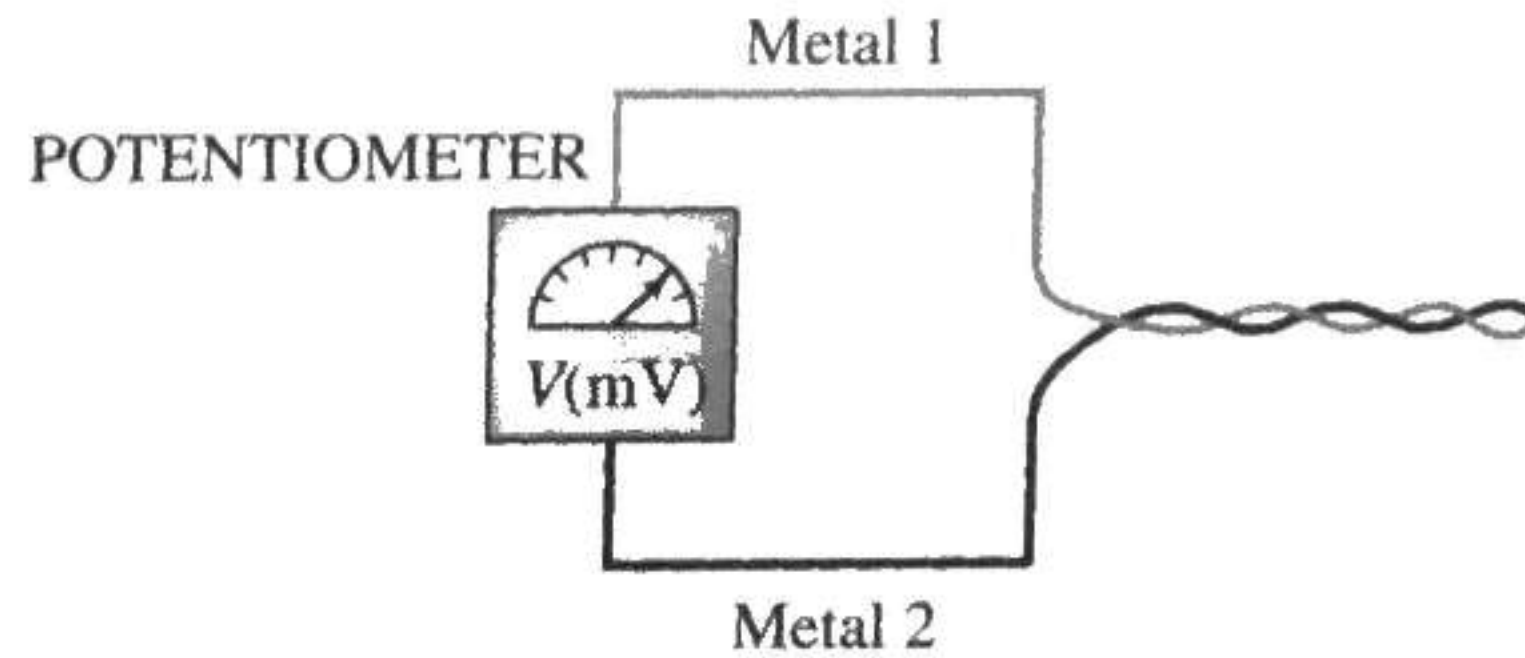


3.65. A **thermocouple** is a temperature-measurement device that consists of two dissimilar metal wires joined at one end. An oversimplified diagram follows.



A voltage generated at the metal junction is read on a potentiometer or millivoltmeter. When certain metals are used, the voltage varies linearly with the temperature at the junction of the two metals:

$$V(\text{mV}) = aT(^{\circ}\text{C}) + b$$

An iron-constantan thermocouple (constantan is an alloy of copper and nickel) is calibrated by inserting its junction in boiling water and measuring a voltage $V = 5.27 \text{ mV}$, and then inserting the junction in silver chloride at its melting point and measuring $V = 24.88 \text{ mV}$.

- (a) Derive the linear equation for $V(\text{mV})$ in terms of $T(^{\circ}\text{C})$. Then convert it to an equation for T in terms of V .
- (b) If the thermocouple is mounted in a chemical reactor and the voltage is observed to go from 10.0 mV to 13.6 mV in 20 s , what is the average value of the rate of change of temperature, dT/dt , during the measurement period?
- (c) State the principal benefits and disadvantages of thermocouples.