**Answer script upload link: https://forms.gle/rgTtBJszhDwLHxp46**

**ASUTOSH COLLEGE**

**(Affiliated to University of Calcutta)**

**Semester 3- Examination**

**Physics-Honours (practical)**

**Paper-CC6**

**Full Marks-30**

**Time- 2Hrs**

**Answer any one question**

1. **Coefficient of thermal expansion of a metallic rod :**

**a)** Write the working formula for finding the coefficient of thermal expansion of a metallic rod using a optical lever with appropriate diagrammatic description. (10)

**b)** Given are the following data for the measurement of the metallic rod before and after steam is passed through the optical lever set up : Initial mean length of the rod : 50.4 cm, mean length of the optical lever 'a': 4.44cm, mean distance between mirror and scale 'D'=106m

| Condition | Thermometer reading (T) in $°C$ | Scale reading through telescope in cm | Temperature difference in $°C$ | Linear displacement of the scale reading in cm |
|---|---|---|---|---|
| Before passing steam | 31.1 | 32.9 | | |
| After Passing Steam | 96 | 31.1 | | |

Complete the above table. (6)

**c)** Calculate the coefficient of linear expansion of the material of the rod using the data above . (9)

**d)** What do you mean by coefficient of linear thermal expansion? (2)

**e)** What is the unit of coefficient of thermal expansion? (1)

**f)** Does the coefficient of linear thermal expansion change if we change the length of the rod. (2)

**2. Coefficient of Thermal conductivity of a bad conductor by Lee and Charlton's disc method .**

**a)** Give the working formula for calculating the coefficient of thermal conductivity with diagrammatic description of the apparatus. ('S' being the bad conducting sheet and 'C' the lower metallic disc) (10)

**b)** Given are the following data for the bad conducting sheet and other parts of the apparatus: Mass of the metallic disc : 0.96 Kg, Specific heat of the disc : 382.2 $J/Kg^{-1}K^{-1}$, Radius of the bad conducting sheet S : 0.056 m, Mean thickness of the bad conducting sheet S : 0.304 cm, Mean thickness of the metallic disc : 1.24 cm. More over the stady state temperatures, above and below the sheet S are $\theta_1 = 100°C$ (above), $\theta_2 = 81.7°C$ (bellow). Next the following cooling data is given :

| Sl. no. | Time in sec (t) | Temp of the lower disc in $\theta\ in\ °C$ |
|---|---|---|
| 1. | 0 | 96.6 |
| 2. | 60 | 94.8 |
| 3. | 120 | 92.8 |
| 4. | 180 | 90.7 |
| 5. | 240 | 88.4 |
| 6. | 300 | 86.3 |
| 7. | 360 | 84.4 |
| 8. | 420 | 82.3 |
| 9. | 480 | 79.6 |
| 10. | 540 | 77.8 |
| 11. | 600 | 76.2 |
| 12. | 660 | 74.5 |

| | | |
|---|---|---|
| 13. | 720 | 73.0 |
| 14. | 780 | 71.5 |
| 15. | 840 | 70.2 |

Plot $\theta\ vs\ t$ curve and hence find $\frac{d\theta}{dt}$ at the steady temperature of the lower disc i.e. $81.7°C$. (10)

**c)** Hence find the coefficient of thermal conductivity of the bad conductor. (5)

**d)** What do you mean by coefficient of thermal conductivity? (2)

**e)** What is its unit ? (1)

**f)** Does it depend on the dimensions of the object whose conductivity you are measuring ? (2)

**3. Callibration of Thermocouple:**

**a)** Draw the circuit diagram for calibration of constantan-copper thermocouple and write the formula for the thermo emf $e$. (8)

**b)** Given the following data : Temperature of the cold junction = $0°C$, E.M.F. of the battery = 1.07 V, Resistance of the potentiometer wire R=22 Ω. Length of the potentiometer wire L=1000 cm, and potential drop per unit length $\rho$ taken to be $= 5 \times 10^{-6} V/cm$ , from which resistance $R_1$ in the main circuit is computed.

| Sl. No. | Temperature of the hot junction in $°C$ | Total length required to balance $(l)$ in cm | Thermo emf $e$ in mV |
|---|---|---|---|
| 1 | 31 | 198.5 | |
| 2 | 38.5 | 243.1 | |
| 3 | 49.3 | 326.4 | |
| 4 | 54 | 384.9 | |

| | | | |
|---|---|---|---|
| 5 | 59 | 418.7 | |
| 6 | 64 | 466.6 | |
| 7 | 69 | 504.2 | |
| 8 | 74.2 | 537 | |
| 9 | 79.2 | 572.8 | |
| 10 | 83.8 | 611 | |
| 11 | 90.2 | 620.1 | |

Complete the following table and hence plot thermo emf $(e)$ $vs$ temperature $(t)$.

(12)

**c)** Calculate the slope of the $e\ vs\ t$ curve to calibrate the thermocouple . (5)

**d)** What is Seebeck effect? (2)

**e)** What is Peltier effect? (2)

**f)** What is the relationship between thermo-e.m.f. $(e)$ and temperature $(t)$ of the hot junction when the cold junction is kept at $0°C$. (1)