Answer Sheet

Exercise 1.1

Δp, mmHg	l_1, cm	l_2, cm	l, cm					
-5.2	0.0	97.6	97.6					
27.7	5.0	98.1	93.1					
61.8	10.0	98.6	88.6					
102.8	15.0	99.1	84.1					
147	20.0	99.55	79.55					
196	25.0	100.2	75.2					
250.3	30.0	100.8	70.8					

Briefly explain why the edge of water column in the tube near the manometer moves when the pressure is changed?

compression of air in the manometer inlet

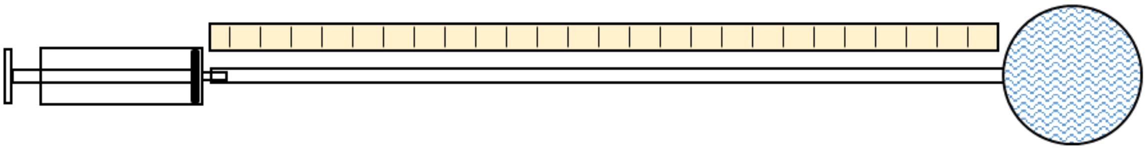
(and changing in cross-section area of the tube)

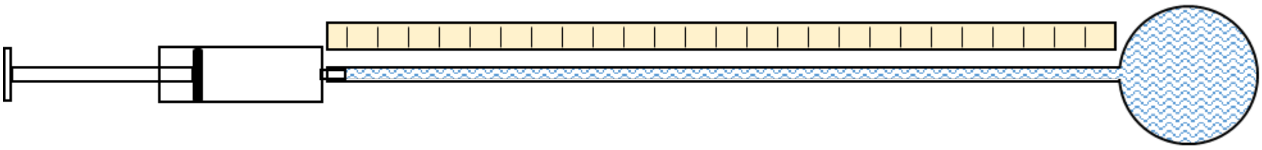
Exercise 1.2

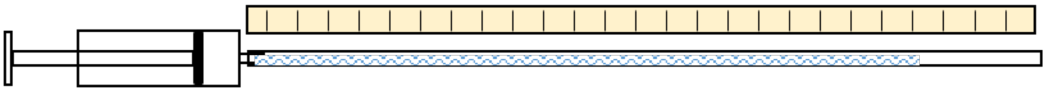
Volume of the tube channel v_0: 11 ml	Tube length L: 149 cm
Cross-section area of the tube channel s_0: 7.4 mm^2	

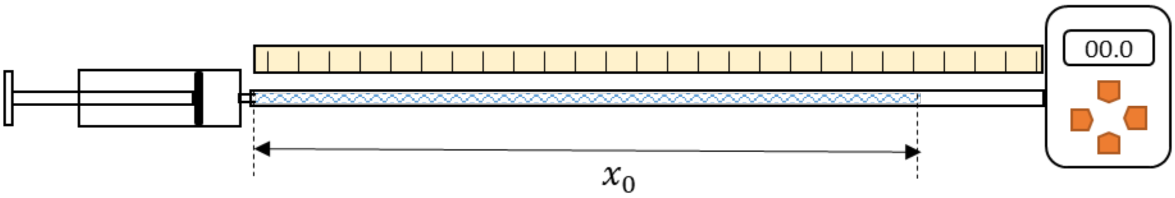
Δp, mmHg	x_1, cm	x_2, cm	$\frac{\Delta s}{s_0}$, cm					
5.8	0.5	89.9	0.0000					
20.7	2	91.2	0.0022					
41.4	4	93.1	0.0034					
63.7	6	95	0.0045					
87.6	8	96.85	0.0062					
111.8	10	98.7	0.0078					
138.4	12	100.5	0.0101					
165	14	102.3	0.0123					
194.4	16	104	0.0157					
224.3	18	105.7	0.0190					
256.4	20	107.5	0.0213					

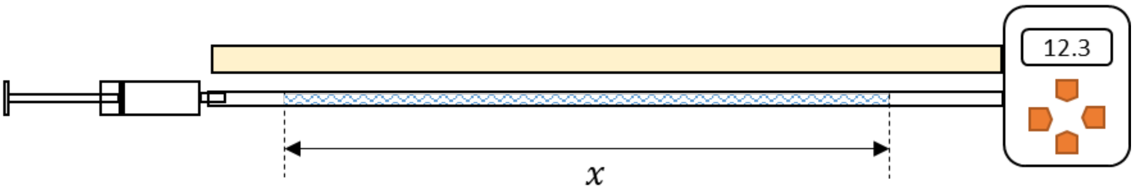
Explain the method of measuring the relationship between the tube cross-section area and pressure in the tube.









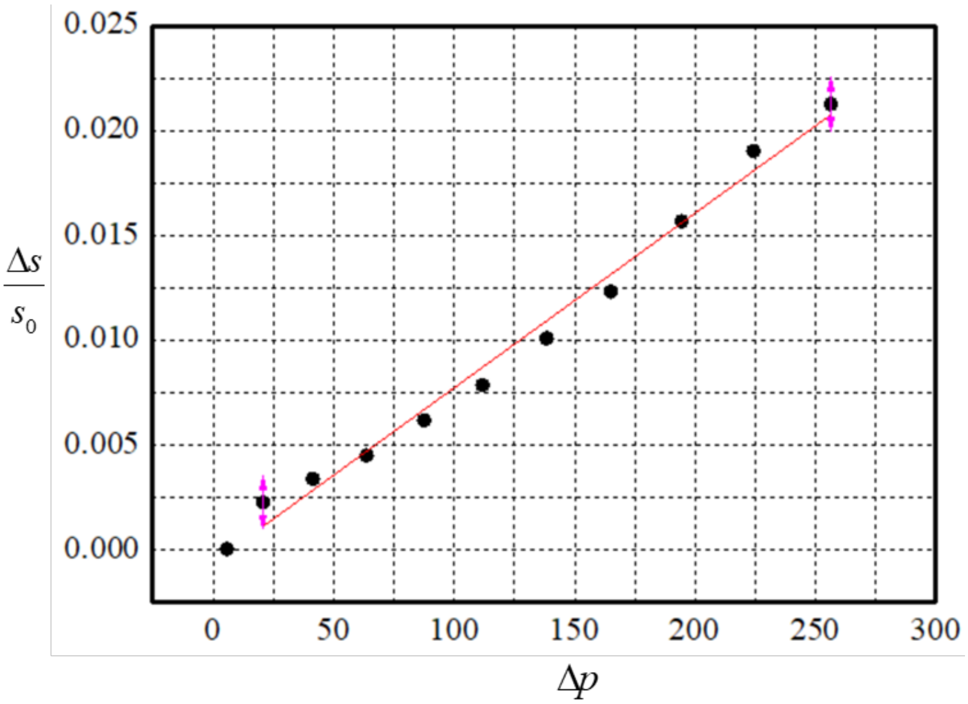


$$\frac{\Delta s}{s_0} = 1 - \frac{x}{x_0}$$

Slope of the graph:

8.3 mmHg^{-1}

Graph of $\frac{\Delta s}{s_0}$ against Δp



Exercise 1.3

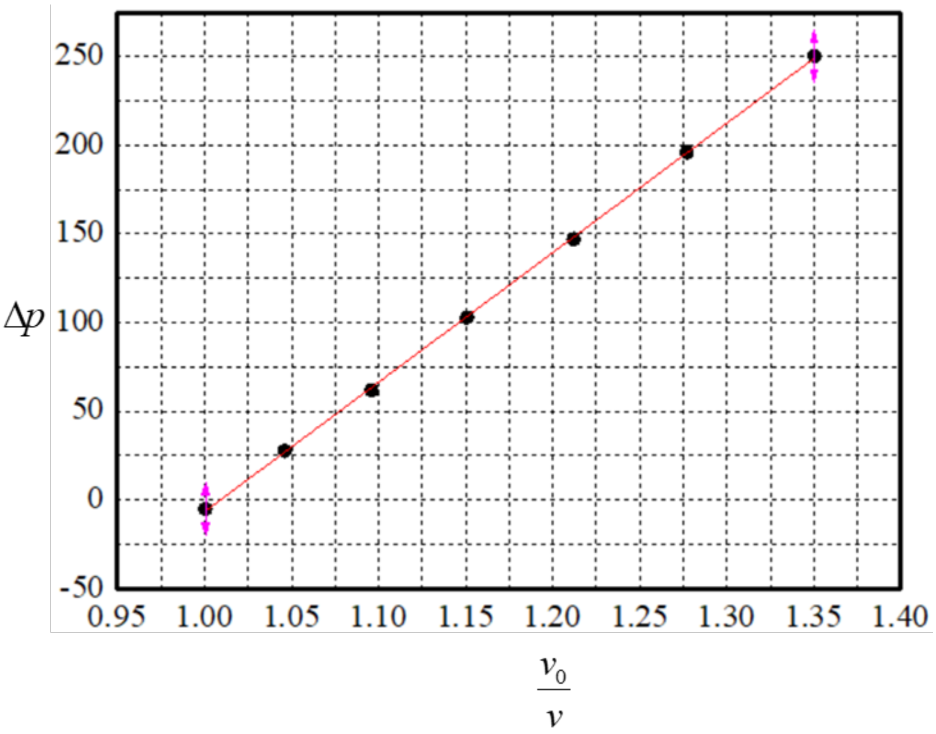
Δp, mmHg	l, cm	$\frac{l_0}{l}$	$\frac{s_0}{s}$	$\frac{V_0}{V}$				
-5.2	97.6	1.000	1.000	1.000				
27.7	93.1	1.048	0.998	1.046				
61.8	88.6	1.102	0.995	1.096				
102.8	84.1	1.161	0.992	1.151				
147	79.55	1.227	0.988	1.212				
196	75.2	1.298	0.984	1.277				
250.3	70.8	1.379	0.980	1.350				

Slope of the graph:	Graph intercept:
730 mmHg	–737 mmHg

Value of p_0:

734±5 mmHg

Graph of Δp versus $\frac{V_0}{V}$



Exercise 1.4

Does pressure p_0 coincide with the atmospheric pressure? (Underline the correct answer)	
Rise	[✓ Fall]
Should pressure p_0 and atmospheric pressure be the same? (Underline the correct answer)	
Rise	[✓ Fall]
Briefly explain your answer if you think that the measured pressure and atmospheric pressure should not coincide: *Because of the vapor pressure*	

Exercise 1.5

Flask volume: 122 ml	Tube volume: 3 ml

Change in volume, ml	**Manometer readings (equilibrium pressure, mmHg.)**			
0	0			
20	–111.7			
40	–189			

Exercise 1.6

Formula for the total number of carbon dioxide moles in the flask:

$$\nu = \frac{pV}{RT} + \frac{\alpha p V_w}{RT_0}$$

Formula for partial pressure p of carbon dioxide as a function of manometer reading Δp:

$$p = p_0 + \Delta p$$

Water volume in the flask:	Temperature inside the flask (temperature of water in the box):
39.9 ml	23.9 °C

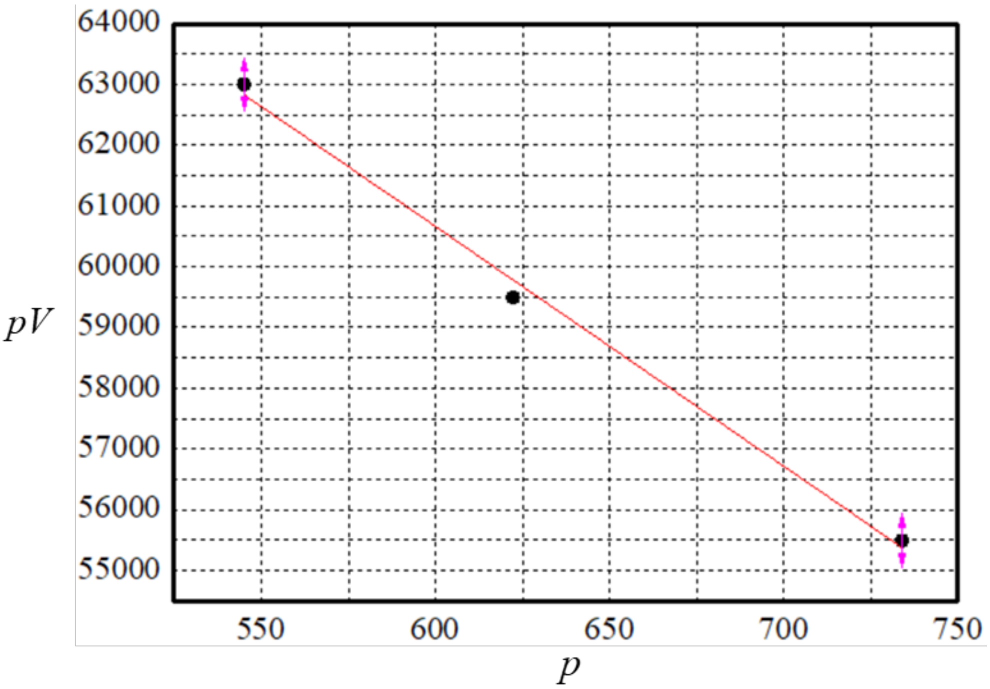
Slope of the graph:	Solubility of carbon dioxide in water:
39.4	0.9

Estimate of error in carbon dioxide solubility:

±0.2

Δp, mmHg	ΔV, ml	V, ml	p, mmHg	pV, mmHg· ml				
0	0	75.6	734	55490				
20	–111.7	95.6	622.3	59491				
40	–189	115.6	545	63002				

Graph of *pV* against *p*


64000
63000
62000
61000
60000
59000
58000
57000
56000
55000
pV
550
600
650
700
750
p

Exercise 2.1

Temperature of water in the box: $t_1 = 23.9\ ^{o}\mathrm{C}$	Temperature of water in the water bath: $t_2 = 50.8\ ^{o}\mathrm{C}$
Manometer reading at room temperature: $\Delta p_1 = -0.2$ mmHg	Manometer reading corresponding to the pressure in the flask placed in the water bath: $\Delta p_2 = 132.0$ mmHg

Exercise 2.2

Change of vapor pressure in the flask:

$$\Delta p_v = 65.7 \text{ mmHg}$$

Formulas for calculating the change of vapor pressure in the flask:

$$\Delta p_v = \Delta p_2 - \Delta p_1 - p_0 \frac{t_2 - t_1}{T_0 + t_1}$$

Exercise 2.3

Flask volume: 122 ml	Volume of water in the flask: $V_w' = 39.1$ ml
Manometer reading corresponding to equilibrium at room temperature: $\Delta p_1' =$-64 mmHg	Manometer reading corresponding to equilibrium in the flask immersed in water bath: $\Delta p_2' = 169$ mmHg

Exercise 2.4

<table>
<tr><td>Partial pressure of carbon dioxide at room temperature:
$p_1 = 670$ mmHg</td><td>Partial pressure of carbon dioxide in the flask placed in the water bath:
$p_2 = 837.3$ mmHg</td></tr>
<tr><td colspan="2">Formulas for calculations:
$$p_1 = p_0 + \Delta p_1'$$
$$p_2 = p_0 + \Delta p_2' - p_v$$</td></tr>
</table>

Exercise 2.5

<table>
<tr><td colspan="2">Solubility of gas at the water bath temperature:
0.5</td></tr>
<tr><td colspan="2">Does the solubility rise or fall as the temperature rises? (Underline the correct answer)</td></tr>
<tr><td>Rise</td><td>[✓ Fall]</td></tr>
<tr><td colspan="2">Formulas for calculations:
$$\frac{p_1 V'}{RT_1} + \frac{\alpha_1 p_1 V_w'}{RT_0} = \frac{p_2 V'}{RT_2} + \frac{\alpha_2 p_2 V_w'}{RT_0}$$
$$\alpha_2 = \frac{T_0}{p_2 V_w'}\left(\frac{\alpha_1 p_1 V_w'}{T_0} + \frac{p_1 V'}{T_1} - \frac{p_2 V'}{T_2}\right)$$</td></tr>
</table>