Non-ideal capacitors

Depending on how far participant's measurements are from the correct ones, an extra multiplier **η** is applied to reduce the points for the task.

For each task (for example, A1, A2, B1, ...) the final score has to be rounded up to a single decimal digit.

Part A: Capacitors at room temperature (4 points)

A.1 (2.3 pt)	Graphs are plotted with correct axes, units and reasonable ranges (data fills most of the graph)	0.1 pt
	Graph $C_1(U)$ 0.3 points only if it is from -7 V to 7 V and its magnitude changes no more than 0.5% 0.1 points if its magnitude changes more than 0.5% or is plotted within a more limited range (f.e. 0 V to 7 V)	0.3 pt
	Graph $C_2(U)$. 0.5 points only if it is from -7 V to 7 V and its highest at 0 V. 0.2 points if it is from -7 V to 7 V, but its highest not at 0 V or if it increases with magnitude of voltage 0 points if it's only shown between 0 V and ± 7 V	0.5 pt
	Correct C_1 value (error under 10%) These points are void if $C_1(U)$ magnitude changes more than 0.5% η = 0.3, if error within 10–15%	0.2 pt
	Correct C_2 values (error under 20%) η = 0.7, if error within 20–30% η = 0.5, if error within 30–40% η = 0.2, if error within 40–50%	1.0 pt
	Correct $C(U)$ formula	0.2 pt

A.2 (0.5 pt)	Correct voltage (within 10%) and capacitor η = 0.7, if error within 10–15% η = 0.5, if error within 15–20% η = 0.2, if error within 20–25%	0.5 pt

A.3 (1.2 pt)	Correct q_1 value (within 0.5% from $C_1 \cdot 6\,V$)	0.2 pt
	Correct q_2 value (within 10%) η = 0.7, if error within 10–15% η = 0.5, if error within 15–20% η = 0.2, if error within 20–25%	1.0 pt

Part B: Calibrating NCT thermistor (1 point)

B.1 (1.0 pt)	Correct R_0 formula	0.7 pt
	Correct R_0 value (within 10%) η = 0.7, if error within 10–15% η = 0.4, if error within 15–25%	0.3 pt

Part C: Capacitors at different temperatures (3 points)

C.1 (1.3 pt)	Graphs are plotted with correct axes, units and reasonable ranges (data fills most of the graph)	0.1 pt
	Graphs $C_1(U)$ at different temperatures. To get these points C_1 must not depend on voltage or temperature at all	0.3 pt
	Graphs $C_2(U)$ at different temperatures. 0.3 pt given per temperature if $C_2(U)$ is highest at 0 V and its capacitance doesn't increase with the magnitude of voltage	0.9 pt

C.2 (0.5 pt)	Graphs are plotted with correct axes, units and reasonable ranges (data fills most of the graph)	0.1 pt
	Graphs $C_1(T)$ and $C_2(T)$ at 0 V and 6 V versus the temperature. –0.2 pt penalty if C_1 clearly depends on voltage or temperature –0.2 pt penalty if no points at room temperature	0.4 pt

C.3 (1.2 pt)	Correct $C_1(85\ °C)/C_1(40\ °C)$ ratio values (within 0.5%) 0.2 pt for correct values at 0 V and 0.2 pt for correct values at 6 V	0.4 pt
	Correct $C_2(85\ °C)/C_2(40\ °C)$ ratio values (within 10%) 0.4 pt for correct values at 0 V and 0.4 pt for correct values at 6 V η = 0.7, if error within 10–15% η = 0.5, if error within 15–20% η = 0.2, if error within 20–25%	0.8 pt

Part D: Sources of measurement errors (2 points)

D.1 (1.0 pt)	Correct answer for main source of error for $C_1(9\,V)$ measurement.	0.2 pt
	Given reasoning for the answer	0.5 pt
	The answer table has been filled correctly	0.3 pt

D.2 (1.0 pt)	Correctly determined main source of error for $C_2(9\,V)$ measurement.	0.2 pt
	Given reasoning for the answer: wrote $\lvert \mathrm{d}uC(t)\rvert/\mathrm{d}t\rvert_2 \gg \lvert \mathrm{d}uC(t)\rvert/\mathrm{d}t\rvert_4$ or $\lvert \mathrm{d}uC(t)\rvert/\mathrm{d}t\rvert_2 > K \cdot \lvert \mathrm{d}uC(t)\rvert/\mathrm{d}t\rvert_4$, where $K \geq 2$ is any multiplier 0.3 pt, if just inequality $\lvert \mathrm{d}uC(t)\rvert/\mathrm{d}t\rvert_2 > \lvert \mathrm{d}uC(t)\rvert/\mathrm{d}t\rvert_4$ is given	0.5 pt
	The answer table has been filled correctly	0.3 pt