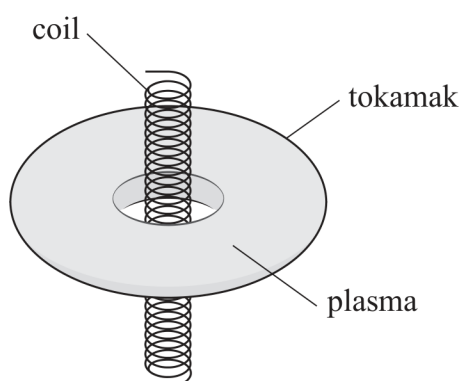16 At the Culham Centre for Fusion Energy (CCFE), experiments are carried out on plasmas.

A plasma is an ionised gas which is an electrical conductor. The plasma at CCFE is contained in a doughnut-shaped vessel known as a tokamak.

A current in the plasma is produced by steadily increasing a current in a coil passing through the hole at the centre of the tokamak.

The plasma in the tokamak acts as a single conducting loop around the central coil.

(a) Explain how steadily increasing the current in the central coil produces a current in the plasma.

(4)

(b) The plasma can be considered to be a cylinder of length 13.2 m and cross-sectional area 2.30 m².

(i) Show that the resistance of the plasma is about $1.9 \times 10^{-7} \, \Omega$.

resistivity = $3.30 \times 10^{-8} \, \Omega \, m$

(2)

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(ii) In a particular experiment, the current in the central coil is increased steadily from zero to its maximum value in a time of 25.0 s.
When the current in the central coil reaches its maximum, the magnetic flux linkage with the plasma loop is 16.9 Wb.

Calculate the heating power produced in the plasma.

(4)

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Heating power = ...

(Total for Question 16 = 10 marks)