# Solution

2.1
Connect the circuit as shown in fig. 19.17

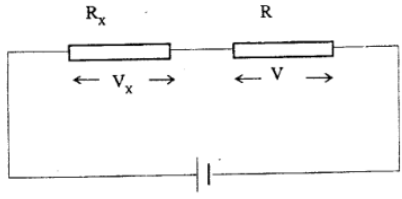



Fig. 19.17

$R_X$ .... 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 $R = 47{,}5\ \Omega$
$$\frac{R_X}{R} = \frac{V_X}{V}$$
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

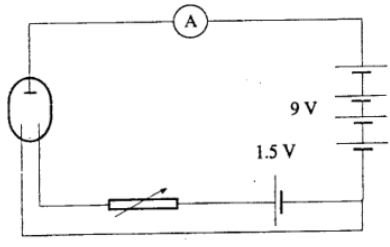



Fig 19.18

- 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.

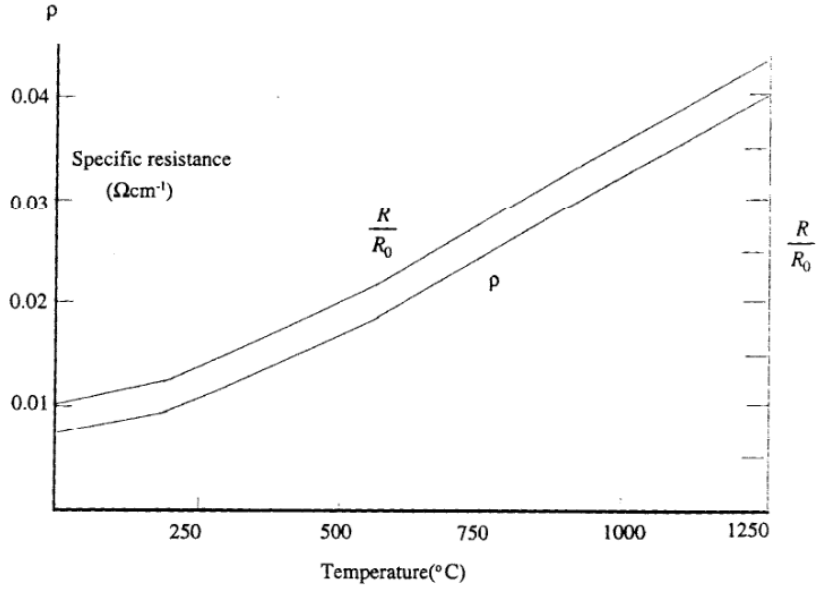



Fig 19.19

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

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

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

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

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.