

CALCULATING A SPRING CONSTANT DYNAMIC METHOD

k /Nm⁻¹ 23.1

Mass /g	10 periods /s	10 periods /s	10 periods /s	Period /s	error in T /s	Mass /kg measured	Recalibrated mass /kg	mass upper error /kg	mass lower error /kg	Period ²	Period ² lower error	Period ² upper error	4* π^2 *Re calibrated mass /kg	4* π^2 *mass upper error /kg	4* π^2 *mass lower error /kg
100	4.19	4.27	4.23	0.423	0.003	0.100	0.098	0.001	0.001	0.179	0.007	0.007	3.948	0.054	0.036
150	5.1	5.06	5.22	0.513	0.007	0.150	0.147	0.001	0.001	0.263	0.009	0.009	5.922	0.054	0.053
200	6.07	5.88	6	0.598	0.008	0.200	0.196	0.002	0.002	0.358	0.004	0.004	7.896	0.054	0.071
250	6.58	6.62	6.54	0.658	0.003	0.250	0.246	0.002	0.002	0.433	0.025	0.025	9.870	0.054	0.089
300	7.51	7.15	7.14	0.727	0.017	0.300	0.295	0.003	0.003	0.528	0.010	0.010	11.844	0.054	0.107
350	7.74	7.72	7.59	0.768	0.007	0.350	0.344	0.003	0.003	0.590	0.021	0.021	13.817	0.054	0.124
400	8.45	8.18	8.18	0.827	0.013	0.400	0.393	0.004	0.004	0.684	0.014	0.014	15.791	0.054	0.142
450	8.71	8.91	8.8	0.881	0.008	0.450	0.442	0.004	0.004	0.776	0.015	0.016	17.765	0.054	0.160
500	9.36	9.16	9.3	0.927	0.008	0.500	0.491	0.005	0.005	0.860	0.009	0.010	19.739	0.054	0.178
550	9.65	9.7	9.58	0.964	0.005	0.550	0.540	0.005	0.005	0.930	0.020	0.020	21.713	0.054	0.195
600	10.24	10.09	10	1.011	0.010	0.600	0.589	0.005	0.005	1.022	0.010	0.010	23.687	0.054	0.213
650	10.45	10.44	10.55	1.048	0.005	0.650	0.638	0.006	0.006	1.098	0.000	0.000	25.661	0.054	0.231

Estimated time measurement error (+/-) /s
0.02

100g mass sample and estimated % error
98.3 97.2 99.6 97.5

Mean average mass /g 98.15
Standard deviation /g 0.93

So expect mass to be 0.982 of quoted mass, with fractional error of 0.93/98.15 = 0.009

Hooke's law & NII

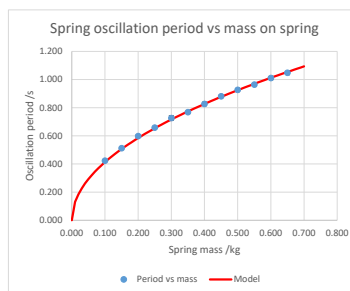
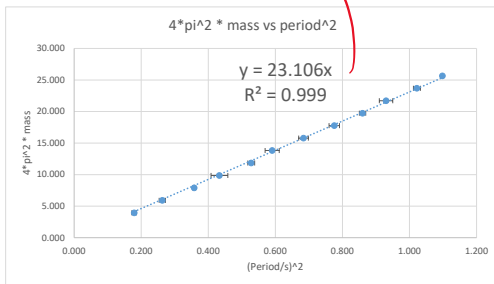
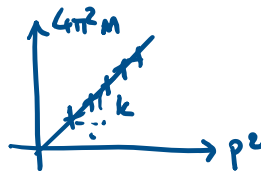
$$m\ddot{x} = -kx$$

$$\therefore \ddot{x} = -\frac{k}{m}x$$

$$\uparrow \text{SHM} : \ddot{x} = -\left(\frac{2\pi}{P}\right)^2 x$$

$$\text{So } P^2 = \frac{4\pi^2 m}{k} \therefore \frac{4\pi^2 m}{P^2} = k$$

$$k = 23.1 \text{ Nm}^{-1}$$



MODEL

Mass /kg	Period /s
0	0
0.01	0.13073
0.02	0.18488
0.03	0.22643
0.04	0.261459
0.05	0.29232
0.06	0.320221
0.07	0.345878
0.08	0.369759
0.09	0.392189
0.1	0.413403
0.11	0.433581
0.12	0.452861
0.13	0.471352
0.14	0.489145
0.15	0.506314
0.16	0.522918
0.17	0.539012
0.18	0.554639
0.19	0.569837
0.2	0.58464
0.21	0.599078
0.22	0.613157
0.23	0.626891
0.24	0.640284
0.25	0.653341
0.26	0.666066
0.27	0.679291
0.28	0.691756
0.29	0.704491
0.3	0.717427
0.31	0.727872
0.32	0.739518
0.33	0.750984
0.34	0.762278
0.35	0.773407
0.36	0.784378
0.37	0.795197
0.38	0.805871
0.39	0.816406
0.4	0.826806
0.41	0.837078
0.42	0.847225
0.43	0.857251
0.44	0.867162
0.45	0.876961
0.46	0.886651
0.47	0.896237
0.48	0.905721
0.49	0.915107
0.5	0.924398
0.51	0.933596
0.52	0.942704
0.53	0.951726
0.54	0.960662
0.55	0.969517
0.56	0.978291
0.57	0.986987
0.58	0.995607
0.59	1.004153
0.6	1.012627
0.61	1.021031
0.62	1.029366
0.63	1.037634
0.64	1.045837
0.65	1.053976
0.66	1.062052
0.67	1.070068
0.68	1.078024
0.69	1.085921
0.7	1.093762

CALCULATING A SPRING CONSTANT
STATIC METHOD

Strength of gravity
 g / Nkg^{-1} 9.81

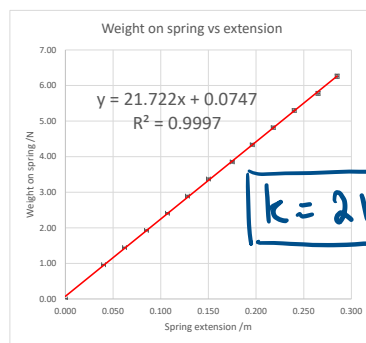
Mass /g	ring top /mm	Extension x /mm	Extensio n x /m	Weight /N measured	Recalibrated weight /N	Weight upper error /N	Weight lower error /N
0	625	0	0.000	0.00	0.00	0.00	0.00
100	585	40	0.040	0.98	0.96	0.01	0.01
150	563	62	0.062	1.47	1.45	0.01	0.01
200	540	85	0.085	1.96	1.93	0.02	0.02
250	518	107	0.107	2.45	2.41	0.02	0.02
300	497	128	0.128	2.94	2.89	0.03	0.03
350	475	150	0.150	3.43	3.37	0.03	0.03
400	450	175	0.175	3.92	3.85	0.04	0.04
450	429	196	0.196	4.41	4.34	0.04	0.04
500	407	218	0.218	4.91	4.82	0.04	0.04
550	385	240	0.240	5.40	5.30	0.05	0.05
600	360	265	0.265	5.89	5.78	0.05	0.05
650	340	285	0.285	6.38	6.26	0.06	0.06

Estimated measurement error (+/-) /m
0.002

100g mass sample and estimated % error
98.3 97.2 99.6 97.5

Mean average mass /g 98.15
 Standard deviation /g 0.93

So expect mass to be 0.982 of quoted mass, with fractional error of 0.93/98.15 =
0.009



(if ignore
 \propto error, about
 $\pm 1\%$ for mass
 uncertainties)

Hooke's Spring:

$mg = kx$
 weight \uparrow extension
 Spring constant

