Answer on Question #52083, Physics, Field Theory

20 The temperature at which the tungsten filament of a 12 V and 36W lamp operates is 1730°C. If the temperature coefficient of resistance of tungsten is 6×10−3/K, find the resistance of the lamp at a room temperature of 20°C

10.00Ω
0.45Ω
0.39Ω
4.00Ω

Solution

Resistance at 1730°C

$$R\left(t=1730^0C\right)=\frac{U^2}{P}=\frac{\left(12V\right)^2}{36W}=4\Omega$$

Resistance versus of temperature

$$R(t)=R_0\left(1+\alpha t\right) \tag{1}$$

where R_0 is the resistance at zero degrees Celsius; $\alpha=6\cdot10^{-3}K^{-1}$ the temperature coefficient of resistance of tungsten.

Then

$$R\left(t=20^0C\right)=R_0\left(1+\alpha\cdot20^0C\right)=\frac{R\left(t=1730^0C\right)}{\left(1+\alpha\cdot1730^0C\right)}\left(1+\alpha\cdot+20^0C\right)=\frac{4\left(1+6\cdot10^{-3}K^{-1}\cdot20^0C\right)}{\left(1+6\cdot10^{-3}K^{-1}\cdot1730^0C\right)}=0.39\Omega$$

Answer: $R\left(t=20^0C\right)=0.39\Omega$