We know that the electrical resistivity changes with temperature. If the temperature T doesn't vary too much, a linear approximation is typically used: $\rho(T) = \rho_0\big(1 + \alpha(T - T_0)\big)$.

So, from the given data we will have:

$9.75 = 52.5 \cdot \big(1 + \alpha \cdot (100 - 0)\big) => \alpha = \frac{9.75-52.5}{52.2 \cdot 100} \approx -0.008143\ \frac{1}{°C}$.

Now we can find the temperature when thermometer's resistance is 8.25 Ohms. In this case we will have: $T_0 = 100°C, \rho_0 = 9.75\ Ohms$. And we need to find T, when $\rho = 8.25\ Ohms$.

We will have: $\rho(T) = \rho_0\big(1 + \alpha(T - T_0)\big) => T = T_0 + \frac{\rho - \rho_0}{\rho_0 \cdot \alpha} = 100 + \frac{8.25-9.75}{9.75 \cdot (-0.008143)} =$ $118.9°C$.

Answer: $118.9°C$.