

**LAMPIRAN A**  
**CONTOH PERHITUNGAN**

## Lampiran A. Contoh Perhitungan

Tabel A.1 Massa Molar Atom

<b>Ar (g/mol)</b>	
<b>Li</b>	<b>6.941</b>
<b>Ni</b>	<b>58.6934</b>
<b>Mn</b>	<b>54.938</b>
<b>Co</b>	<b>58.933</b>
<b>O</b>	<b>15.9994</b>
<b>N</b>	<b>14.0067</b>
<b>C</b>	<b>12</b>
<b>H</b>	<b>1.0079</b>
<b>Na</b>	<b>22.9897</b>
<b>S</b>	<b>32.065</b>
<b>SO4</b>	<b>96.0626</b>
<b>CO3</b>	<b>59.9982</b>
<b>OH</b>	<b>17.0073</b>
<b>H2O</b>	<b>18.0152</b>

Tabel A.2 Massa Molar Molekul

<b>Massa molar</b>	<b>Nilai</b>
<b>Li<sub>2</sub>CO<sub>3</sub></b>	<b>73.8802</b>
<b>LiOH</b>	<b>23.9483</b>
<b>NiSO<sub>4</sub>.6H<sub>2</sub>O</b>	<b>262.847</b>
<b>Mn(SO<sub>4</sub>).H<sub>2</sub>O</b>	<b>169.016</b>

<b>CoSO4.7H2O</b>	<b>263.087</b>
<b>Na2CO3</b>	<b>105.978</b>
<b>Na2C2O4</b>	<b>133.977</b>
<b>NaHCO3</b>	<b>83.9958</b>
<b>(NH4)CO3</b>	<b>96.0748</b>
<b>H2C2O4</b>	<b>89.9976</b>
<b>NaOH</b>	<b>39.997</b>
<b>MnCO3</b>	<b>114.936</b>
<b>NiCO3</b>	<b>118.692</b>
<b>NiMnCo- C2O4</b>	<b>181.966</b>
<b>NiMnCo-CO3</b>	<b>117.964</b>
<b>NiMnCo-OH2</b>	<b>91.9809</b>
<b>Li-NiMnCoO2</b>	<b>96.9061</b>

Molar 2M

$$V_{tot} = \frac{mol}{molar\ yang\ diinginkan} \times 1000$$
$$= \frac{0,516}{2} \times 1000 = 257,9817\ ml \approx 258$$

NMC = 50 gr

$$mol = \frac{massa}{Mr} = \frac{50}{96,9060} = 0,516$$

Perhitungan Massa Prekursor Ni Yang digunakan:

$$massa\ NiSO_2.6H_2O = 0,51596 \times 262,847$$

$$massa = mol \times Mr = 135,618 \times 0,7 = 94,934\ gr$$

Perhitungan Massa Prekursor Mn Yang digunakan:

$$massa\ MnSO_4.H_2O = 0,52596 \times 169,0158$$

$$massa = mol \times Mr = 87,205 \times 0,2 = 17,441\ gr$$

Perhitungan Massa Prekursor Co Yang digunakan:

$$massa\ CoSO_4.7H_2O = 0,52596 \times 263,0868$$

$$massa = mol \times Mr = 135,7422 \times 0,1 = 13,574\ gr$$

Perhitungan Massa Prekursor Oksalat Yang digunakan:

$$massa\ H_2C_2O_4.2H_2O = 0,52596 \times 126,028$$

$$massa = mol \times Mr = 65,0254 \times 1,1 = 71,5279\ gr$$

**LAMPIRAN B**  
**DATA PENELITIAN**

## Lampiran B. Data Penelitian

**Tabel B.1** Data EIS

Index	Frequency (Hz)	Z' ( $\Omega$ )	-Z'' ( $\Omega$ )	Z ( $\Omega$ )	-Phase ( $^\circ$ )	Time (s)
1	50000	5.00024	4.03472	6.42506	38.9002	18.9759
2	40029	5.32004	4.7732	7.14747	41.8988	20.2112
3	32047	5.69767	5.64327	8.01934	44.7252	21.5529
4	25656	6.14947	6.67236	9.07394	47.3353	23.6914
5	20540	6.68689	7.88555	10.3391	49.7023	25.8801
6	16444	7.33297	9.31995	11.8589	51.8042	28.0188
7	13165	8.10761	11.0036	13.668	53.6167	30.1373
8	10540	9.04788	12.9889	15.8296	55.1395	32.1798
9	8437.8	10.1904	15.3183	18.3982	56.3665	34.2424
10	6755.2	11.5782	18.0295	21.427	57.2922	35.4827
11	5408.1	13.2703	21.189	25.0015	57.9418	37.6361
12	4329.6	15.3403	24.8436	29.1981	58.3057	38.8361
13	3466.2	17.8802	29.0699	34.1286	58.4053	40.9598
14	2775	20.9933	33.935	39.9037	58.2578	42.9773
15	2221.6	24.8348	39.4646	46.6285	57.8181	44.0971
16	1778.6	29.5891	45.7122	54.4529	57.0854	46.8915
17	1423.9	35.476	52.6322	63.472	56.0186	48.7826
18	1140	42.6946	60.1157	73.7342	54.6174	50.7648
19	912.64	51.5264	68.0526	85.3589	52.8686	52.8224

<b>Index</b>	<b>Frequency (Hz)</b>	<b>Z' (<math>\Omega</math>)</b>	<b>-Z'' (<math>\Omega</math>)</b>	<b>Z (<math>\Omega</math>)</b>	<b>-Phase (<math>^\circ</math>)</b>	<b>Time (s)</b>
20	730.65	62.1094	76.1477	98.2652	50.7978	54.9562
21	584.95	74.6297	83.953	112.329	48.3646	57.1556
22	468.3	88.9567	91.2392	127.428	45.7257	59.2835
23	374.91	104.992	97.4637	143.257	42.8704	60.5543
24	300.15	122.451	102.224	159.512	39.8557	61.8653
25	240.3	140.997	105.252	175.949	36.7408	64.1196
26	192.38	160.024	106.186	192.05	33.5668	67.1149
27	154.01	179.003	105.098	207.576	30.4185	68.3857
28	123.3	197.395	102.1	222.237	27.3496	69.7424
29	98.713	214.727	97.2973	235.742	24.3763	71.9765
30	79.028	230.663	91.1068	248.004	21.553	73.3123
31	63.269	244.934	83.9907	258.935	18.9274	74.749
32	50.652	257.496	76.3388	268.574	16.5133	78.5301
33	40.551	267.848	68.4256	276.45	14.3305	81.4436
34	32.465	276.512	60.7955	283.117	12.4001	83.0016
35	25.991	283.369	53.6414	288.401	10.7192	84.6555
36	20.808	288.953	47.4141	292.817	9.31858	86.5102
37	16.658	293.94	42.0775	296.936	8.14656	88.3858

<b>Index</b>	<b>Frequency (Hz)</b>	<b>Z' (<math>\Omega</math>)</b>	<b>-Z'' (<math>\Omega</math>)</b>	<b>Z (<math>\Omega</math>)</b>	<b>-Phase (<math>^\circ</math>)</b>	<b>Time (s)</b>
38	13.336	297.414	37.4941	299.768	7.18521	90.4279
39	10.677	300.418	33.9506	302.331	6.4477	92.5956
40	8.5478	303.051	31.2987	304.663	5.89653	94.7937
41	6.8432	305.355	29.5133	306.778	5.52063	97.0871
42	5.4786	307.518	28.5949	308.845	5.31244	99.4614
43	4.3861	309.496	28.6913	310.823	5.29638	102.92
44	3.5114	311.618	29.5535	313.017	5.41766	105.278
45	2.8112	313.101	31.4175	314.673	5.73005	107.773
46	2.2506	315.115	34.388	316.986	6.22796	110.35
47	1.8018	318.204	38.4619	320.52	6.892	113.032
48	1.4425	320.702	43.7097	323.667	7.76123	115.825
49	1.1548	323.724	50.647	327.662	8.89192	118.723
50	0.92454	327.095	58.8014	332.339	10.1911	123.955
51	0.74017	331.819	68.7808	338.873	11.7106	127.181
52	0.59257	337.108	81.2214	346.755	13.5464	130.755
53	0.4744	342.895	94.994	355.81	15.4846	134.672
54	0.3798	351.408	112.572	368.999	17.7626	142.47
55	0.30406	361.527	133.181	385.278	20.2231	147.243
56	0.24343	372.43	158.751	404.853	23.0865	152.752
57	0.19488	385.228	184.976	427.337	25.6491	165.046



<b>Index</b>	<b>Frequency (Hz)</b>	<b>Z' (<math>\Omega</math>)</b>	<b>-Z'' (<math>\Omega</math>)</b>	<b>Z (<math>\Omega</math>)</b>	<b>-Phase (<math>^\circ</math>)</b>	<b>Time (s)</b>
58	0.15602	400.991	219.758	457.26	28.7244	172.328
59	0.12491	419.645	257.778	492.495	31.5614	189.767
60	0.1	443.142	304.181	537.495	34.4665	210.724

**Tabel B.2** Lanjutan Data EIS

<b>Index</b>	<b>Frequency (Hz)</b>	<b>Z' (<math>\Omega</math>)</b>	<b>-Z'' (<math>\Omega</math>)</b>	<b>Z (<math>\Omega</math>)</b>	<b>-Phase (<math>^\circ</math>)</b>	<b>Time (s)</b>
1	50000	4.10523	3.55572	5.43103	40.8972	18.9519
2	40029	4.36417	4.23789	6.08323	44.159	20.1774
3	32047	4.67409	5.04677	6.87873	47.1955	22.3713
4	25656	5.04461	6.00398	7.84193	49.9627	23.627
5	20540	5.49366	7.14177	9.01028	52.4315	25.8962
6	16444	6.03726	8.49221	10.4195	54.5903	28.0451
7	13165	6.69945	10.0901	12.1117	56.4175	29.2856
8	10540	7.5112	11.9839	14.1433	57.9217	31.4895
9	8437.8	8.52033	14.2312	16.5868	59.0907	33.5217
10	6755.2	9.7821	16.8729	19.5034	59.8968	34.7776
11	5408.1	11.3727	19.9735	22.9843	60.3433	36.9214
12	4329.6	13.4032	23.5785	27.1217	60.3839	39.0445
13	3466.2	15.9999	27.7273	32.0125	60.0131	40.3005
14	2775	19.3393	32.4331	37.7613	59.1932	43.0842
15	2221.6	23.5969	37.6327	44.4188	57.911	45.0508
16	1778.6	28.9738	43.2116	52.0262	56.1578	47.8095
17	1423.9	35.6284	48.9048	60.5067	53.9257	48.9139
18	1140	43.6423	54.5186	69.835	51.3226	51.0373
19	912.64	53.003	59.6035	79.7615	48.3546	53.1803
20	730.65	63.4951	63.9766	90.1368	45.2164	55.2832

<b>Index</b>	<b>Frequency (Hz)</b>	<b>Z' (<math>\Omega</math>)</b>	<b>-Z'' (<math>\Omega</math>)</b>	<b>Z (<math>\Omega</math>)</b>	<b>-Phase (<math>^\circ</math>)</b>	<b>Time (s)</b>
21	584.95	74.8923	67.2774	100.673	41.934	57.4867
22	468.3	86.6979	69.429	111.072	38.6883	59.5747
23	374.91	98.5573	70.4463	121.145	35.5563	60.8453
24	300.15	110.261	70.6036	130.929	32.6327	62.1565
25	240.3	121.708	70.1683	140.486	29.9648	64.3804
26	192.38	132.63	69.1349	149.567	27.5313	65.621
27	154.01	143.241	67.829	158.489	25.3389	67.8908
28	123.3	153.28	66.1136	166.931	23.3317	69.2116
29	98.713	163.441	64.4032	175.672	21.5068	71.4761
30	79.028	173.221	62.3362	184.096	19.7921	72.8578
31	63.269	182.603	59.848	192.16	18.1465	74.3097
32	50.652	191.926	57.1195	200.246	16.5736	75.7768
33	40.551	200.289	53.8934	207.413	15.0603	78.7414
34	32.465	208.177	50.3238	214.173	13.5897	81.1475
35	25.991	215.363	46.6265	220.353	12.2161	82.7658
36	20.808	221.499	42.838	225.603	10.9459	84.6204
37	16.658	226.608	39.3026	229.991	9.83945	86.4956
38	13.336	231.196	36.0694	233.993	8.86734	88.5371
39	10.677	234.966	33.3606	237.322	8.08088	90.705

<b>Index</b>	<b>Frequency (Hz)</b>	<b>Z' (<math>\Omega</math>)</b>	<b>-Z'' (<math>\Omega</math>)</b>	<b>Z (<math>\Omega</math>)</b>	<b>-Phase (<math>^\circ</math>)</b>	<b>Time (s)</b>
40	8.5478	238.064	31.2552	240.107	7.47951	93.841
41	6.8432	240.72	29.7788	242.555	7.05207	96.0391
42	5.4786	242.859	29.166	244.604	6.84811	98.4133
43	4.3861	245.324	29.3005	247.068	6.8109	100.813
44	3.5114	247.409	30.4131	249.271	7.00801	103.262
45	2.8112	249.52	32.3418	251.607	7.38529	105.758
46	2.2506	251.411	35.2087	253.864	7.9721	108.334
47	1.8018	253.863	39.4622	256.912	8.83573	111.016
48	1.4425	256.268	44.4777	260.099	9.84613	113.793
49	1.1548	259.048	51.3088	264.081	11.2034	116.697
50	0.92454	263.11	59.7542	269.81	12.7952	121.909
51	0.74017	267.3	70.0632	276.33	14.6876	125.134
52	0.59257	271.658	82.3124	283.854	16.8568	128.723
53	0.4744	277.946	97.0033	294.387	19.239	132.625
54	0.3798	284.455	114.877	306.776	21.9912	140.409
55	0.30406	293.367	137.592	324.03	25.1271	145.167
56	0.24343	302.106	162.613	343.091	28.2919	150.687
57	0.19488	314.639	191.56	368.365	31.334	162.966
58	0.15602	329.69	227.313	400.458	34.5853	170.218
59	0.12491	346.449	271.585	440.211	38.0933	187.642

<b>Index</b>	<b>Frequency (Hz)</b>	<b>Z' (<math>\Omega</math>)</b>	<b>-Z'' (<math>\Omega</math>)</b>	<b>Z (<math>\Omega</math>)</b>	<b>-Phase (<math>^\circ</math>)</b>	<b>Time (s)</b>
60	0.1	372.578	322.023	492.456	40.8372	197.798

**LAMPIRAN C**  
**GAMBAR ALAT DAN BAHAN**

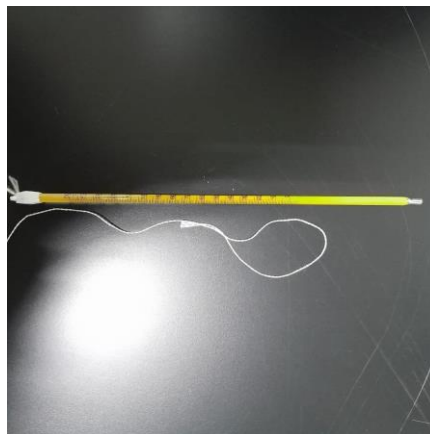
**Lampiran C. Gambar Alat dan Bahan**



**Gambar C.1** *Electronic Balance*



**Gambar C.2** *pH meter*



**Gambar C.3** *Termometer Batang*



**Gambar C.4 Oven**

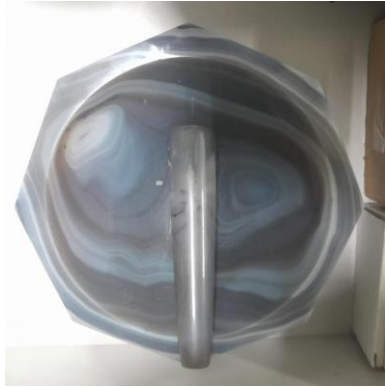


**Gambar C.5 Hotplate**



**Gambar C.6 Muffle Furnace**





**Gambar C.7 Mortar**



**Gambar C.8 Ayakan**



**Gambar C.9 Krusibel**



**Gambar C.10** Batang Statif



**Gambar C.11** Sarung Tangan Latex



**Gambar C.12** *Electrochemical Impedance Spectroscopy (EIS)*



**Gambar C.13** *Cyclic Voltammetry (CV)*



**Gambar C.14** Mesin Cetak *Slurry*



**Gambar C.15** Gelas Kimia



**Gambar C.16** NiSO<sub>4</sub>·7H<sub>2</sub>O



**Gambar C.17** MnSO<sub>4</sub>·H<sub>2</sub>O



**Gambar C.18** CoSO<sub>4</sub>·7H<sub>2</sub>O



**Gambar C.19** C<sub>2</sub>H<sub>2</sub>O<sub>4</sub>·2H<sub>2</sub>O



**Gambar C.20** *Glove Box*



**Gambar C.21** *Spatula*



**Gambar C.22** *Pipet Tetes*