5 Fig.5 illustrates the connection between the copper and filament wires of a lamp. The diameter of the copper wire is 1.50 mm and the diameter of the filament wire is 0.020 mm.
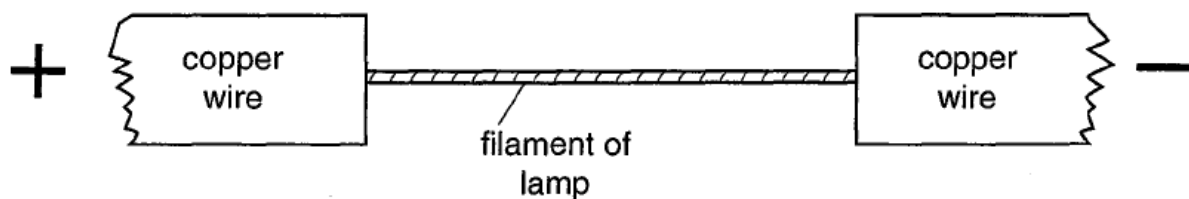

Fig. 5

The number density of charge carriers in copper is 8.49×10^{28} m^{-3}, and the number density of charge carriers in tungsten is 3.40×10^{28} m^{-3}. The uncoiled filament wire is 1.5 m long and has a resistance of 300 Ω.

(a) State and explain whether the current in the copper wire and tungsten filament are the same.

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....[1]

(b) Calculate the resistivity of the filament wire.

resistivity = ... Ω m   [2]

(c) **(i)** The drift velocity of electrons in the copper wire is 0.021 x 10^{-3} m s^{-1}.
Determine the drift velocity of electrons in the tungsten filament.

drift velocity = …………………. m s^{-1} [3]

(ii) Use your answers to **(c)(i)** to explain why the filament of the lamp gets hot but the copper leads stay relatively cold.

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(iii) The filament wire is now replaced with another tungsten wire of the same length, but twice its diameter. The potential difference (p.d.) across the wire is unchanged. The temperature of both wires is the same.

Without any calculations, state and explain the change, if any, to the drift velocity of the charge carriers in the second filament wire.

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