A power-law current–voltage relationship in a 3.6 V Zener diode

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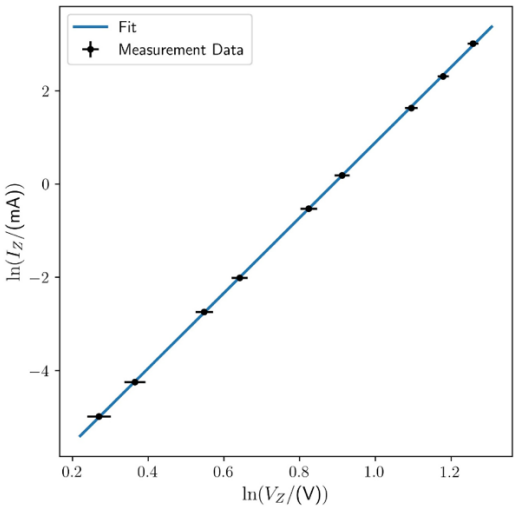
Rationale and objective: Physics laboratories often demonstrate simple mathematical relationships — current proportional to voltage (Ohm's law), or distance proportional to time squared in motion. Relationships where one quantity depends on another raised to a very high power are far rarer in lab settings, yet they offer valuable opportunities to teach advanced data analysis beyond straight-line fitting.

Summary: This study investigates whether a common, low-cost electronic component — a 3.6 V Zener diode — can serve as a clean classroom demonstration of such a high-order relationship. When connected in reverse (reverse bias), the diode's current-voltage behaviour was measured using only batteries, standard resistors, and a digital multimeter.



Measured reverse-bias I–V characteristic of the 3.6 V Zener diode in logarithmic scale.

Outcome: The results show that the current through the diode follows the voltage raised to the 8th power ($I \propto V^8$), confirmed across approximately ten diodes of the same model. Plotting the data on a log-log scale produces a remarkably straight line, making the power-law relationship visually obvious and easy to analyse.

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Related SDGs goal: 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Related publications:

1. Fisher D G (1992) Diode characteristics to determine Boltzmann constant. *Phys. Teach.* **30** 315-6.
2. Önder F, Önder E B and Ogur M (2019) Determination of diode characteristics by using Arduino. *Phys. Teach.* **57** 244.