Date 17/2/21 Expt. No. 3

Expt. Name Seebeck effect Page No. 6

Experiment-3

Aim:

To verify the temperature difference and thermo emf of a thermocouple relation b/w two hot junctions.

Theory:

The conversion of temperature difference to electric current and vice-versa is termed as thermoelectric effect. To measure the voltage, one must use a second conductor material which generates a different voltage under the same temperature gradient. The voltage difference generated by the two materials can then be measured and related to the corresponding temperature gradient.

Based on Seebeck's principle, thermocouples can only measure temperature differences and need a known reference temp. to yield the absolute readings.

$$V = a\,(T_h - T_c)$$

V → Voltage difference b/w two dissimilar metals.

a → Seebeck coefficient

$T_h - T_c$ → Temp. difference b/w hot and cold junctions.

Teacher's Signature:

Type R:

Platinum - Rhodium

T(°C)	V (Volt)
200	1.469
400	3.408
600	5.583
800	7.95
1000	10.506
1200	13.228
1400	16.04
1600	18.835
1768	21.101

Type K:

Chromel - Alumel

T(°C)	V (Volt)
150	1.041
300	2.401
450	3.933
600	5.583
750	7.34
900	9.205
1050	11.173
1200	13.228
1372	15.645

Type E:

chromel - Constantan

T(°C)	V
100	0.647
200	1.469
300	2.401
400	3.408
500	4.471
600	5.583
700	6.743
800	7.938
900	9.205
1000	10.506

Type J:

Iron - Constantan

T(°C)	V
100	0.647
200	1.469
300	2.391
400	3.408
500	4.46
600	5.583
700	6.743
800	7.938
900	9.205
1000	10.506
1100	11.85
1200	13.228

Type T:

copper - Constantan

T (°C)	V (volt)
40	0.232
80	0.501
120	0.80
160	1.124
200	1.46
240	1.831
280	2.207
320	2.597
360	2.997
400	3.408

Calculation:

Thermal power coefficient

$$= \frac{dV}{dT} = \text{slope of graph}$$

$$= \frac{y_2 - y_1}{x_2 - x_1} = \frac{18.835 - 3.408}{1600 - 400} = 0.0127138$$

TYPE R			TYPE K				
T (degree C)	V (Volt)		T	V			
200	1.469		150	1.041			
400	3.408		300	2.401			
600	5.583		450	3.933			
800	7.95		600	5.583			
1000	10.506		750	7.34			
1200	13.228		900	9.205			
1400	16.04		1050	11.173			
1600	18.835		1200	13.228			
1768	21.101		1372	15.645			
slope	0.0127138397			0.01200150248			
TYPE E			TYPE J			TYPE T	
T	V		T	V		T	V
100	0.647		100	0.647		40	0.232
200	1.469		200	1.469		80	0.501
300	2.401		300	2.391		120	0.8
400	3.408		400	3.408		160	1.124
500	4.471		500	4.46		200	1.46
600	5.583		600	5.583		240	1.831
700	6.743		700	6.743		280	2.207
800	7.938		800	7.938		320	2.597
900	9.205		900	9.205		360	2.997
1000	10.506		1000	10.506		400	3.408
			1100	11.85			
			1200	13.228			
slope	0.01101121212			0.01151062937			0.008888030303

Date _____ Expt. No. _____

Expt. Name _____ Page No. _____

Procedure :

- Select the type of thermocouple from the dropdown box.
- Adjust the temperature slider to a specific temperature.
- The emf generated can be viewed through the voltmeter.
- The temperature v/s emf graph can be analysed.

Variable region :

1. Choose ThermoCouple Type → user can select different kinds of thermocouple with this combo box.
2. Hot Temp. Slider → slider is used to change temperature of hot junction.
3. Reference Temperature Slider → used to change reference temp.

Observations :

Slope of Type R = $\frac{y_2 - y_1}{x_2 - x_1} = \frac{18.835 - 3.408}{1600 - 400} = 0.0127138$ ..

Type K = $\frac{13.228 - 5.583}{1200 - 600} = 0.0120015$

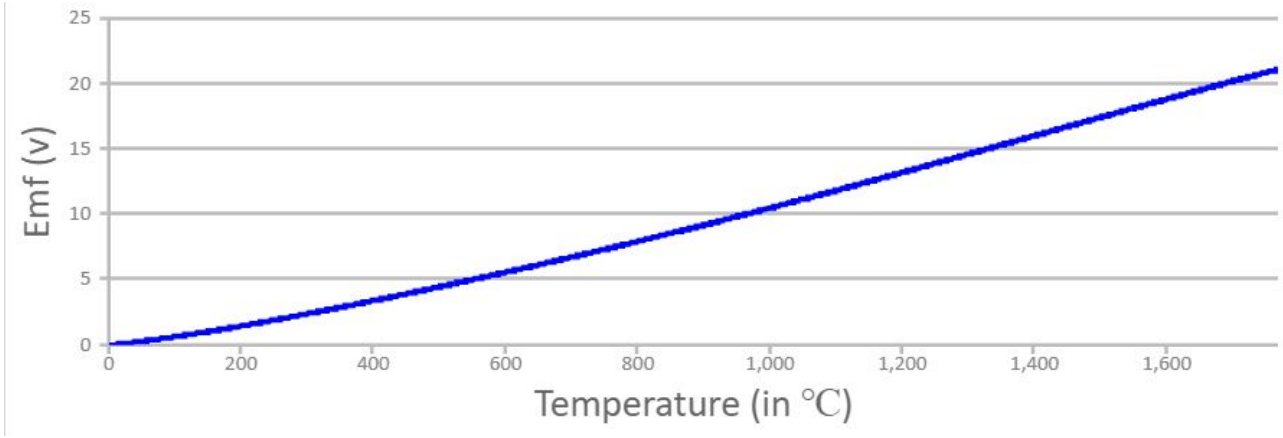
Type E = $\frac{6.743 - 3.408}{700 - 400} = 0.0110112$

Type J = $\frac{9.205 - 4.46}{900 - 500} = 0.0115106$

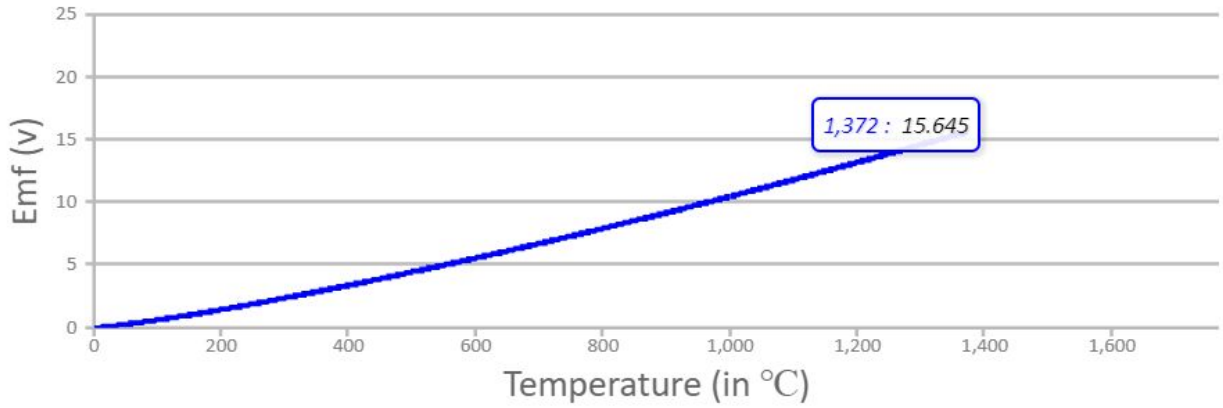
Type T = $\frac{2.997 - 1.46}{360 - 200} = 0.008888$

Teacher's Signature: _____

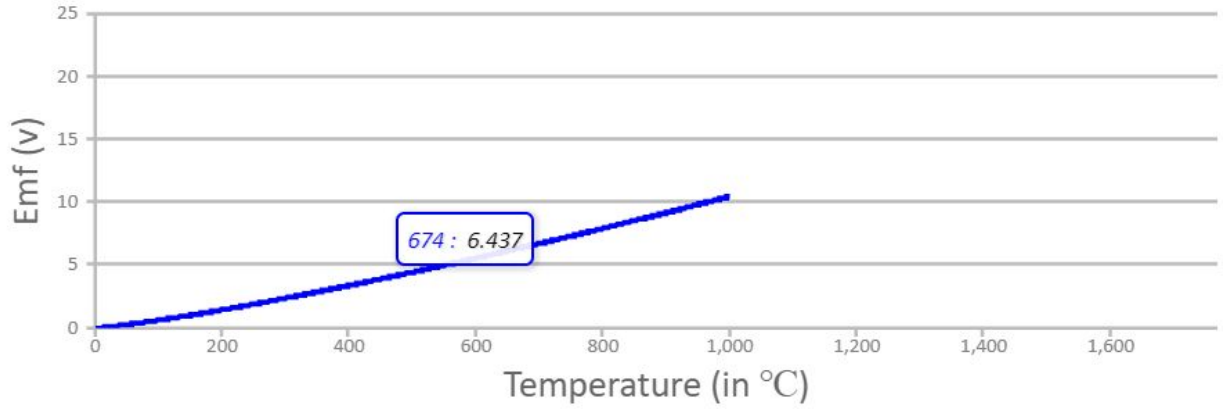
Type R



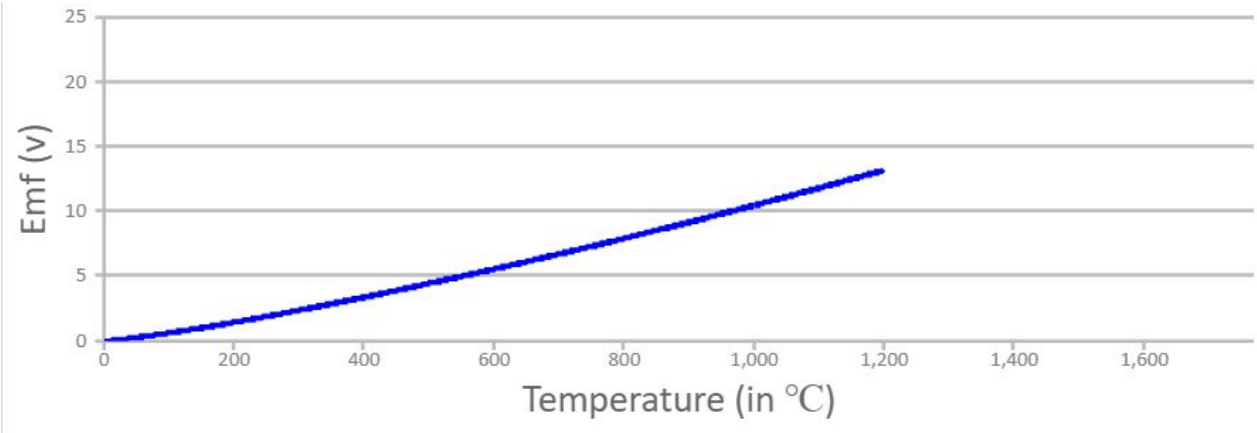
Type K



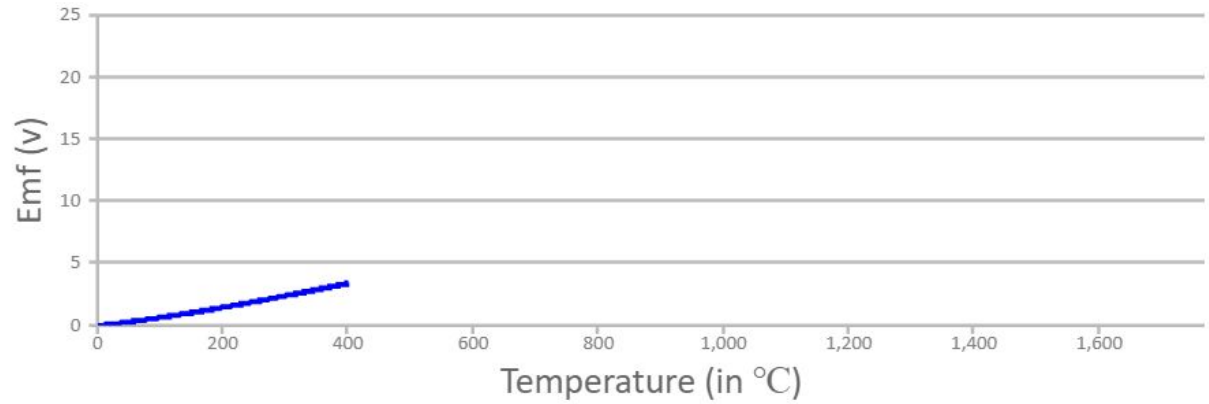
Type E



Type J


25
20
15
10
5
0
Emf (v)
0
200
400
600
800
1,000
1,200
1,400
1,600
Temperature (in °C)

Type T


25
20
15
10
5
0
Emf (v)
0
200
400
600
800
1,000
1,200
1,400
1,600
Temperature (in °C)