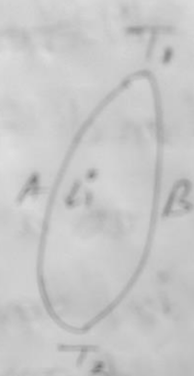
14.11

Thermel emf : To form closed circuit if two different metel are joined together and their two jonetions are maintained at a different temperature an emf is developed this emf is known as thermel emf. its magnitudes depends on the temperature differenee of their jonetion

Seeba effect : when two different metal (A and B) are joined together of both ends and a differenee of temperature is maintained between the two jonetion, a current flows to through the close loop this effect is known as seeknet effect.

The density of electron in metal difference from one metal to another and in the same metals depends on temparacture. For this reason seeback emf is arised. When the two different metals are joined and two junction are kept at different temperature electrons. Diffusion at the junction take place at different rate there is a net motion of the electiron as through the electrons were driven by

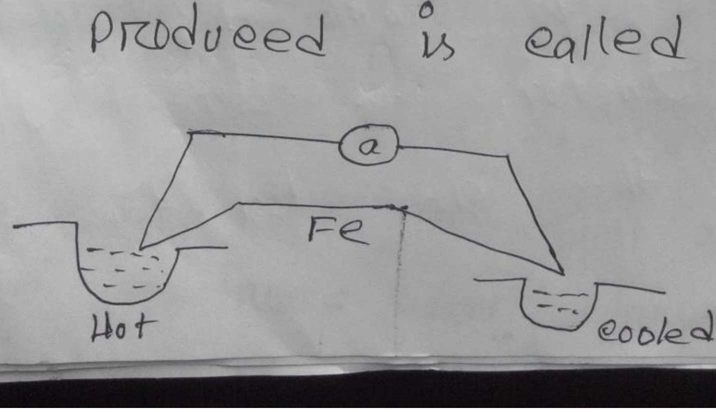


$T_1 > T_2$

non- electron static field.

Pelter effect: Pelter effect is the Complementary phenomeon to seeback effect. At constant temperature when current is passed a cross a Junction of two different metal heating or cooling of the Junction takes places depending on the direction of the flow of the current and

Thermo couple : If two wires of two dissimilar metals are Joined at both ends and if two Jonctions are maintained at different temperature then a current flows in the circuit and an emf is established the established emf in the circuit depends on the thermal conditions and is called thermal electromotive force the combinations of differ ent metals in which thermal emf is produced is called thero couple.



Uses of thermocouple :

(i) The thermocouple is used to measured on onknown temperature.

(ii) Thermo emf can be measured with the help of thermocouple.

V.V.I

Thomson effect :

When a current, flows through an oneaually heeted metal there is an absorption or evolution of heat through out in the body of the metal. This is known as thomson effect consider a copper bar AB heeted in the middle at the Point . fig (1)

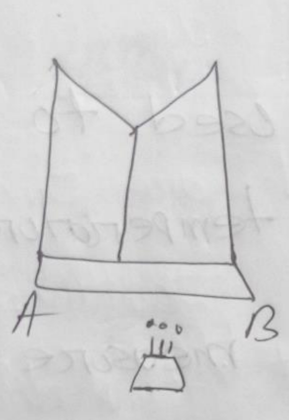


fig (2)

fig (1)

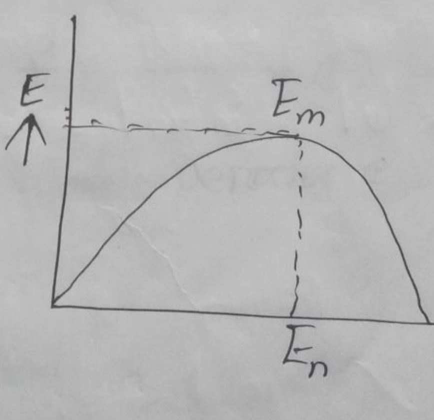
A corrent is passed from A to B. it is observed that heat is obsarbed in the part Ae and P volved in the part eB. This is known as Positive thomson effect. similar effect is observed in metal like Ar, Zn, sb and eD.

In this case of Iron bar AB heat is evolved in the part Ae and observed in the part eB fig (b) this is known negative thomson effect. Similar effect is observed in metals like Pt, Ni, eo and Bi for lead the thomson effect is zero. The thomson effect is reversible.

4 What is netural temperature and inversion temperature Relation between netural temperature and inversion tem perature.

V.VA

Soln: Netural temperature: The temperature of the hot junction at which the termes emf becomes maximum is called the neutral temparature. the neutral temperature is constant for a point of metal.



100%

Inversion temperature : The temporture of which the thermo emf decrease to zero value is called the temperatore of inversion for the thermocuple. At this ~~them~~ temperatore the_

Relation : we know

$$E = at + bt^2 \quad \text{--- (i)}$$

$$\frac{dE}{dt} = a + 2bt \quad \text{--- (ii)}$$

When neutral temperature $t = t_n$ then E is maximum

$$\therefore \frac{dE}{dt} = 0$$

From eqn (ii)

$$a + 2bt_n = 0$$

$$t_n = -\frac{a}{2b} \quad \text{--- (iii)}$$

Again inversion temperature $t = t_i$ then $E = 0$

From eqn (i)

$$0 = at_i + bt_i^2$$

$$\text{or } at_i + bt_i^2 = 0$$

or $t_i(a + bt_i) = 0$

or, $a + bt_i = 0$

or $bt_i = -a$

or $t_i = -\frac{a}{b}$ ——— (iv)

From eq^n (iii) and (iv)

$$\boxed{t_i = 2t_n}$$

Thermo electric power :

Thermo electric power is define as the rute of change of thermo emf with temperature of a thermo couple is formed from two metals and A and B the difference of temperature of the jonction is T kelvin. the thermo emf E is given by the eqn

$$E = at + bT^2$$

A graph between E and T is a Parabola

$$\frac{dE}{dT} = a + 2bT$$

$\frac{dE}{dT}$ is called thermo electric power.

□ law of thermo emf

□ law of addition of thermal electromotive forces.

① law of Intermediate metal :

The introduction of any additional metal into any thermoelectric circuit does not alter the thermo emf provided the metal introduced is entirely at the same temperature as the point at which the metal is introduced.

② low of intermediate temperature :

The thermo emf E_1^3 of a thermo couple whose junction are maintained at temperature T_1 and T_3 is equal to the sum of the emf E_1^2 and E_2^3 when the junction are maintained at temperature T_1 T_2 and T_2 T_3 respectly. Thes,

$$E_1^3 = E_1^2 + E_2^3$$

1108

4. Calculate the maximum emf in Fe – Pb thermo couple the cold function of which is kept $0°C$ given $a = 13.8$ $\mu V/°C$ and $b = -0.015\ \mu V(°C)^2$

Soln:

we know,

$$E = at + bt^2 \text{ ——— (1)}$$

$a = 13.8$

$b = -0.015$

when $\frac{dE}{dT} = 0$ then $t = t_n$

$$a + 2bt_n = 0$$

$$t_n = -a/2b$$

$$t_n = -\frac{13.8}{2 \times 0.015}$$

$$= 460$$

Now, maximum emf

$$E_{max} = at_n + bt_n^2$$

$$= 13.8 \times 460 + \{-0.015 \times (460)^2\}$$

$$= 3174\ \mu V$$

[4] calculate the Neutral temperature and temperature of inversion when a thermocouple cold junction and 0°C where $a = 10.3\ \mu V/°C$ $b = -0.01\ \mu V/(°C)^2$

Soln: we know,

$$t_n = 2t_n - \frac{a}{2b}$$

$$= -\frac{10.3}{-0.01 \times 2}$$

$$= 515$$

$$t_i = 2t_n$$

$$= 2 \times 515$$

$$= 1030$$

□ Find the neutral temperature of thermo couple using the relation
$E = at + bt^2$

Solⁿ: Emf vs temperature curve up to temperature inversion is approximately parabola and equation of emf can be written as $E = at + bt^2$ where a and b are constant. At absolute temperature, E can be written as

$$E = a(T_2 - T_1) + b(T_2 - T_1)^2$$

at $T_1 = 273k$ 0°C and $T_2 = T$

Then $E = a(T - 273) + b(T - 273k)^2$

differenting this eq^n we get

$$\frac{dE}{dt} = a + 2bT$$

At temperature t_n

$$\frac{dE}{dt} = 0$$

$$a + 2bt_n = 0$$

$$t_n = -\frac{a}{2b}$$

This is the netural temperature

at inversion temp

$$t = t_i$$

$$E = 0 \quad at_i + at_i^2$$

$$\boxed{\cancel{or = 0 \quad at_i + t_i}}$$

$$or \; t_i (a + bt_i) = 0$$

$$t_i = 0 \text{ and } = -\frac{a}{b}$$

* When $a = 5.7\ uV/^\circ C$ $b = -.03\ uV/^\circ C^2$ calculte Neutral temperature and inverction temperature maximum emf

Soln :

We know, Neutral temperature

$$T_n = -\frac{a}{2b}$$

$$= -\frac{5.7}{2 \times (-0.03)}$$

$$= 95$$

$$T_i = 2t_n$$

$$= 2 \times 95$$

$$= 190$$

Maximum emf,

$$e = a + 2bt_n$$

$$= 5.7 + 2(-0.03) \times 95 = 0$$