

Solution: Exp. problem 1

Task 1			Points
(a)	m[g]	R₀[mm]	0.95
	21	40.5	
	25	39.5	
	29	38.5	
	31	37.5	
	34	36.5	
	36	35.5	
	39	34.5	
	43	33.5	
	46	32.5	
	50	31.5	
	53	30.5	
	57	29.5	
	62	28.5	
	67	27.5	
	73	26.5	
	79	25.5	
	86	24.5	
	94	23.5	
	102	22.5	
	113	21.5	
	124	20.5	
	137	19.5	
	150	18.5	
	168	17.5	
	189	16.5	
	212	15.5	
	274	13.5	
	417	10.5	

Task 1

Points

(a)

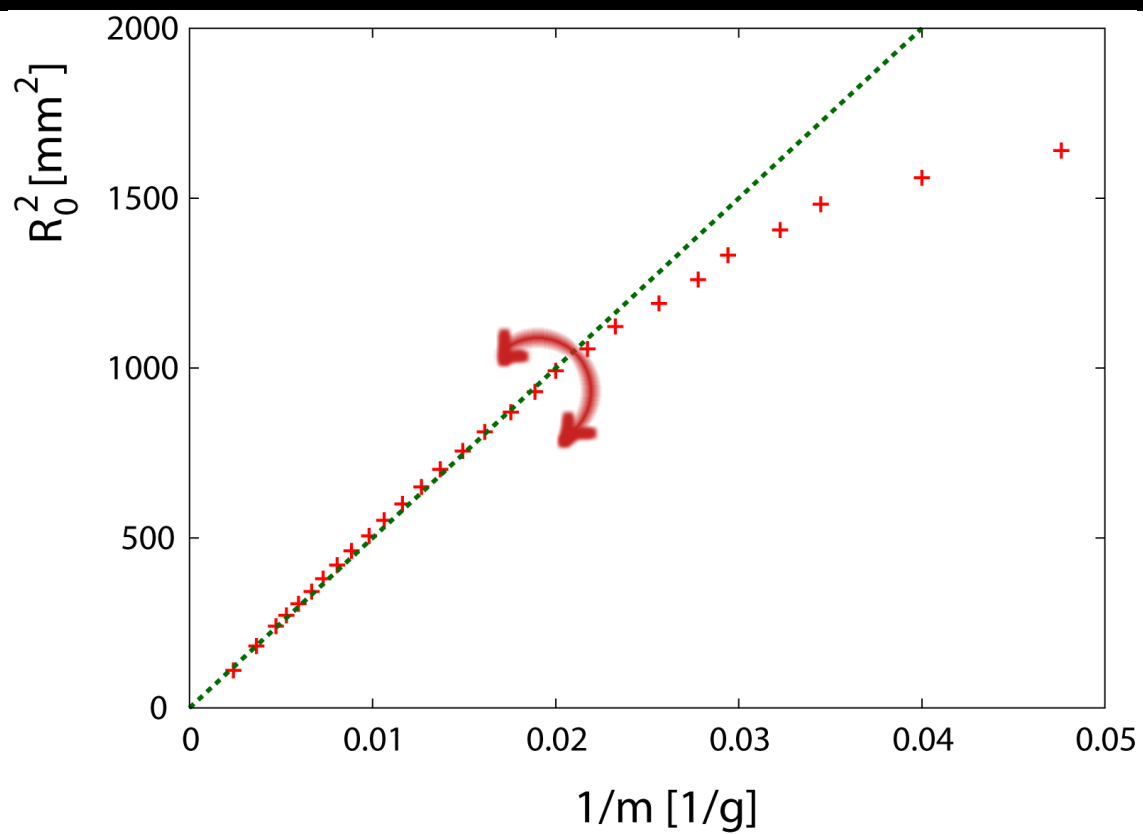
0.95

$m[\text{g}]$	$R_0[\text{mm}]$
40	29.9
42	29.8
45	29.6
47	29.4
50	29.3
52	29.1
54	28.9
57	28.8
59	28.6
61	28.4
64	28.3
71	27.8
78	27.3
92	26.3
105	25.3
118	24.3
129	23.3
143	22.3
157	21.3
171	20.3
189	19.3
211	18.3
235	17.3
259	16.3
293	15.3
336	14.3
386	13.3
449	12.3

Task 1

Points

(b)



$$a = 50000 \text{ g mm}^2$$

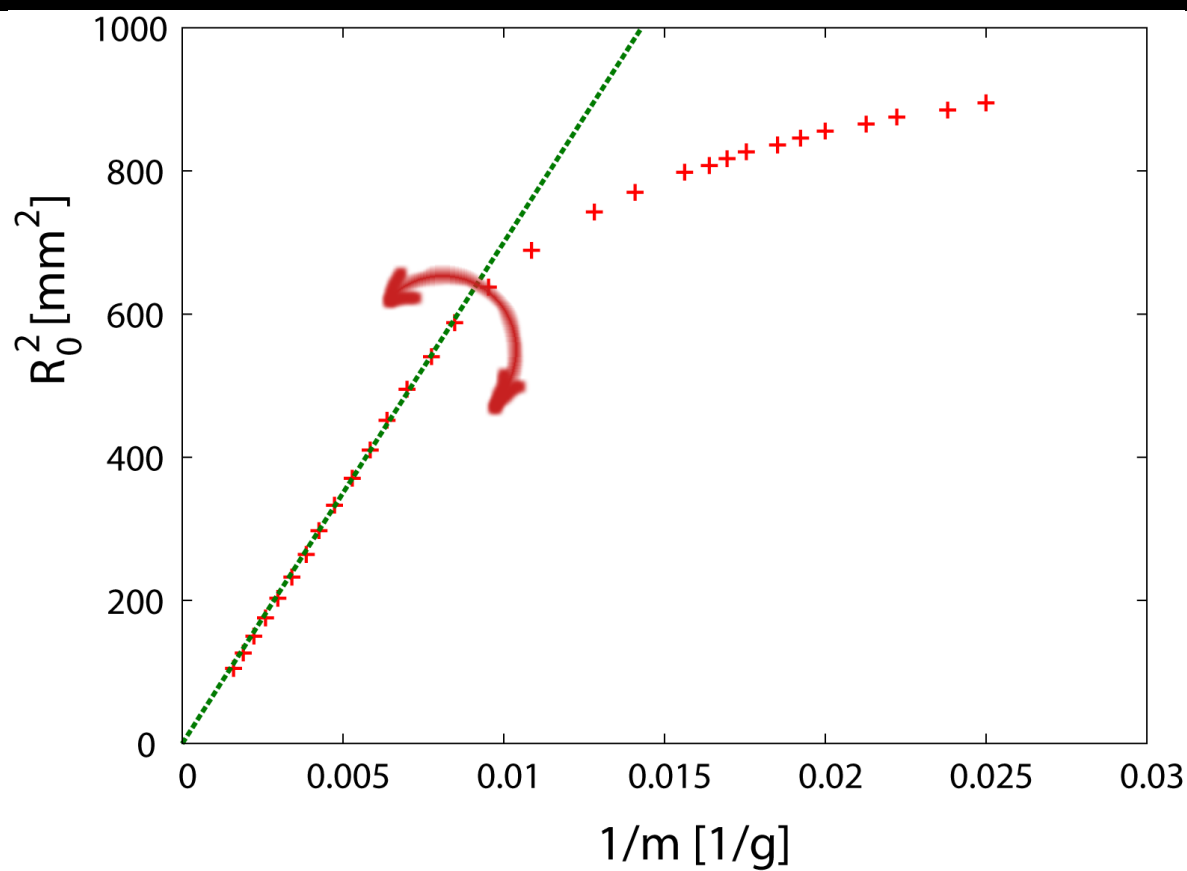
1.4

Task 1

Points

(b)

1.4



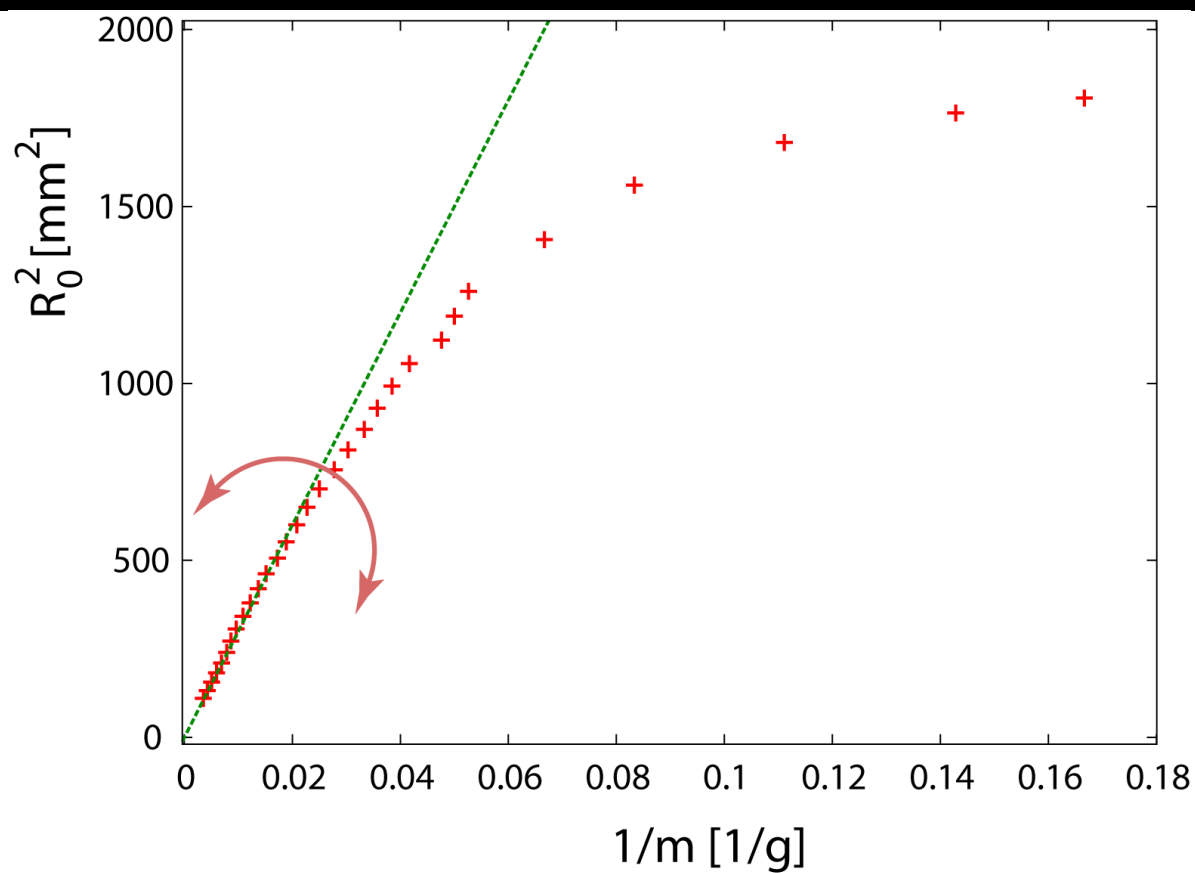
$$a = 70000 \text{ g mm}^2$$

Task 1		Points																																																										
(b)	$\kappa = \frac{2ag}{\pi d} = 1.5 \text{ mJ}$	0.5																																																										
	$\kappa = \frac{2ag}{\pi d} = 1.5 \text{ mJ}$	0.5																																																										
	$\frac{R_0}{R_c} \leq 0.70$ $\frac{R_0}{R_c} \leq 0.77$	0.5																																																										
Task 2		Points																																																										
	<table><tr><th>m[g]</th><th>R₀[mm]</th></tr><tr><td>6</td><td>42.5</td></tr><tr><td>7</td><td>42.</td></tr><tr><td>9</td><td>41.</td></tr><tr><td>12</td><td>39.5</td></tr><tr><td>15</td><td>37.5</td></tr><tr><td>19</td><td>35.5</td></tr><tr><td>20</td><td>34.5</td></tr><tr><td>21</td><td>33.5</td></tr><tr><td>24</td><td>32.5</td></tr><tr><td>26</td><td>31.5</td></tr><tr><td>28</td><td>30.5</td></tr><tr><td>30</td><td>29.5</td></tr><tr><td>33</td><td>28.5</td></tr><tr><td>36</td><td>27.5</td></tr><tr><td>40</td><td>26.5</td></tr><tr><td>44</td><td>25.5</td></tr><tr><td>48</td><td>24.5</td></tr><tr><td>53</td><td>23.5</td></tr><tr><td>58</td><td>22.5</td></tr><tr><td>66</td><td>21.5</td></tr><tr><td>73</td><td>20.5</td></tr><tr><td>82</td><td>19.5</td></tr><tr><td>92</td><td>18.5</td></tr><tr><td>104</td><td>17.5</td></tr><tr><td>116</td><td>16.5</td></tr><tr><td>127</td><td>15.5</td></tr><tr><td>145</td><td>14.5</td></tr><tr><td>168</td><td>13.5</td></tr></table>	m[g]	R ₀ [mm]	6	42.5	7	42.	9	41.	12	39.5	15	37.5	19	35.5	20	34.5	21	33.5	24	32.5	26	31.5	28	30.5	30	29.5	33	28.5	36	27.5	40	26.5	44	25.5	48	24.5	53	23.5	58	22.5	66	21.5	73	20.5	82	19.5	92	18.5	104	17.5	116	16.5	127	15.5	145	14.5	168	13.5	0.9
m[g]	R ₀ [mm]																																																											
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Task 2

Points

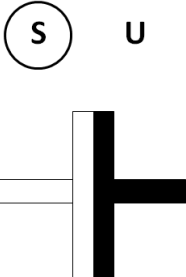
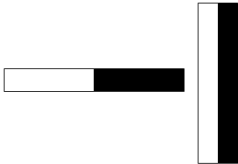
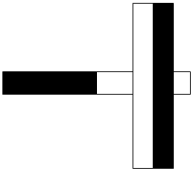
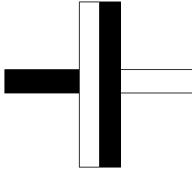
0.9



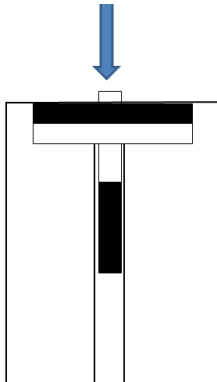
$$a = 27000 \text{ g mm}^2$$

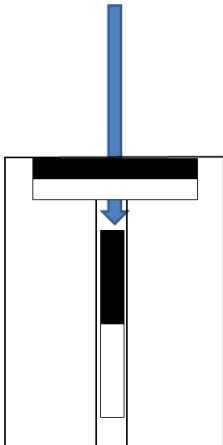
Task 2		Points
	$\kappa = 0.8 \text{ mJ}$	1.0
Task 3		Points
	Young modulus of the blue foil: $Y = 2.0 \text{ GPa}$	0.6
	Young modulus of the colorless foil: $Y = 2.5 \text{ GPa}$	0.4
Total:		10

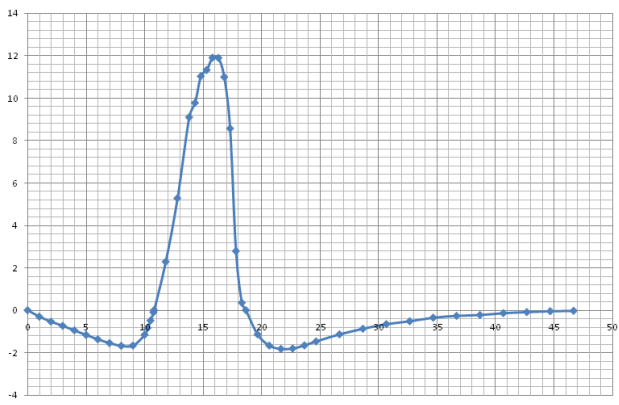
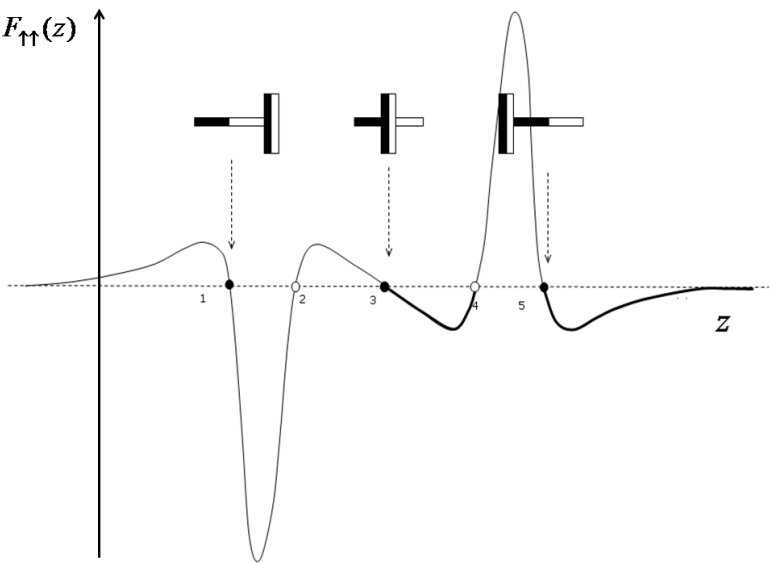
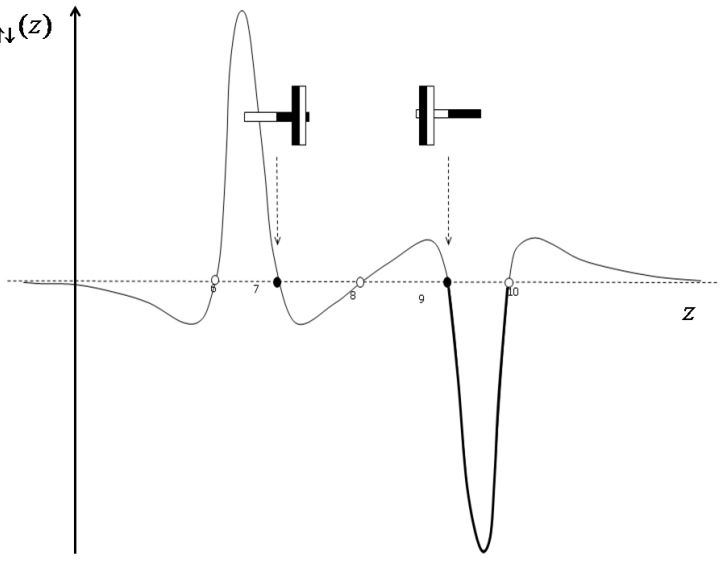
Solution - Exp. Problem 2

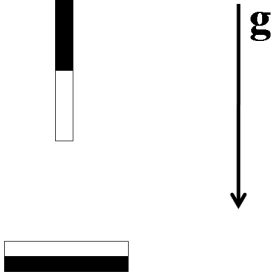
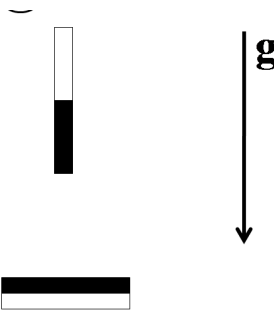
Task 1		Points
		0.25
		0.45
		0.45
		0.45

	S U	0.45
	S U	0.45
Task 2		Points
Symmetries that should be utilized in the measurements: $F_{\uparrow\downarrow}(z) = -F_{\uparrow\downarrow}(-z)$ $F_{\uparrow\downarrow}(z) = -F_{\uparrow\uparrow}(z)$ From the two above one gets also $F_{\uparrow\uparrow}(z) = -F_{\uparrow\uparrow}(-z)$		0,6
By using the setup as it is, the whole curve can be measured by starting the measurements from three stable equilibrium points; the equilibrium point (z_0) can be measured also by using the setup. Configuration: </		

	<table><tr><td>119</td><td>5</td></tr><tr><td>140</td><td>6</td></tr><tr><td>158</td><td>7</td></tr><tr><td>171</td><td>8</td></tr><tr><td>170</td><td>9</td></tr><tr><td>118</td><td>10</td></tr><tr><td>85</td><td>10,25</td></tr><tr><td>50</td><td>10,5</td></tr><tr><td>10</td><td>10,75</td></tr></table>	119	5	140	6	158	7	171	8	170	9	118	10	85	10,25	50	10,5	10	10,75																									
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85	10,25																																											
50	10,5																																											
10	10,75																																											
Configuration:		0,8																																										
Measurements:	<table><tr><td>z0=10.8mm</td><td>m [g]</td><td>Δz [mm]</td></tr><tr><td></td><td>0</td><td>0</td></tr><tr><td></td><td>233</td><td>1</td></tr><tr><td></td><td>538</td><td>2</td></tr><tr><td></td><td>927</td><td>3</td></tr><tr><td></td><td>996</td><td>3,5</td></tr><tr><td></td><td>1124</td><td>4</td></tr><tr><td></td><td>1154</td><td>4,5</td></tr><tr><td></td><td>1213</td><td>5</td></tr><tr><td></td><td>1212</td><td>5,5</td></tr><tr><td></td><td>1120</td><td>6</td></tr><tr><td></td><td>873</td><td>6,5</td></tr><tr><td></td><td>284</td><td>7</td></tr><tr><td></td><td>36</td><td>7,5</td></tr></table>	z0=10.8mm	m [g]	Δz [mm]		0	0		233	1		538	2		927	3		996	3,5		1124	4		1154	4,5		1213	5		1212	5,5		1120	6		873	6,5		284	7		36	7,5	
z0=10.8mm	m [g]	Δz [mm]																																										
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	927	3																																										
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	Configuration:  Measurements: <table border="1" data-bbox="336 828 855 1630"> <thead> <tr> <th>$z_0=18.6\text{mm}$</th><th>$m \text{ [g]}$</th><th>$\Delta z \text{ [mm]}$</th></tr> </thead> <tbody> <tr><td></td><td>0</td><td>0</td></tr> <tr><td></td><td>116</td><td>1</td></tr> <tr><td></td><td>170</td><td>2</td></tr> <tr><td></td><td>186</td><td>3</td></tr> <tr><td></td><td>184</td><td>4</td></tr> <tr><td></td><td>169</td><td>5</td></tr> <tr><td></td><td>150</td><td>6</td></tr> <tr><td></td><td>116</td><td>8</td></tr> <tr><td></td><td>89</td><td>10</td></tr> <tr><td></td><td>67</td><td>12</td></tr> <tr><td></td><td>53</td><td>14</td></tr> <tr><td></td><td>36</td><td>16</td></tr> <tr><td></td><td>27</td><td>18</td></tr> <tr><td></td><td>23</td><td>20</td></tr> <tr><td></td><td>14</td><td>22</td></tr> <tr><td></td><td>9</td><td>24</td></tr> <tr><td></td><td>5</td><td>26</td></tr> <tr><td></td><td>3</td><td>28</td></tr> </tbody> </table>	$z_0=18.6\text{mm}$	$m \text{ [g]}$	$\Delta z \text{ [mm]}$		0	0		116	1		170	2		186	3		184	4		169	5		150	6		116	8		89	10		67	12		53	14		36	16		27	18		23	20		14	22		9	24		5	26		3	28	0,8
$z_0=18.6\text{mm}$	$m \text{ [g]}$	$\Delta z \text{ [mm]}$																																																									
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	14	22																																																									
	9	24																																																									
	5	26																																																									
	3	28																																																									
Task 3		Points																																																									
	Due to symmetry, it is sufficient to plot e.g., the following graph in detail:	2																																																									

	$F_{\uparrow\uparrow}(z)$ [N]  z [mm]	
	$F_{\uparrow\uparrow}(z)$  z	1
	$F_{\uparrow\downarrow}(z)$  z	1

		0,5
	OR 	
Total:		10.0