(a) To make it detect low currents, we can put a shunt resistor in parallel with the coil. This leads to Eq. 26.7, p. 994:

\[ I_{I_f} R_c = \left( I_f - I_{I_f} \right) R_{sh} \]

Plug in values for a 20 mA ammeter.

\[ \left( \frac{300 \times 10^{-6}}{A} \right) (25 \Omega) = \left( 20 \times 10^{-3} A - \frac{300 \times 10^{-6}}{A} \right) R_{sh} \]

Solve for shunt resistor:

\[ R_{sh} = \frac{\left( \frac{300 \times 10^{-6}}{A} \right) (25 \Omega)}{\left( 20 \times 10^{-3} A - \frac{300 \times 10^{-6}}{A} \right)} \]

\[ R_{sh} = 0.54 \text{\Omega} \]

(b) Calorimeter used as a voltmeter. See Fig. 26-15(b), p. 993.

\[ V = I_{I_f} (R_c + R_{sh}) \]

Plug in values from 500mV voltmeter:

\[ \left( \frac{500 \times 10^{-3}}{V} \right) = \left( \frac{500 \times 10^{-6}}{A} \right) (25 \text{\Omega} + R_{sh}) \]

Solve for \( R_{sh} \):

\[ R_{sh} = \frac{500 \times 10^{-3}}{\frac{500 \times 10^{-6}}{A}} - 25 \text{\Omega} \]

\[ R_{sh} = 975 \text{\Omega} \]