**Names** _____

**Objectives:**

1) Develop an understanding of RTDs
2) Understand sources of error in temperature measurement with RTDs
3) Investigate 2-wire, 3-wire, and 4-wire measurements

**Deliverables**

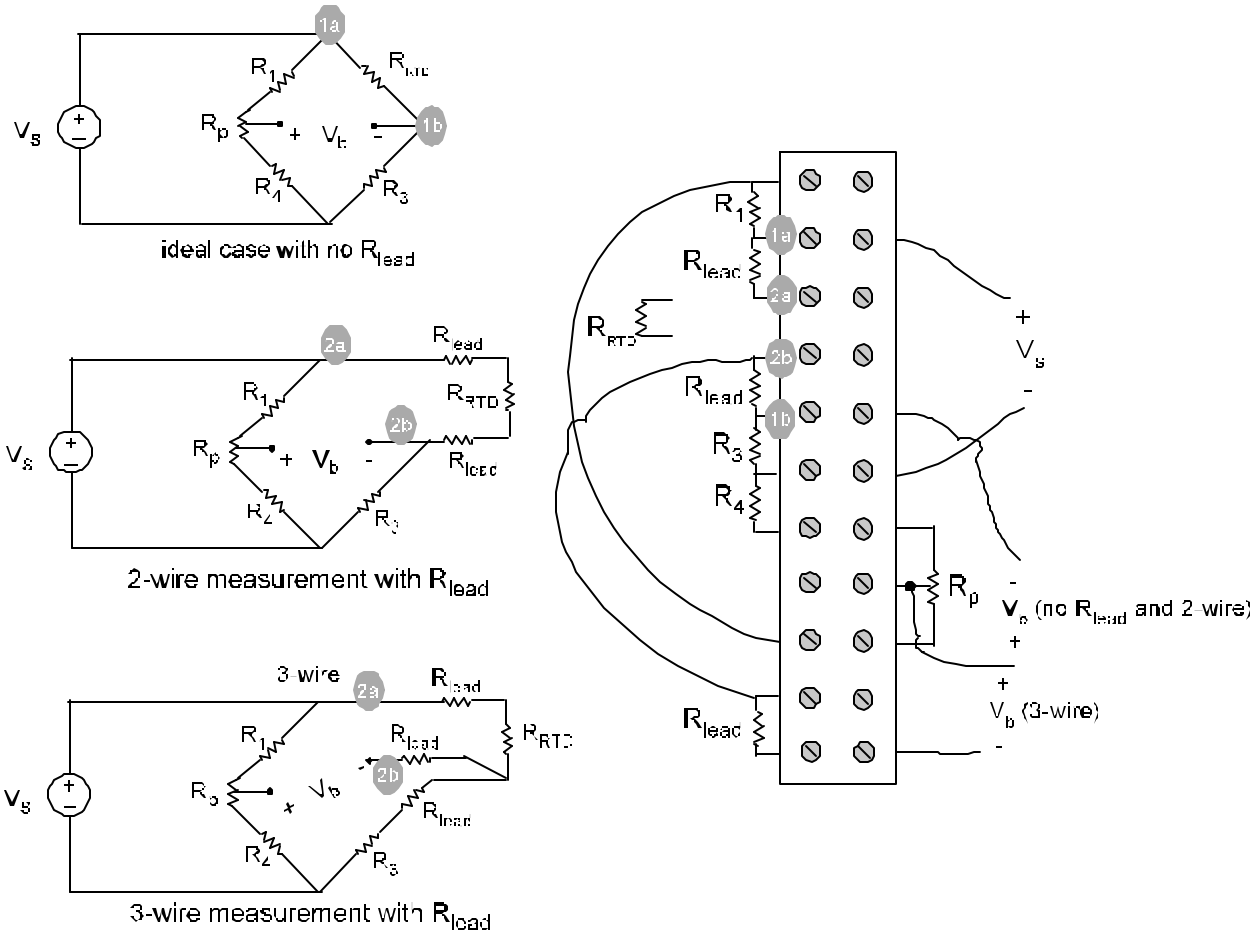
1) Analysis of 2-wire and 3-wire bridge measurements including an estimation of error.
2) Completed procedure

**Procedure**

**2-wire RTD bridge measurement**

1. Build the temperature measurement system shown below.
   $R_1 = R_2 = R_3 = 100\ \Omega$, $R_{lead} = 2.7\ \Omega$

*schematic for 2-wire and 3-wire RTD laboratory measurements*



2. With $V_s$ = 6V, and the RTD at steady-state temperature in an ice bath, null the bridge with no $R_{lead}$. (use connections labeled 1 in the diagram above, measure at $V_b$ for no $R_{lead}$).

3. Now, using 2-wire measurement (use connections labeled 2 and $V_b$ at 2-wire), $V_b$ = _____ when RTD is in the ice bath.

4. Again, using 2-wire measurement, $V_b$ = _____ when RTD is at human body temperature.

5. Still using 2-wire, $V_b$ = _____ when RTD is in boiling water.

**3-wire RTD bridge measurement**

6. With $V_s$ = 6V, and the RTD at steady-state temperature in an ice bath, null the bridge with no $R_{lead}$. (use connections labeled 1 in the diagram above, measure at $V_b$ for no $R_{lead}$).

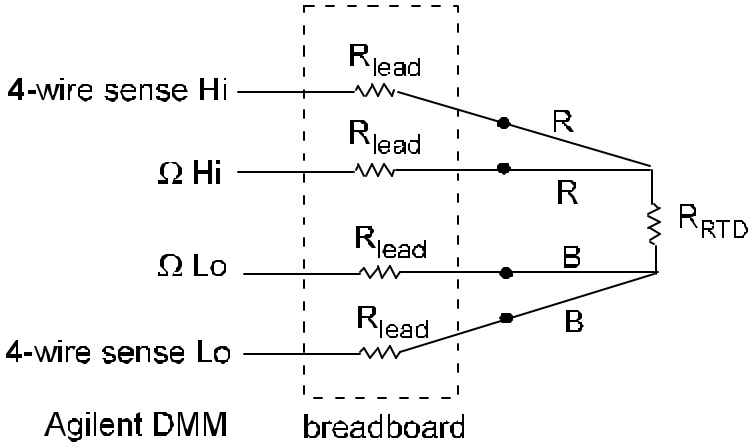
7. Now, using 3-wire measurement (use connections labeled 2 and $V_b$ at 3-wire), $V_b$ = _____ when RTD is in the ice bath.

8. Again, using 3-wire measurement, $V_b$ = _____ when RTD is at human body temperature.

9. Again, using 3-wire, $V_b$ = _____ when RTD is in boiling water.

**2-wire and 4-wire DMM measurements**

10. Construct the measurement system shown below. ($R_{lead}$ = 2.7 Ω)




11. With the RTD in an ice bath, measure the apparent resistance of the RTD using 2-wire and 4-wire measurements.

$R_{RTD(2\text{-wire})}$ = _____ $R_{RTD(4\text{-wire})}$ = _____

12. With the RTD at human body temperature, measure the apparent resistance of the RTD using 2-wire and 4-wire measurements.
    $R_{RTD(2\text{-}wire)}$ = _____ $R_{RTD(4\text{-}wire)}$ = _____

13. With the RTD in boiling water, measure the apparent resistance of the RTD using 2-wire and 4-wire measurements.
    $R_{RTD(2\text{-}wire)}$ = _____ $R_{RTD(4\text{-}wire)}$ = _____

**Table of temperature measurements**

RTDs in lab are all 100Ω platinum with DIN (European) standard RTD characteristics

For this table, record the temperature that corresponds to the apparent RTD resistance. Do not compensate for $R_{lead}$. For the bridge measurements, measure $V_b$ and then calculate $R_{RTD}$ for the case of $R_{LEAD}$ =0. For DMM measurements, simply use table to find T corresponding to measured resistance.

| | $T_{ice\ bath}$ | $T_{boiling\ water}$ | $T_{body}$ |
|---|---|---|---|
| 2-wire bridge | | | |
| 3-wire bridge | | | |
| 2-wire DMM | | | |
| 4-wire DMM | | | |

In the areas below, record the actual temperatures extracted corresponding to the true $R_{RTD}$ by properly considering $R_{lead}$.

## A. Calculations for 2-wire RTD bridge measurements

*Estimated error caused by not compensating for $R_{lead}$ in temperature measurement using 2-wire RTD bridge measurement.*

$DT_{ice\ bath}$ = _____

$DT_{body}$ = _____

$DT_{boiling\ water}$ = _____

## B. Calculations for 3-wire RTD bridge measurements

*Estimated error caused by not compensating for $R_{lead}$ in temperature measurement using 3-wire RTD bridge measurement.*

$DT_{ice\ bath}$ = _____

$DT_{body}$ = _____

$DT_{boiling\ water}$ = _____

## C. Calculations for 2-wire RTD DMM measurements

*Estimated error caused by not compensating for $R_{lead}$ in temperature measurement using 2-wire DMM measurement.*

$DT_{ice\ bath}$ = _____

$DT_{body}$ = _____

$DT_{boiling\ water}$ = _____