Marker _____ Student Code _____

E. Carbon Dioxide Solubility in Water

Marking (Total) 200		Moderation (New Total)	

1.1	7 different data points $\Delta p(l) \leq 250\ mmHg$ in data table (2 each)	14	17		
	Any reason (one is enough) with the necessary effect (water edge moves to manometer).	1			
	The effect with the greatest impact: Compression of air in the manometer inlet (and may be other CORRECT reasons)	2			
1.2	Volume of the tube channel $V_0 \approx 11\ ml$	2	39		
	Tube length $L \approx 150\ cm$	1			
	Cross-section formula $s = V_0/L$	1			
	Cross-section area of the tube channel $s_0 = [7.0 \div 8.0]\ mm^2$	3			
	Correct method description	5			
	7 data points $\frac{\Delta s}{s_0}(\Delta p)$ in data table (2 each)	14			
	Graph $\frac{\Delta s}{s_0}(\Delta p)$	3			
	Slope of the graph $\frac{d}{dp}\left(\frac{\Delta s}{s_0}\right) = [7 \div 9.5] \cdot 10^{-5}\ mmHg^{-1} = [5.3 \div 7.1] \cdot 10^{-7}\ Pa^{-1}$ *Without units of measurements – only 7*	10			
1.3	Graph $\frac{V_0}{V}(\Delta p)$	3	19		
	Slope of the graph	3			
	Intercept of the graph	3			
	Value of $p_0 = [700 \div 740]\ mmHg$ *Without units of measurements – only 7*	10			
1.4	No (Does pressure p_0 coincide with the atmospheric pressure?)	3	11		
	No (Should pressure p_0 and atmospheric pressure be the same?)	3			
	Reason: Vapor pressure	5			
1.5	Flask volume $\approx 120\ ml$	1	20		
	Tube volume $\approx 3\ ml$	1			
	3 data points: change in volume & pressure (6 each)	18			
1.6	Total moles of CO_2 in flask $\nu = \frac{pV}{RT} + \frac{\alpha p V_w}{RT_0}$	5	30		
	Partial pressure of CO_2 $p = p_0 + \Delta p$	3			
	Water volume in flask $\approx 45\ ml$	1			
	Temperature inside the flask (room temperature)	1			
	Graph $pV(p)$	3			
	Slope of the $pV(p)$ graph	3			
	Solubility of CO_2 $\alpha = [0.6 \div 1.0]$	10			
	Error estimation for α ($\geq$10%)	4			

2.1	Temperature of (cold) water in the box $t_1 \approx 25℃$	1	9		
	Temperature of (hot) water in the bath $t_2 \approx 50℃$	1			
	Manometer reading at room temperature $\Delta p_1 \approx 0\ mmHg$	2			
	Manometer reading at bath temperature $\Delta p_2 \approx 130\ mmHg$	5			
2.2	Change of vapor pressure in the flask: $\Delta p_v = [55 \div 70]\ mmHg$ *Without units of measurements – only 7*	10	15		
	Formula for vapor change $\Delta p_v = \Delta p_2 - \Delta p_1 - p_0 \frac{t_2 - t_1}{T_0 + t_1}$	5			
2.3	Flask volume $\approx 120\ ml$	1	14		
	Volume of water in the flask $\approx 45\ ml$	1			
	Pressure at equilibrium at room temperature $\Delta p_1' \approx -60\ mmHg$	6			
	Pressure at equilibrium at bath temperature $\Delta p_2' \approx 170\ mmHg$	6			
2.4	Partial pressure of CO_2, room temperature $p_1 = p_0 + \Delta p_1'$	3	7		
	Partial pressure of CO_2, bath temperature $p_2 = p_0 + \Delta p_2' - p_v$	4			
2.5	Solubility of gas at water bath temperature α_2 (calculations)	4	19		
	Fall (Does the solubility rise or fall as the temperature rises?)	8			
	Formula $\alpha_2 = \alpha_1 \frac{p_1}{p_2} + \frac{T_0 V'}{p_2 V_w'} \left(\frac{p_1}{T_1} - \frac{p_2}{T_2} \right)$	7			