Solution

2.1

Connect the circuit as shown in fig. 19.17

R_X .... resistance to be determined
R ...... known value of resistance

Measure potential difference across R_X and R. Chose the value of R which gives comparable value of potential difference across R_X.

In this particular case $R = 47{,}5\ \Omega$

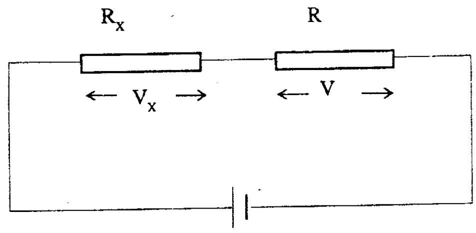

Fig. 19.17

$$\frac{R_X}{R} = \frac{V_X}{V}$$

where V_X and V are values of potential differences across R_X and R respectively.
R_X can be calculated from the above equation.
(The error in R_X depends on the errors of V_X and V_R).

2.2

Connect the circuit as shown in fig. 19.18

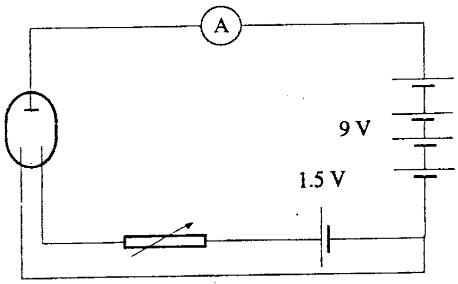

Fig 19.18

- Begin the experiment by measuring the resistance R_0 of the tungsten cathode when there is no heating current
- Add resistor $R = 1000\ \Omega$ into the cathode circuit, determine resistance R_1 of the tungsten cathode, calculate the resistance of the current-carrying cathode.
- Repeat the experiment, using the resistor $R = 100\ \Omega$ in the cathode circuit, determine resistance R_2 of tungsten cathode with heating current in the circuit.
- Repeat the experiment, using the resistor $R = 47{,}5\ \Omega$ in the cathode circuit, determine resistance R_3 of tungsten cathode with heating current in the circuit.
- Plot a graph of $\frac{R_1}{R_0}, \frac{R_2}{R_0}$ and $\frac{R_3}{R_0}$ as a function of temperature, put the value of $\frac{R_0}{R_0} = 1$ to coincide with room temperature i.e. 18°C approximately and draw the remaining part of the graph parallel to the graph of specific resistance as a function of temperature provided in the problem. From the graph, read values of the temperature of the cathode T_1, T_2 and T_3 in Kelvin.

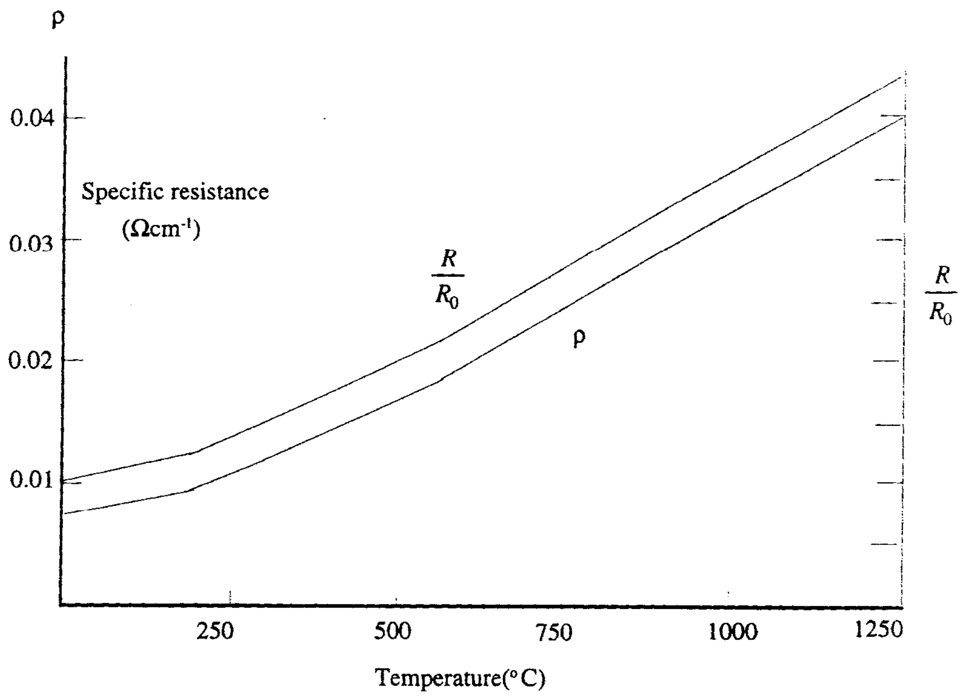

Fig 19.19

From the equation $I = C \cdot T^2 \cdot e^{-\frac{W}{k \cdot T}}$

we get $\ln\frac{I}{T^2} = -\frac{W}{k \cdot T} + \ln C$

Plot a graph of $\ln\frac{I}{T^2}$ against $\frac{1}{T}$.

The curve is linear. Determine the slope m from this graph. $-m = -\frac{W}{k}$

Work function W can be calculated using known values of m and k (given in the problem).

Error in W depends on the error of T which in turn depends on the error of measured R.