16481.62	-39.4539
481.9478	-50.2793	2824.88	-31.7359	16519.62	-39.478
483.0588	-50.259	2831.392	-31.6975	16557.7	-39.5021

484.1724	-50.2387	2837.919	-31.659	16595.87	-39.5261
485.2885	-50.2184	2844.461	-31.6203	16634.13	-39.5502
486.4072	-50.1981	2851.018	-31.5815	16672.47	-39.5742
487.5285	-50.1779	2857.591	-31.5426	16710.91	-39.5982
488.6524	-50.1576	2864.178	-31.5036	16749.43	-39.6222
489.7788	-50.1373	2870.781	-31.4644	16788.04	-39.6461
490.9079	-50.117	2877.398	-31.4251	16826.74	-39.67
492.0395	-50.0967	2884.032	-31.3857	16865.53	-39.694
493.1738	-50.0764	2890.68	-31.3461	16904.41	-39.7179
494.3107	-50.0561	2897.344	-31.3064	16943.38	-39.7417
495.4502	-50.0357	2904.023	-31.2665	16982.44	-39.7656
496.5923	-50.0154	2910.717	-31.2265	17021.59	-39.7894
497.7371	-49.9951	2917.427	-31.1864	17060.82	-39.8133
498.8845	-49.9748	2924.152	-31.1462	17100.15	-39.8371
500.0345	-49.9545	2930.893	-31.1058	17139.57	-39.8608
501.1872	-49.9342	2937.65	-31.0652	17179.08	-39.8846
502.3426	-49.9139	2944.422	-31.0245	17218.69	-39.9083
503.5006	-49.8935	2951.209	-30.9837	17258.38	-39.9321
504.6613	-49.8732	2958.012	-30.9427	17298.16	-39.9558
505.8247	-49.8529	2964.831	-30.9016	17338.04	-39.9795
506.9907	-49.8325	2971.666	-30.8603	17378.01	-40.0031
508.1594	-49.8122	2978.516	-30.8189	17418.07	-40.0268
509.3309	-49.7919	2985.383	-30.7773	17458.22	-40.0504
510.505	-49.7715	2992.265	-30.7356	17498.47	-40.074
511.6818	-49.7512	2999.163	-30.6937	17538.81	-40.0976
512.8614	-49.7309	3006.076	-30.6517	17579.24	-40.1212
514.0437	-49.7105	3013.006	-30.6095	17619.76	-40.1448
515.2286	-49.6902	3019.952	-30.5671	17660.38	-40.1683
516.4164	-49.6698	3026.913	-30.5246	17701.09	-40.1918
517.6068	-49.6495	3033.891	-30.4819	17741.89	-40.2153
518.8	-49.6291	3040.885	-30.439	17782.79	-40.2388
519.996	-49.6088	3047.895	-30.396	17823.79	-40.2623
521.1947	-49.5884	3054.921	-30.3528	17864.88	-40.2858
522.3962	-49.568	3061.963	-30.3095	17906.06	-40.3092
523.6004	-49.5477	3069.022	-30.266	17947.34	-40.3326
524.8075	-49.5273	3076.097	-30.2223	17988.71	-40.356
526.0173	-49.507	3083.188	-30.1784	18030.18	-40.3794
527.2299	-49.4866	3090.295	-30.1343	18071.74	-40.4028
528.4453	-49.4662	3097.419	-30.0901	18113.4	-40.4261
529.6634	-49.4458	3104.56	-30.0457	18155.16	-40.4495
530.8844	-49.4255	3111.716	-30.0011	18197.01	-40.4728
532.1083	-49.4051	3118.89	-29.9564	18238.96	-40.4961
533.3349	-49.3847	3126.079	-29.9114	18281	-40.5194
534.5644	-49.3643	3133.286	-29.8663	18323.14	-40.5426
535.7967	-49.3439	3140.509	-29.8209	18365.38	-40.5659
537.0318	-49.3235	3147.748	-29.7754	18407.72	-40.5891

538.2698	-49.3031	3155.005	-29.7297	18450.15	-40.6123
539.5106	-49.2828	3162.278	-29.6838	18492.69	-40.6356
540.7543	-49.2624	3169.567	-29.6377	18535.32	-40.6587
542.0009	-49.242	3176.874	-29.5914	18578.04	-40.6819
543.2503	-49.2216	3184.198	-29.5449	18620.87	-40.7051
544.5027	-49.2012	3191.538	-29.4981	18663.8	-40.7282
545.7579	-49.1807	3198.895	-29.4512	18706.82	-40.7513
547.016	-49.1603	3206.269	-29.4041	18749.95	-40.7745
548.277	-49.1399	3213.661	-29.3568	18793.17	-40.7976
549.5409	-49.1195	3221.069	-29.3092	18836.49	-40.8206
550.8077	-49.0991	3228.494	-29.2614	18879.91	-40.8437
552.0774	-49.0787	3235.937	-29.2135	18923.44	-40.8668
553.3501	-49.0583	3243.396	-29.1652	18967.06	-40.8898
554.6257	-49.0378	3250.873	-29.1168	19010.78	-40.9128
555.9043	-49.0174	3258.367	-29.0682	19054.61	-40.9358
557.1857	-48.997	3265.878	-29.0193	19098.53	-40.9588
558.4702	-48.9765	3273.407	-28.9702	19142.56	-40.9818
559.7576	-48.9561	3280.953	-28.9208	19186.69	-41.0047
561.048	-48.9357	3288.516	-28.8713	19230.92	-41.0277
562.3413	-48.9152	3296.097	-28.8215	19275.25	-41.0506
563.6377	-48.8948	3303.695	-28.7714	19319.68	-41.0735
564.937	-48.8743	3311.311	-28.7211	19364.22	-41.0964
566.2393	-48.8539	3318.945	-28.6706	19408.86	-41.1193
567.5446	-48.8334	3326.596	-28.6198	19453.6	-41.1422
568.8529	-48.813	3334.264	-28.5687	19498.45	-41.1651
570.1643	-48.7925	3341.95	-28.5174	19543.39	-41.1879
571.4786	-48.7721	3349.654	-28.4659	19588.45	-41.2107
572.796	-48.7516	3357.376	-28.414	19633.6	-41.2336
574.1165	-48.7312	3365.116	-28.362	19678.86	-41.2564
575.4399	-48.7107	3372.873	-28.3096	19724.23	-41.2792
576.7665	-48.6902	3380.648	-28.257	19769.7	-41.3019
578.096	-48.6697	3388.442	-28.2041	19815.27	-41.3247
579.4287	-48.6493	3396.253	-28.1509	19860.95	-41.3474
580.7644	-48.6288	3404.082	-28.0975	19906.73	-41.3702
582.1032	-48.6083	3411.929	-28.0437	19952.62	-41.3929
583.4451	-48.5878	3419.794	-27.9897	19998.62	-41.4156
584.7901	-48.5673			20044.72	-41.4383

73

/100

PAGE 1



Comment 1

Wrong module title

PAGE 2

PAGE 3



Comment 2

The word "parasitic" is an adjective. It is used to describe something. You have used it as a noun, i.e. the name of something, which is incorrect.

"The breadboard has additional parasitic effects, such as...."



Comment 3

contact is not a material.



Cap. Error

Capitalization



Comment 4

They have *been* used....



Citation Needed

Cite Source:

Please use the link below to find links to information regarding specific citation styles:

<https://www.plagiarism.org/article/citation-styles>



Caption required

You should always include a caption on figures, equations and tables to allow you to refer to them in your text.

e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....



Comment 5

This is an odd description. The term frequency literally means "how often something happens". to say there is no frequency indicates things are still happening, but at random intervals.

In this situation, I think you mean at 0Hz or at DC.

QM

Contraction

In formal academic writing, you should avoid using contractions like "aren't" "can't" "don't" etc. instead you should use the full form of the words. "Are not" "Can not", "Do not".

PAGE 4

QM

Caption required

You should always include a caption on figures, equations and tables to allow you to refer to them in your text.

e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....



Comment 6

Good description of resonance. Could do with a couple more references though.

PAGE 5



Comment 7

missing apostrophe.

The output voltage *belongs* to the circuit, so an apostrophe is used to show ownership.

The circuit's output voltage...



Comment 8

You should include the equation for Q factor as it is something you are using to compare the two circuits

QM

Caption required

You should always include a caption on figures, equations and tables to allow you to refer to them in your text.

e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....

PAGE 6

QM

Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.

QM

Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.

QM

Caption required

You should always include a caption on figures, equations and tables to allow you to refer to them in your text.

e.g. An illustration of this can be seen in figure 2. The relationship of the variables is shown in equation 2. Table 1 shows the results of the first experiment where the control variable, temperature in degrees celsius is shown in the first column....

QM

Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.



Comment 9

Good data collection



Comment 10

knowing the resistance of the inductor, you could have proven that this is what was causing the difference by doing another simulation with this resistance in series with the inductor.



Comment 11

Are these differences likely a function of the limited resolution of the signal generator in the first circuit and the spacing of the measurements in the second?

QM

Ref Qual

You should try to use more high quality reference sources, such as textbooks from reputable academic publishers and articles from peer reviewed journals.

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27

PAGE 28

PAGE 29

PAGE 30

PAGE 31

GRADING FORM: SMU GENERIC_SMOSEY

CHARLES H

72.55

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Engagement with a limited range of mostly relevant and credible sources but with some reliance on information gained through class contact. Consistently accurate application of referencing. Some omissions or minor errors.

3.3

KNOWLEDGE & UNDERSTANDING

Knowledge of the basic underlying concepts and principles of a subject.

-  Exceptional, detailed knowledge and understanding of the basic underlying concepts and principles

24

COGNITIVE & INTELLECTUAL

Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.

-  Sound evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately. Ability to devise arguments using evidence to make mostly appropriate and valid judgements.
You could have scored more marks here by using another simulation to support your argument.

19.5

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.

-  An advanced application of a range of taught, basic methods, materials, tools and/or techniques. The context of the application is well considered, and insightful. Excellent evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.

22.5

TRANSFERABLE SKILLS

Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.

-  Work is accurate, coherent, fluent, well-structured and organised. Demonstrates very good skills for employment requiring the exercise of some

3.25

personal responsibility, with just occasional minor weakness. You communicate complex technical concepts clearly and concisely, making them accessible to both technical and non-technical audiences.

You need to caption things correctly. Using different text styles for headings would make your report neater.