Light Emitting Diodes (LEDs)

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, B2, ...) the final score has to be rounded up to a single decimal digit.

Part A: Volt-ampere characteristics at different temperatures (5.0 points)

A.1 (2.5 pt)	Graph $I_{\mathrm{LED}}(U_{\mathrm{LED}})$, 4 curves at different temperatures. 0.1 pt. for the axis and ranges correctly marked; 0.6 pt for each curve (4 × 0.6 max). **−1** pt penalty if $I_{\mathrm{LED}}(U_{\mathrm{LED}})$ curves are not smooth and have less than 15 points per curve.	2.5 pt

A.2 (1.0 pt)	Table 4 × 4 cells. Each cell is worth of 1/16 pt = 0.0625 pt. Marking is based on the average of five biggest errors of all U values. Correct if within 3%; η = 0.7, if error within 4–7% η = 0.5, if error within 8–10% η = 0.2, if error within 11–12% At final step, the sum of cell points multiplied by **η** has to be averaged to a single decimal digit by general averaging rules.	1.0 pt

A.3 (1.5 pt)	Graph $U_{\mathrm{LED}}(I_{\mathrm{LED}}, T)$: 4 curves with linear approximations; 0.2 pt for the axis and ranges correctly marked; 0.2 pt for each curve (4 × 0.2 max). −0.25 pt penalty if $U_{\mathrm{LED}}(I_{\mathrm{LED}}, T)$ if linear approximations not shown.	1.0 pt
	Table 1 × 4 cells. Each cell is worth of 0.5/4 pt = 0.125 pt. Correct $\frac{\Delta U(I,T)}{\Delta T}$ value (within 5%). Marking is based only on the biggest error of all four values. η = 0.7, if error within 6–10% η = 0.5, if error within 11–15% η = 0.2, if error within 16–20%	0.5 pt

Part B: Measurement of the LED Volt-Ampere characteristics at continuous driving current (3.5 points)

B.1 (1.5 pt)	Graph $I_{\mathrm{LED}}(U_{\mathrm{LED}})$: single curve with derivatives at certain points: 0.15 pt for the axis and ranges correctly marked; 0.6 pt for the smooth graph with at least 15 points. −0.25 pt penalty if $I_{LED}(U_{LED})$ curves are not smooth and have less than 15 points.	0.5 pt
	Only U_{LED} and T_{PCB} are required and. Each cell is worth of 1/8 pt. = 0.125 pt. T_{J} and ΔU are not evaluated. Correct $I_{\mathrm{LED}}(U_{\mathrm{LED}})$ values (error under 5%) Marking is based only on the biggest error of U_{LED} (other values are not evaluated at this point since they can depend on room temperature etc.) η = 0.7, if error within 6–10% η = 0.5, if error within 11–15% η = 0.2, if error within 16–20%	1.0 pt

B.2 (0.5 pt)	Table 1 x 4 cells. Each cell is worth of 0.4/4 pt. = 0.1 pt. 0.1 pr for the graphical representation of the derivatives on B.1 graph. Correct $\frac{dI}{dU}$ values (within 5%). Marking is based only on the biggest error of all four values. η = 0.7, if error within 6–10% η = 0.5, if error within 11–15% η = 0.2, if error within 16–20%	0.5 pt

B.3 (1.5 pt)	Graph $\Delta T(P)$: 4 points with linear approximation. 0.1 pt for the axis and ranges correctly marked; 0.2 pt for the correct P points on X axis (~6, ~20, ~40 and ~83 mW); 0.2 pt for the linear approximation visually correctly shown.	0.5 pt
	Table 1 × 4 cells. Each cell is worth of 0.5/4 pt = 0.125 pt. Marking is based only on the biggest error of all four values. Correct ΔT values (error under 10%). η = 0.7, if error within 11–15% η = 0.5, if error within 16–20% η = 0.2, if error within 20–30%	0.5 pt
	Correct $\Delta T(P)/P$: value (within 10%) η = 0.7, if error within 11–15% η = 0.5, if error within 16–20% η = 0.2, if error within 20–30%	0.5 pt

Part C: Calculation of the LED current drift due to the temperature (1.5 points)

C.1 (1.5 pt)	Correct I_{LED} values (within 5%) η = 0.7, if error within 6–10% η = 0.5, if error within 11–15% η = 0.2, if error within 16–20%	1.5 pt