

# Electrical Instruments

## 1. Voltmeter

- Always attached in parallel with the element whose voltage you're measuring
- Never need to disturb the circuit
- Ideal: "Infinite" resistance

## 2. Ammeter

- Always connected in series
- Always disturbs the circuit
- Ideal: zero resistance

Ammeter:

$$I_{\max} R_G = (I - I_{\max}) R_{\text{shunt}}$$

Voltmeter:

$$I_{\max} (R_G + R_{\text{series}}) = (I - I_{\max}) R$$