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EXPERIMENT NO. 5

AIM :

To study the variation of thermo E.m.f of a thermo couple with temperature and determine its thermo - electric power.

APPARATAUS REQUIRED :

1. Thermo - Couple
2. Micro - voltmeter

CONSTRUCTION OF THERMO - COUPLE :

The couple employed for the experiment is a copper constantan couple. A single peice of constantan wire is welded at its two ends with two seperate but similar copper wires so as to form two copper constantan junctions. These two junctions are seperately kept in two beakers filled with water, thermometer and stirrers. One of the beakers will be heated while the other is to be kept at room temperature.

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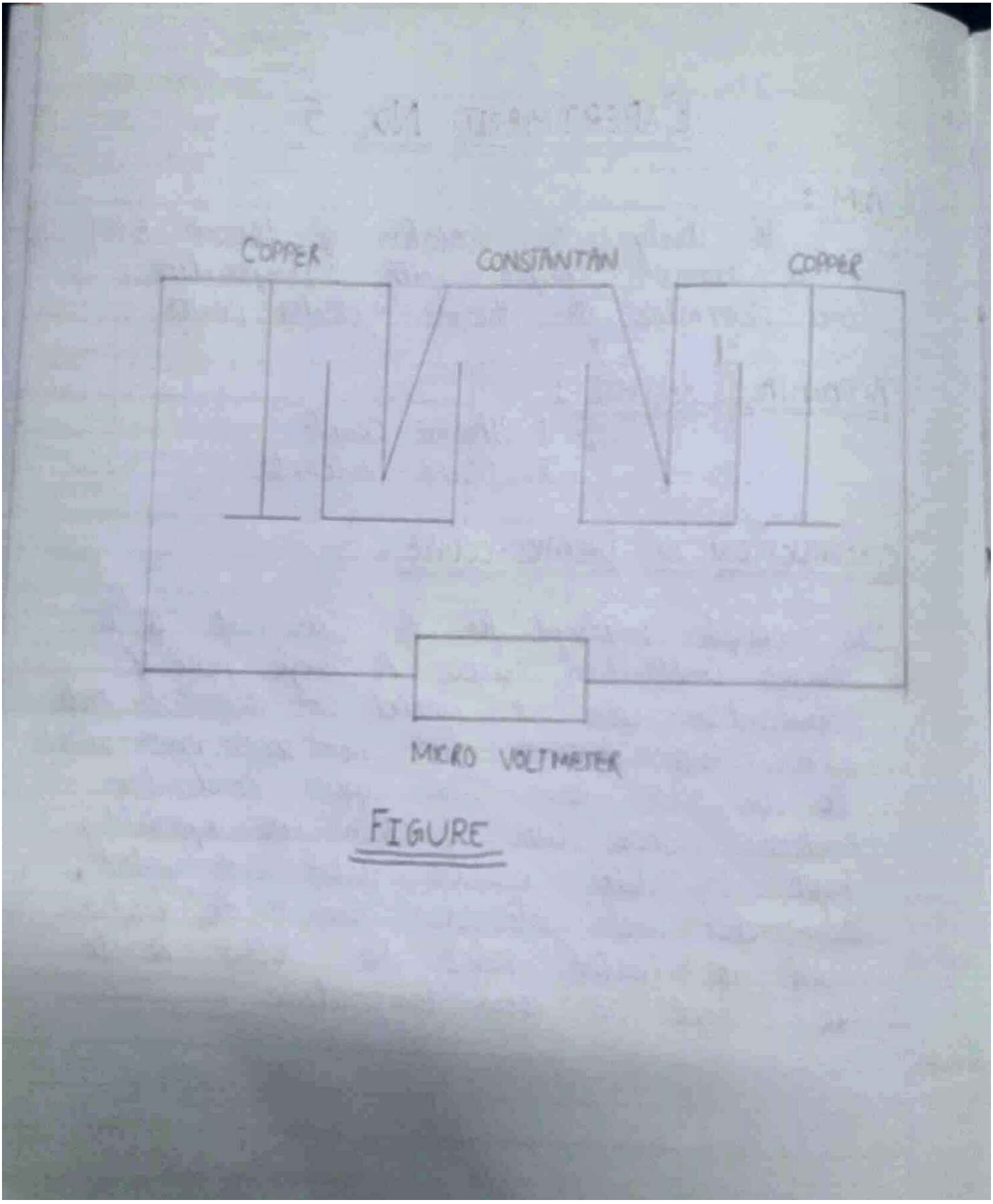

FIGURE

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THEORY :

When two junctions of a thermocouple are kept at two different temperature a thermo emf will be developed in the couple. Note the temperature of the hot junction from thermometer and the corresponding thermo emf from the micro voltmeter.

PROCEDURE :

Make connections as shown in fig. A Graph is plotted with emf measured along the Y-axis and temperature along X-axis.

OBSERVATION :

Temp. of the cold jn at the beginning of exp. = 30 °C
Temp. of the cold jn at the end of exp. = 30 °C
Avgerage temp. of the cold jn = 30 °C

RESULT :

Plot the readings of difference of temperature of hot jn and cold jn in the X-axis and thermo emf in the Y-axis. Draw a straight line passing through the maximum no. of points. Determine the slope of curve.

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S.No	(Temp. of hot junction) − (Temp. of cold junction) (°C)	Thermo Emf (mV)		
		V(Increasing)	V(decreasing)	V_0
1.	30°C − 30°C = 0°C	0.133	0.130	0.132
2.	35°C − 30°C = 5°C	0.142	0.140	0.141
3.	40°C − 30°C = 10°C	0.150	0.156	0.153
4.	45°C − 30°C = 15°C	0.167	0.175	0.171
5.	50°C − 30°C = 20°C	0.192	0.192	0.192
6.	55°C − 30°C = 25°C	0.200	0.208	0.204
7.	60°C − 30°C = 30°C	0.219	0.224	0.221
8	65°C − 30°C = 35°C	0.235	0.244	0.240
9.	70°C − 30°C = 40°C	0.260	0.255	0.258
10.	75°C − 30°C = 35°C	0.281	0.270	0.276

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Then the thermo electric power = Slope of this curve
(tanθ) = thermoemf developed / °C

For calculating the thermo electric constants, two points (θ_1, C_1) and (θ_2, C_2) are chosen from the curve so obtained. Two quad. eqn formed are,

$$e_1 = a\theta_1 + b\theta_1^2$$
$$e_2 = a\theta_2 + b\theta_2^2$$

from this two eqn the values of a and b are determined.

Thermo electric constant $a = 4.89 \times 10^{-3}$ And $b = 5.6 \times 10^{-5}$

The neutral temperature t_n of the couple $t_n = -a/b$.

PRECAUTIONS:

Water at the hot junction should be stirred constantly.

CALCULATIONS:

$$C_1 = a\theta_1 + b\theta_1^2$$

$$\Rightarrow 0.24 = a(35) + b(35)^2$$
$$0.0685 = a + 35b \quad \text{— (1)}$$

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$$E_2 = aQ_2 + bQ_2^2$$

$$0.387 = 60a + b(60)^2$$

$$0.00545 = a + 60b \quad \text{——(2)}$$

from (1) and (2)

$$\Rightarrow \quad 25b = -0.0014$$

$$b = -5.6 \times 10^{-5}$$

Substituting b in eqn (1), we get

$$a = 4.89 \times 10^{-3}$$

The Neutral temperature t_n of the couple,

$$t_n = -a/b$$

$$t_n = -\frac{4.89 \times 10^{-3}}{-5.6 \times 10^{-5}} \Rightarrow \boxed{t_n = 87.32^\circ C}$$

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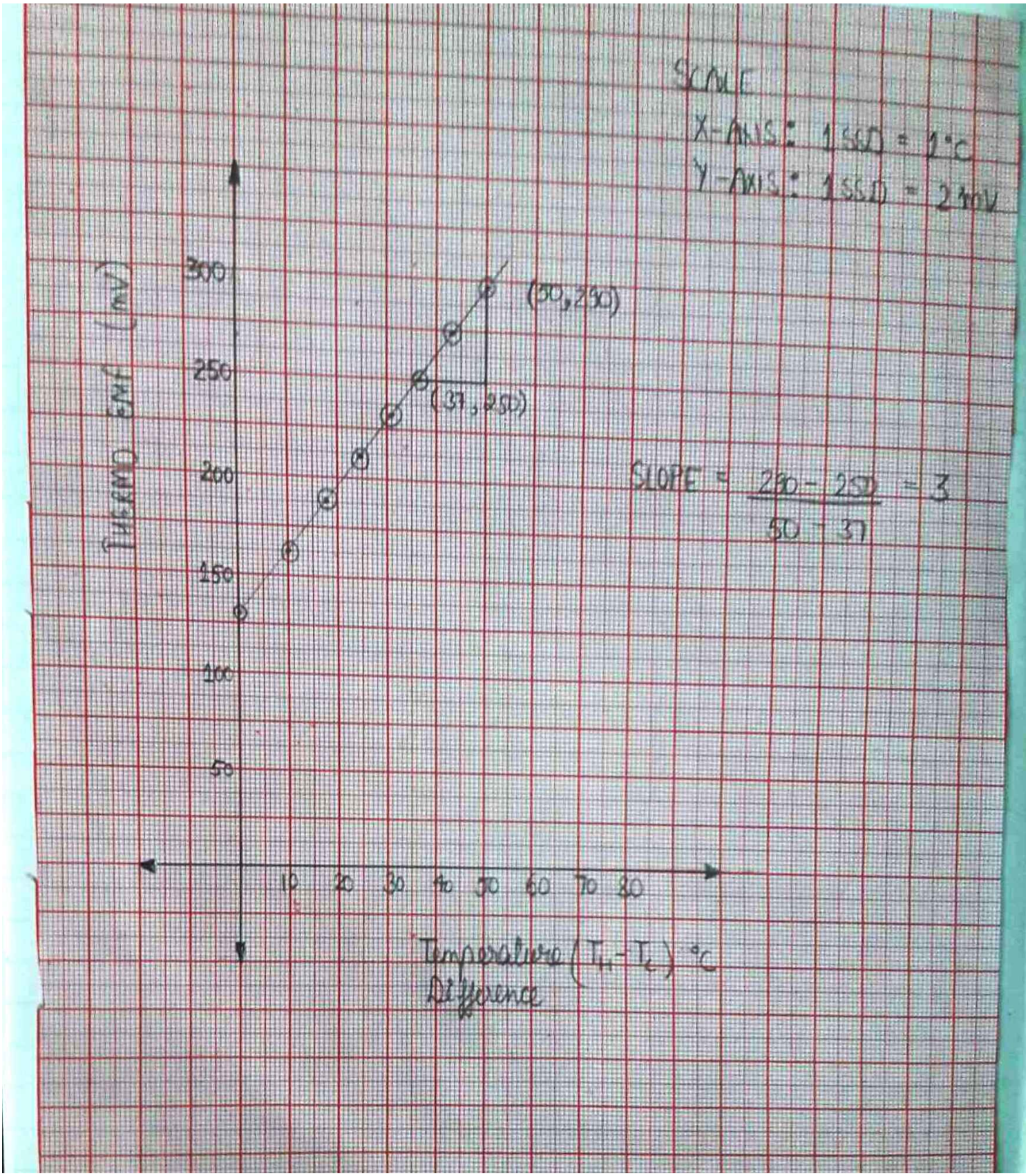
SCALE
X-AXIS: 1 SQ = 1°C
Y-AXIS: 1 SQ = 2 mV
(50, 250)
(37, 250)
SLOPE = 250 - 250 / 50 - 37 = 3
300
250
200
150
100
50
10 20 30 40 50 60 70 80
Temperature Difference (T1 - T2) °C