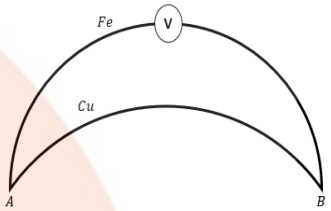
Thermoelectric Effect

(Daywise Assignment)

Day: 1

1. Which of the following is the phenomenon of production of emf by maintaining a difference of temperature between two junctions of dissimilar metals?
   a. Joule's Effect b. Seebeck Effect c. Peltier Effect d. Thomson's Effect
2. Study the following list of thermoelectric series and answer the question below:
   Sb, Fe, Zn, Pb, Mn, Cu, Bi
   Which of the following combinations would give the least emf?
   a. Sb & Bi b. Fe & Cu c. Sb & Cu d. Zn & Mn
3. a. What is thermoelectric effect? On what factors does Thermoemf depends?
   b. What are the factors on which temperature of inversion and neutral temperature depends?
   c. What is the cause of Seebeck effect?
   d. What is thermocouple? The figure below shows a $\boldsymbol{Fe - Cu}$ thermocouple with junctions at points A and B.
   Redraw the diagram and assign the hot and cold junction and also assign an arrow for the direction of current.
   e. Does the thermoelectric effect obey the law of conservation of energy?
   f. What is thermoelectric series. Explain the significance of thermoelectric series.

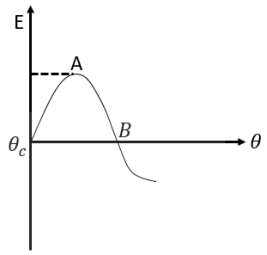


Day: 2

1. Which combination of metal in thermocouple gives the maximum thermo emf in equal temperature difference at the two ends?
   a. Iron and copper b. Zinc and iron c. Antimony and bismuth d. Antimony and copper
2. If the cold junction of a thermocouple is kept at 0^0C and hot junction is kept at θ^0C, then the relation between neutral temperature θ_n and temperature of inversion θ_i is,
   a. $\theta_n = \theta_i$ b. $\theta_n = \frac{\theta_i}{2}$ c. $\theta_i = \frac{\theta_n}{2}$ d. $\theta_i = \alpha\theta_n + \beta{\theta_n}^2$
3. The neutral temperature of a thermocouple is 300^0C. What is the temperature of inversion if the temperature of cold junction is 16^0C?
   a. 590^0C b. 610^0C c. 310^0C d. 290^0C
4. For a thermocouple, θ_c= 0^0C and $\theta_n = 275^0$C. If θ_c is changed to 20^0C, Then θ_n and θ_i will be reapectively,
   a. 265^0C and 550^0C b. 265^0C and 530^0C c. 275^0C and 550^0C d. 275^0C and 530^0C
5. The plot showing the variation of thermo emf with temperature of the hot junction of thermocouple is,
   a. Parabolic b. Circular c. Hyperbolic d. Elliptical
6. One junction of a thermocouple is maintained at 10^oC and no Thermo emf is developed when the other junction is maintained at 530^oC, then the neutral temperature is
   a. 265^oC b. 270^oC c. 520^oC d. 540^oC
7. a. Due to the temperature, difference between the junctions of thermocouple, thermo emf is produced. How thermo emf varies with temperature of hot junction in the thermocouple. Discuss?
   b. If the temperature of cold junction is lowered, what will be the effect on neutral temperature and the temperature of inversion?
   c. Thermocouple is made with two dissimilar metals. Why do we generally prefer Sb-Bi thermocouple?
   d. The thermo emf E and the temperature of hot junction θ satisfy the relation $E = a\theta + b\theta^2$, where $a = 4.1x10^{-5}V°C^{-1}$ and $b = -4.1x10^{-8}V°C^{-2}$. If the cold junction temperature is 0^0C find the neutral temperature.
   e. The thermo emf E and the temperature of hot junction θ satisfy the relation$E = a\theta + b\theta^2$, where $a = 14\mu V°C^{-1}$ and $b = -0.04\mu V°C^{-2}$. If the cold junction temperature is 0^0C find the neutral temperature and the temperature at which the thermo emf changes sign.

Day-3

1. The thermoelectric power at neutral temperature is,
   a. Zero b. Maximum c. Negative d. None
2. Lead is taken as standard reference material in thermoelectric series, because it shows
   a. Zero Thomson Effect c. Positive Thomson Effect
   b. Negative Thomson Effect d. All of the above
3. a. What is Peltier effect? What is the cause of Peltier effect?
   b. Peltier effect is converse of Seebeck effect. Explain?
   c. Why lead is used as reference metal in thermoelectricity?
   d. Differentiate between Seebeck and Peltier effect.
4. In the graph below.



   a. What is the temperature at points A and B called in thermoelectric effect?
   b. If value of A and B are $320K$ and $500K$, what must be the value of θ_c?
   c. For emf, $E = 10\theta - \frac{3}{100}\theta^2$, What could be the emf at neutral temperature, as given in (b).
5. A thermocouple has cold at $\boldsymbol{0^oC}$ and when the hot junction is at $\boldsymbol{\theta^oC}$, the thermo emf is given by $\boldsymbol{E} = (20\boldsymbol{\theta} + 0.02\boldsymbol{\theta^2})\ \mu V$. What is the temperature of the hot junction if the thermo emf produced is $\boldsymbol{7.5\ mV}$?