

(Q1)

- a) Accuracy is the algebraic difference between the indicated value of the instrument and the true value.

$$\text{Accuracy} = A_{\text{indicated}} - A_{\text{true}}$$

Accuracy measures how close the result to the actual value. But in precision we measure how close the measured values are to one another. This is the difference between Accuracy and Precision. If an Instrument indicate same value repeatedly when it is used to measure same quantity under same circumstances, for any number of time, that is called high precision.

- b) true value - 1.50V  
range - 0-2.5V  
indicated voltage - 1.46V

$$\begin{aligned}\text{Absolute error} &= \text{Measured reading} - \text{True reading} \\ &= 1.46\text{V} - 1.50\text{V} \\ &= \underline{-0.04\text{V}}\end{aligned}$$

$$\begin{aligned}\text{c) Sensitivity} &= \frac{314\Omega - 307\Omega}{230^\circ\text{C} - 200^\circ\text{C}} \\ &= \frac{7}{30} \\ &= \underline{0.233\Omega/^\circ\text{C}}\end{aligned}$$

d)  $T_0 = 10^\circ\text{C}$

$$T_x = T_0 - 0.01x$$

i) Temperature Relation  $T_r = \frac{T_x}{1 + CD}$

but  $T_x = T_0 - 0.01x$

$$\begin{aligned} \therefore T_r &= \frac{T_0 - 0.01x}{1 + CD} \\ &= \frac{10 - 0.01x}{1 + 15D} \end{aligned}$$

when  $x = 5t$

$$T_r = \frac{10 - 0.015t}{1 + 15D}$$

the transient part of the solution

$$T_{rct} = Ce^{-t/15}$$

particular integral part of the solution

$$T_{rpi} = 10 - 0.05(t - 15)$$

$$\therefore T_r = T_{rct} + T_{rpi} = Ce^{-t/15} + 10 - 0.05(t - 15)$$

at initial conditions  $t = 0$

$$T_r = 10$$

$$10 = Ce^{-0} + 10 - 0.05(-15)$$

$$C = -0.75$$

$$\therefore T_r = 10 - 0.75e^{-t/15} - 0.05(t - 15)$$

Time (s)	Altitude (m)	Temperature Reading (°C)	Temperature error
0	0	10	0
10	50	9.86	0.36
20	100	9.55	0.55
30	150	9.15	0.65
40	200	8.70	0.70
50	250	8.22	0.72

- ii) At 5000m ,  
 $t = 5000/5 = 1000s$

$$T_r = 10 - 0.75e^{-1000/15} - 0.05(1000 - 15)$$

$$e^{-1000/15} \approx 0$$

$$\therefore T_r = 10 - 0.05(985) = \underline{\underline{-39.25^\circ C}}$$

e) Calibration is a comparison between a known standard measurement and the measurement using the instrument we use. There are two objects of calibrating measuring instruments. It determines the traceability as well as check the accuracy of the instrument. Calibration is so much important because it helps ensure accuracy of measurements. Calibration develops the accuracy required in research, and innovation. The Quality of the production of millions of products and services around the world. Calibration helps to increase profitability, revenue and also it cut costs and save money. There can be many risks of manufacturing errors, increasing cost if the instruments are not calibrated. There can be legal issues as well as health risks too.