5. Planck's constant

1) When we connect each of the diodes to the battery, we can observe the light of the emitted light; the mapping is as follows: 940 nm — invisible (infrared), 620 nm — red, 590 nm — orange, 525 nm — green; 470 nm — blue; 450 nm — violet.

2) We can measure the current I through the diode (which is also the current through the resistor R), so that the voltage on the diode would be $V_d = \mathcal{E} - IR$, but we don't know the battery voltage. However, we do know that the diode's voltage equals approximately to the photon's energy E_p expressed in electron volts, $E_p = hc/(\lambda e)$. Since we expect that $IR = \mathcal{E} - V_d$, if we plot IR versus $1/\lambda$, we should obtain a straight line

$$IR = \mathcal{E} - \frac{1}{\lambda}\frac{hc}{e}.$$

We can measure the slope of the straight line $A = hc/e$, which allows us to calculate $h = eA/c$.

3) The major source of the uncertainty is not the instrument uncertainties, but the departure of the real diode data from the simplistic model. Therefore we can try to fit the data points with different straight lines making the slope A as steep as possible (while still keeping a reasonable fit with the data points, and also as flat as possible); the uncertainty of A is found as $\Delta A = \frac{1}{2}(A_{\max} - A_{\min})$, and $\Delta h = h\Delta A/A$.