3 **(a)** Copper has one conduction electron per atom. The density of copper is 8960 kg m^{-3}. The mass of one mole of copper is 63.5 g.

Show that the number density of charge carriers in copper is 8.49×10^{28} m^{-3}.

[3]

(b) A composite wire XYZ is made by connecting in series two uniform wires, each of length *L* and made of copper but having different diameters as shown in Fig. 3.1. One wire has diameter *d* and the other wire has diameter 2*d*.

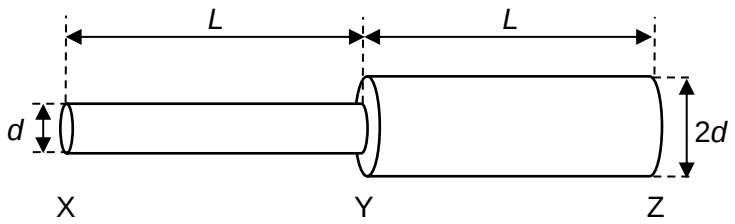

Fig. 3.1

A potential difference is then applied across X and Z of the wire and a current flows through the wire.

On Fig. 3.2, sketch a graph to show how the drift velocity v_d of electrons through the composite wire varies with distance along the wire from end X to end Z.

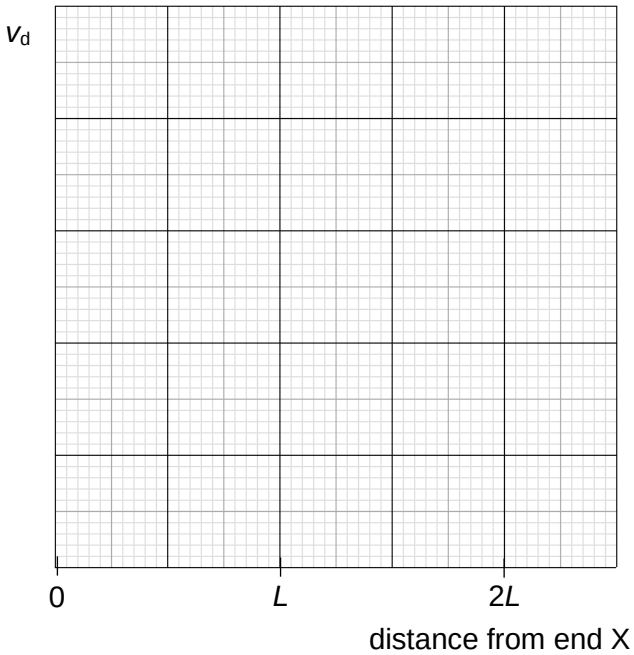

Fig. 3.2 [3]

(c) The mean speed of a conduction electron in the wire is very much greater than the drift velocity of the conduction electrons in the wire.

Explain this observation.

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[Total: 8]

[Turn over