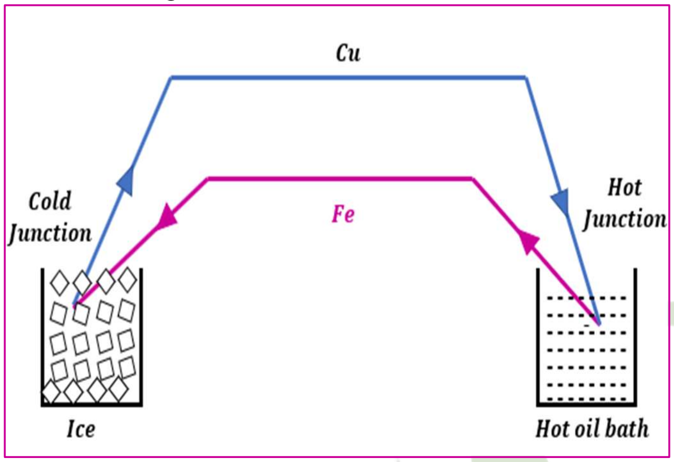
Consider a Fe-Cu thermocouple whose one end is kept in oil bath and another is kept in melting ice, as shown in fig.



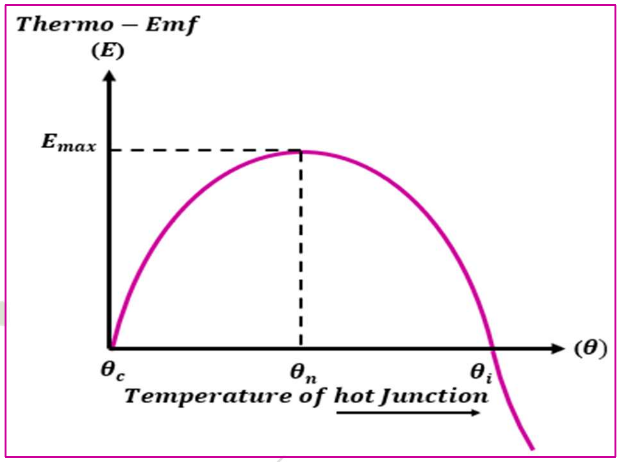


Fig (1): Fe-Cu Thermocouple **Fig (2): Variation of thermo-emf with temperature**

Initially, when both ends (junctions) are **at same temperature**, **no current** flows in the thermocouple (no deflection is observed in galvanometer), and hence no thermo-emf is produced. As the temperature of oil bath is increased, keeping the other end at constant temperature, it is noticed that current begins to flow in the thermocouple. On increasing the temperature of oil bath gradually, it is noticed that thermo emf also increases till it becomes maximum and then start to decrease, as shown in graph below. The thermo emf goes on decreasing and for certain value of temperature, it becomes zero and changes its polarity (direction).

Neutral Temperature:

The temperature of hot junction at which the Thermo-Emf becomes maximum is known as Neutral Temperature (θ_n).

Its value depends on: ***Nature of metal*** used in thermocouple **but** does not depend on the temperature of cold junction (Or does not depend upon the difference in temperature between hot and cold junction).

It is constant for a thermocouple.
The value of neutral temperature for Cu-Fe thermocouple is 270^0C.

Temperature of inversion:

The temperature of hot junction at which the thermo-emf becomes zero and changes its polarity is known as temperature of inversion (θ_i).

Its value depends on: ***Nature of metal*** used in thermocouple and also depends upon the **temperature of cold junction.** Its value is not constant for a thermocouple as it depends on temperature of cold junction.

From symmetry of the graph (a parabolic graph shown in figure (2)),

$$\theta_n - \theta_c = \theta_i - \theta_n$$

or, $$\boxed{\theta_n = \frac{\theta_i + \theta_c}{2}}$$

So, the neutral temperature lies exactly between inversion temperature and temperature of cold junction.