a) Calculate the relative error

$$\text{Absolute error} = \text{Measured reading} - \text{True reading}$$

$$\text{Absolute error} = 1.46 - 1.5$$

$$\text{Absolute error} = -0.04\ \text{V}$$

Thus,

$$\text{Relative error} = \frac{\text{Absolute error}}{\text{true value}}$$

$$\text{Relative error} = -\frac{0.04}{1.5}$$

$$\text{Relative error} = -0.026$$

$$\text{Relative error} = 2.67\%$$

Sensitivity:-

- It is defined as the ratio of the changes in the output of an instrument to a change in the value of the quantity being measured.
- It denotes the smallest change in the measured variable to which the instrument responds.

Sensitivity = change in output/unit change in input = Δoutput/Δinput

Given :- linear relationship between temperature and resistance

For a change in temperature of 30°C , the change in resistance is 7 ohm. Hence the measurement sensitivity is equal to 7/ 30 = 0.233 ohms/°C

Answer :-

Given that :-

→ The temperature 'T_x' at an altitude of 'x' Meter and relation $T_x = T_0 - 0.01$

- We know that

→ Relation for temperature is :-

$$T_r = \frac{T_x}{1+TD}$$

$$= \frac{T_0 - 0.01x}{1+TD}$$

$$T_r = \frac{10 - 0.01x}{1+15D}$$

→ At $x = 5t$

$$T_r = \frac{10 - 0.01(5t)}{1+15D}$$

$$T_r = \frac{10 - 0.05t}{1 + 15D}$$

→ Now, by solving, we get

→ Complementary function :-

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

particular integral :-

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

thus,

$$T_r = T_{rf} + T_{rpi}$$

$$T_r = Ce^{-t/15} + 10 - 0.05(t - 15)$$

Evaluate the value of 'c', by Applying the boundary conditions.

let, $t = 0$

$$T_r = Ce^{-t/15} + 10 - 0.05(t-15)$$

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

$$\boxed{C = -0.75}$$

→ Substitute the 'C' value in above

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

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

a) Given that:-

→ The balloon is released at time zero, and thereafter rises upwards at a velocity = 5 metres/second.

→ Tabulated the value of temperature for different values of 't'

Time	Altitude	Temperature reading	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

b) Given that:-

→ The temperature does the balloon report an altitude = 5000 metres.

→ Where, 5000m, t = 1000s.

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

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

$$T_r = -39.25^{\circ}C$$