5 **(a)** A resistor of resistance R consists of a thin layer of copper deposited uniformly on the surface of an iron wire of radius of 0.60 mm and length 3.0 m as shown in Fig. 5.1. The thickness of the copper is 1.78×10^{-5} m.

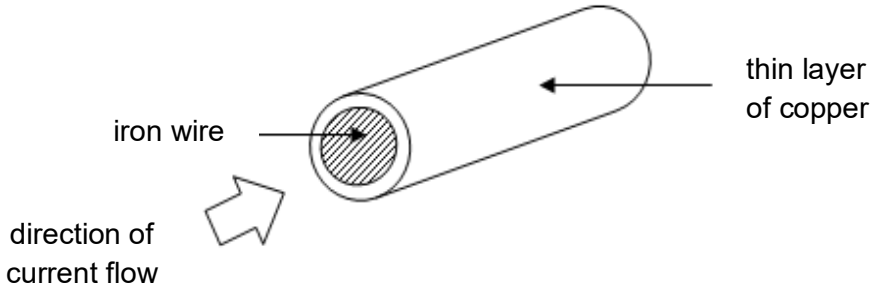

Fig. 5.1

(i) The resistivity of iron and copper are 8.90×10^{-8} Ω m and 1.60×10^{-8} Ω m respectively.

If the resistance of iron wire is 0.236 Ω, show that R is 0.18 Ω.

[2]

(ii) Explain how R changes after the current passes through it for a period of time.

.....

.....

..... [2]

(b) A 50 Hz 240 V alternating sinusoidal voltage is applied across the primary coil of a **step-down** transformer as shown in Fig. 5.2. A diode acting as a rectifier is placed in series with the resistor in **(a)** and the secondary coil.

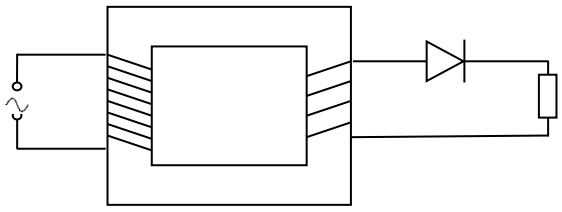

Fig. 5.2

The ratio $\frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$ is 10.

(i) Determine the maximum output voltage from the transformer.

maximum output voltage = ... V [2]

(ii) On Fig. 5.3, sketch the variation with time the output power of the resistor. Label your graph clearly.

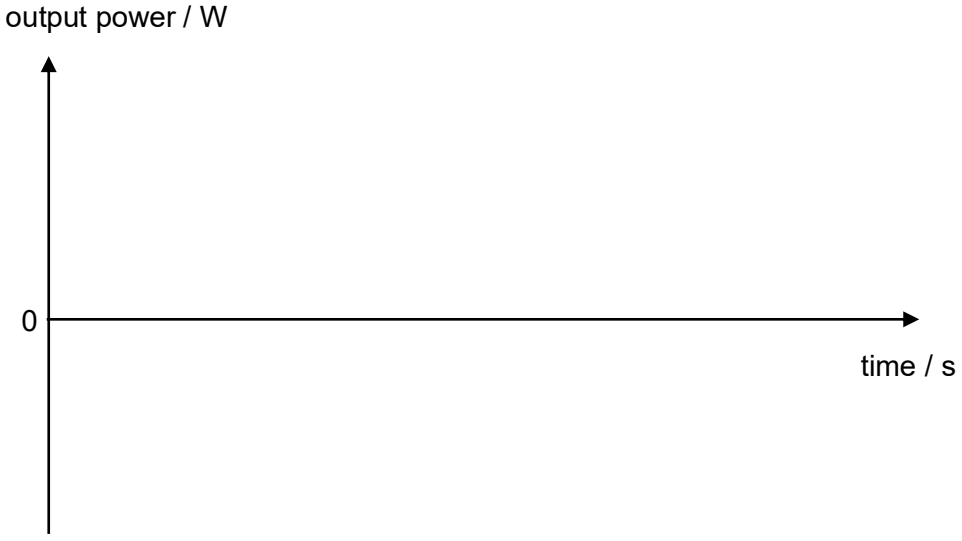

Fig. 5.3

[2]

(iii) Hence, or otherwise, calculate the mean power generated by the resistor. Show your working clearly.

mean power = ... W [3]

(c) In a new electrical circuit as shown in Fig. 5.4, a direct current voltage of 24 V is connected across the resistor in **(a)**. A diode is placed in series with the resistor.

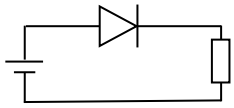

Fig. 5.4

Explain if there is any change to the mean power generated by the resistor as compared to your answer in **(b)(iii)**.

.....
...

..... [1]
...