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Subject - Physics

## PHYSICS VLAB EXPERIMENT - I CHARACTERISTICS OF THERMISTOR

AIM :- To plot the characteristics of thermistor & hence find the temperature coefficient of resistance.

Component: Thermistor, Rheostat, Voltmeter, Multimeter, Oil bath arrangement.

FORMULA The dependence of resistance on temperature used:- can be approximated by following eqn.

$$R = R_0 e^{\beta \left( \frac{1}{T} - \frac{1}{T_0} \right)} \quad \text{--- (1)}$$

$R$  is the resistance of thermistor at the temp  $T$  (in K)

$R_0$  is resistance at given temperature  $T_0$  (in K)

$\beta$  is material specific - constant.

The material specific - constant of a NTC thermistor is calculated by formula shown below & is expressed in degrees Kelvin ( $^{\circ}\text{K}$ ).

Diff. (1) w.r.t  $T$  we get,

$$\frac{dR}{dT} = - \frac{R\beta}{T^2}$$

$$\alpha = - \frac{dR}{RdT}$$

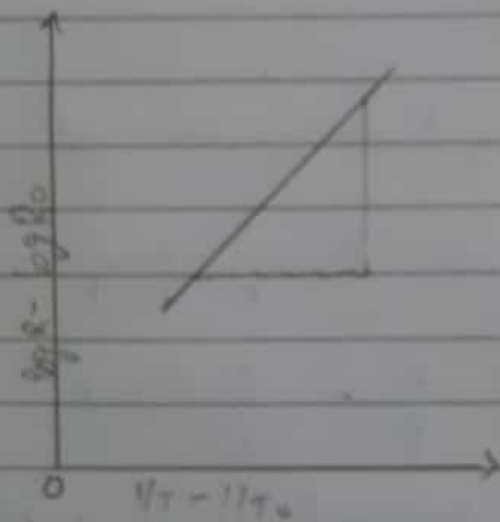
is the temp coefficient of resistance

Taking log of (1) & simplifying we get

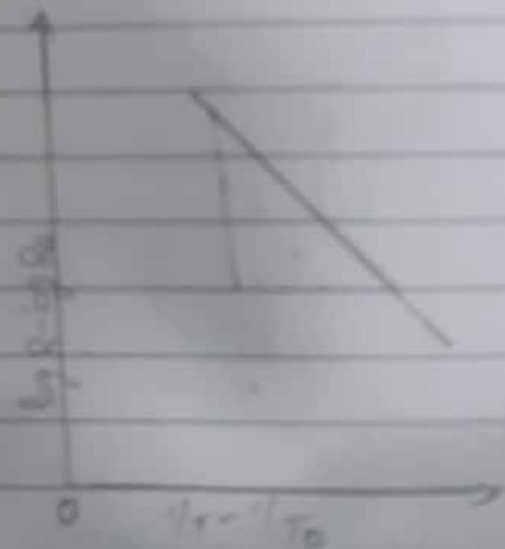
$$\alpha = - \frac{\beta}{T^2} \quad \beta = \frac{\log R - \log R_0}{\frac{1}{T} - \frac{1}{T_0}} \quad \text{--- (2)}$$

$$\frac{1}{T} - \frac{1}{T_0}$$

A graph plotted with  $\log R - \log R_0$  in Y axis & in X axis for NTC & PTC is shown below. The slope of graph gives value of  $\beta$ .

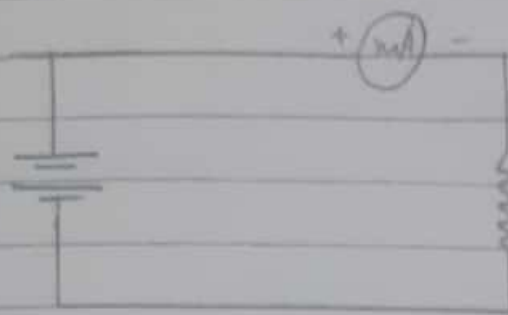


(i) NTC



(ii) PTC

## Circuit Diagram :-



Observation: The least count of Voltmeter is = 0.1V

The least count of Ammeter is = 0.01 mA

The room temperature is = 25°C

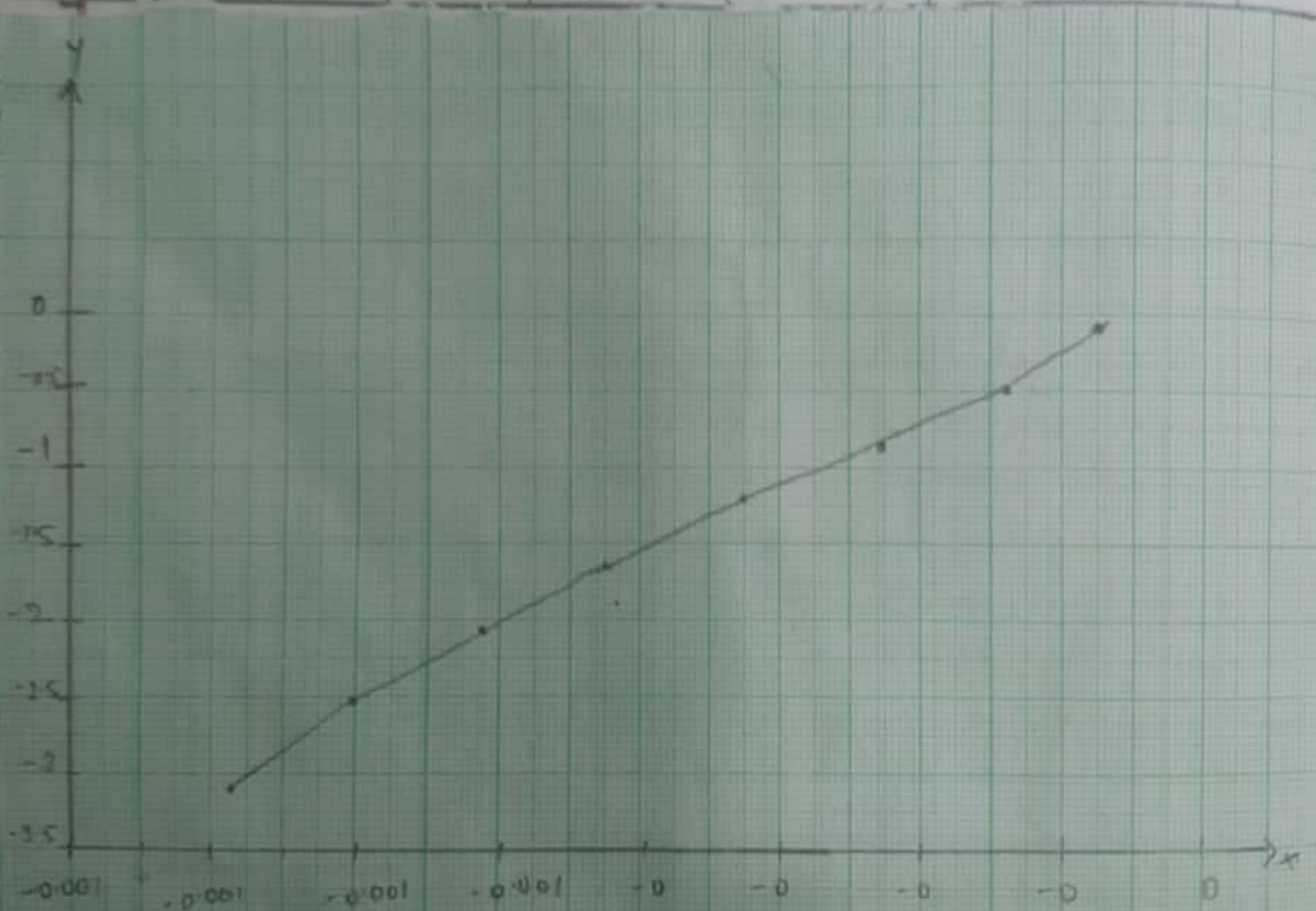
$T_0 = 25$  (degree Celsius)

$R_0 = 100$  ohms

Voltage V	Temp. C	Temp K	Current I(mA)	Resistance	$1/T - 1/T_0$	$\log k - \log R_0$	beta	alpha = beta/T <sup>2</sup>
0.2	30	303	2.7420	84.56	-	-	3340	-0.03637
					0.0000	0.168		
					5			
0.2	40	313	4.1634	59.47	-	-	3225	-0.03291
					0.0001	0.518		
					6			
0.2	50	323	4.9900	40.89	-	-	3576	-0.03427
					0.0002	0.894		
					5			
0.2	60	333	6.9696	27.58	-	-1.29	3685.7	-0.03323
					0.0003		1	
					5			
					.			

0.2	70	343	12.496	17.534	-	-	3824.0	-0.02301
					0.0004	1709	9	
					4			
0.2	80	353	17.902	11.653	-	-	4132.6	-0.02316
					0.0005	2149	9	
					2			
0.2	90	363	28.855	7.335	-	-	4353.3	-0.02323
					0.0006	2612	3	
					0			
0.2	100	373	43.570	4.517	-	-	4622.3	-0.02327
					0.0006	3097	8	
					7			

48



$\frac{1}{T} - \frac{1}{T_0}$  v/s  $\log R - \log R_0$



Result: The material constant of thermistor,  $\beta = 3851.2$   
The temperature coeff. of thermistor,  $\alpha = 0.0235500$   
( $^{\circ}\text{C}^{-1}$ )

Precaution:

1. Temperature may not be taken at regular intervals.
2. Check the connections properly.
3. Note down the readings properly with correct units etc.

Sources of error:

1. units may not be taken properly.
2. Calculations & readings may be incorrect.
3. use Calculators for doing calculation etc.