Transformations & Transmission of Electrical Energy

Question paper 2

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Alternating Currents
Sub Topic	Transformers & Transmission of Electrical Energy
Paper Type	Theory
Booklet	Question paper 2

Time Allowed: **51 minutes**

Score: **/42**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 A student is asked to design a circuit by which a direct voltage of peak value 9.0 V is obtained from a 240 V alternating supply.
The student uses a transformer that may be considered to be ideal and a bridge rectifier incorporating four ideal diodes.
The partially completed circuit diagram is shown in Fig. 6.1.

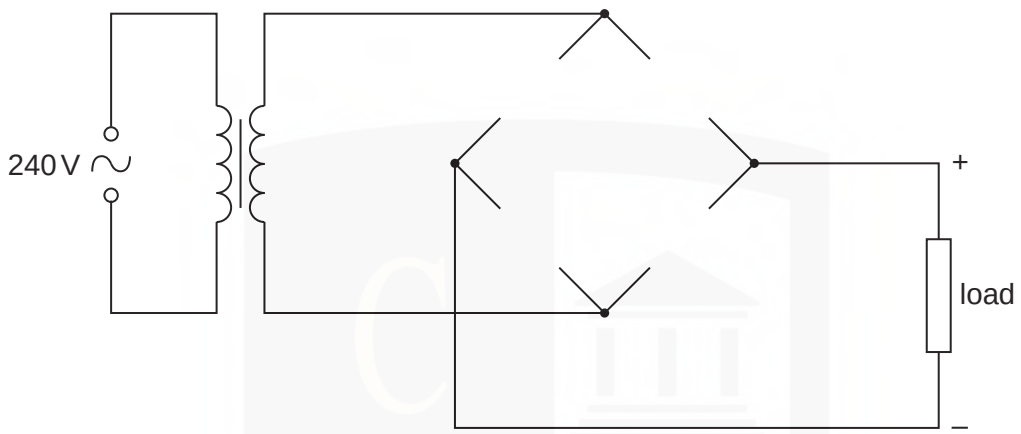

Fig. 6.1

(a) On Fig. 6.1, draw symbols for the four diodes so as to produce the polarity across the load as shown on the diagram. [2]

(b) Calculate the ratio

$$\frac{\text{number of turns on the secondary coil}}{\text{number of turns on the primary coil}}.$$

ratio = ... [3]

2 An ideal iron-cored transformer is illustrated in Fig. 6.1.

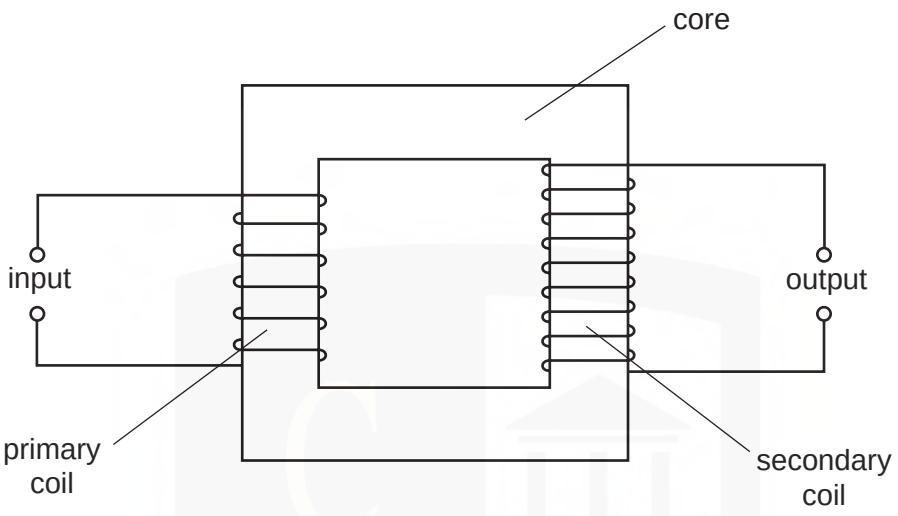

Fig. 6.1

(a) Explain why

(i) the supply to the primary coil must be alternating current, not direct current,

.....

.....

.....[2]

(ii) for constant input power, the output current must decrease if the output voltage increases.

.....

.....

.....[2]

(b) Fig. 6.2 shows the variation with time t of the current I_p in the primary coil. There is no current in the secondary coil.

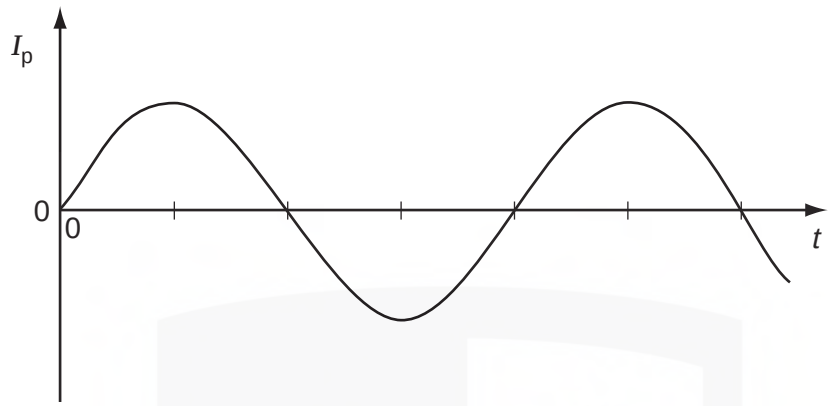

Fig. 6.2

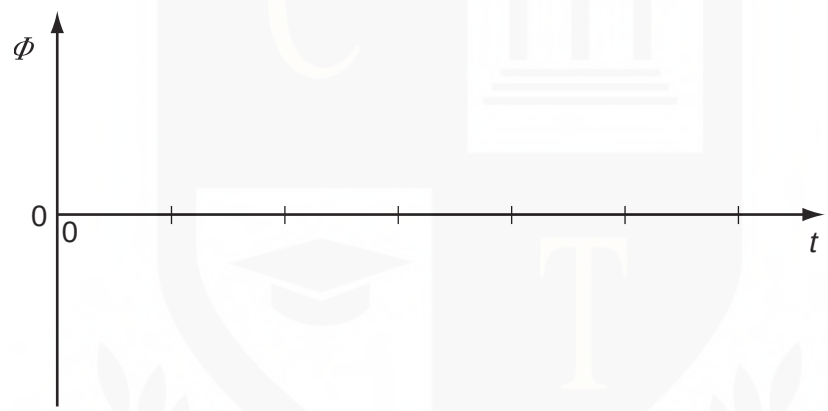

Fig. 6.3

Fig. 6.4

(i) Complete Fig. 6.3 to show the variation with time t of the magnetic flux Φ in the core. [1]

(ii) Complete Fig. 6.4 to show the variation with time t of the e.m.f. E induced in the secondary coil. [2]

(iii) Hence state the phase difference between the current I_p in the primary coil and the e.m.f. E induced in the secondary coil.

phase difference = ... [1]

3 **(a)** The mean value of an alternating current is zero.

Explain

(i) why an alternating current gives rise to a heating effect in a resistor,

.....

.....

..... [2]

(ii) by reference to heating effect, what is meant by the root-mean-square (r.m.s.) value of an alternating current.

.....

.....

.....

..... [2]

(b) A simple iron-cored transformer is illustrated in Fig. 7.1.

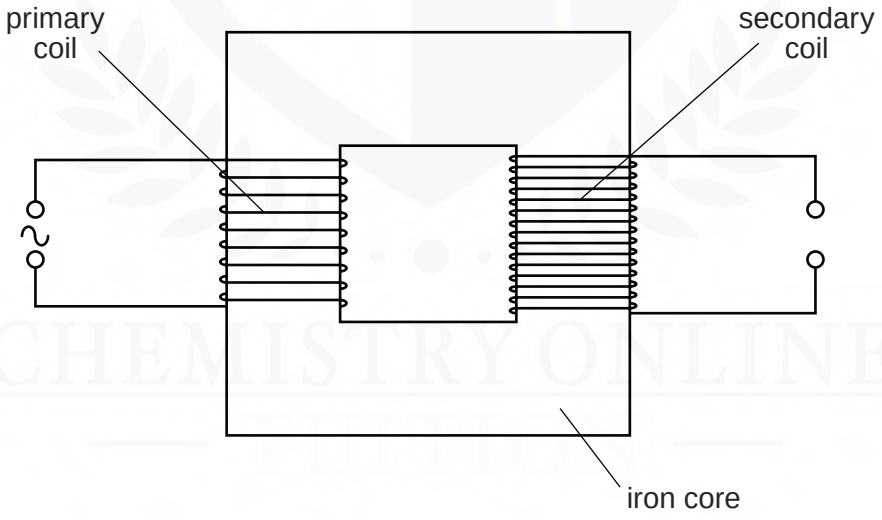

Fig. 7.1

(i) State Faraday's law of electromagnetic induction.

.....

.....

..... [2]

(ii) Use Faraday's law to explain why the current in the primary coil is not in phase with the e.m.f. induced in the secondary coil.

.....

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.....

.....

..... [3]

4 An ideal transformer is illustrated in Fig. 6.1.

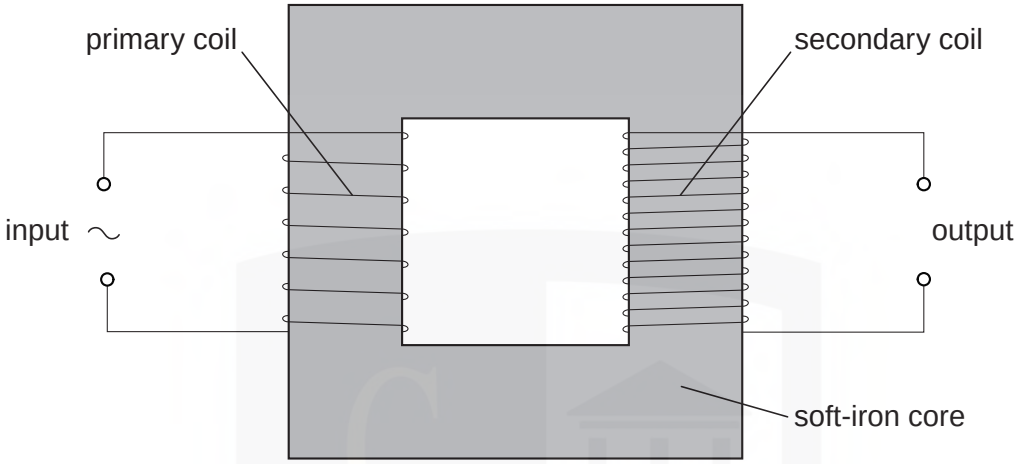

Fig. 6.1

(a) **(i)** State Faraday's law of electromagnetic induction.

.....

.....

..... [2]

(ii) Use the law to explain why a transformer will not operate using a direct current input.

.....

.....

..... [2]

(b) **(i)** State Lenz's law.

.....

.....

..... [2]

(ii) Use Lenz's law to explain why the input potential difference and the output e.m.f. are not in phase.

.....

.....

..... [2]

(c) Electrical energy is usually transmitted using alternating high voltages.

Suggest one advantage, for the transmission of electrical energy, of using

(i) alternating voltage, ...

..... [1]

(ii) high voltage. .....

..... [1]

5 A simple iron-cored transformer is illustrated in Fig. 6.1.

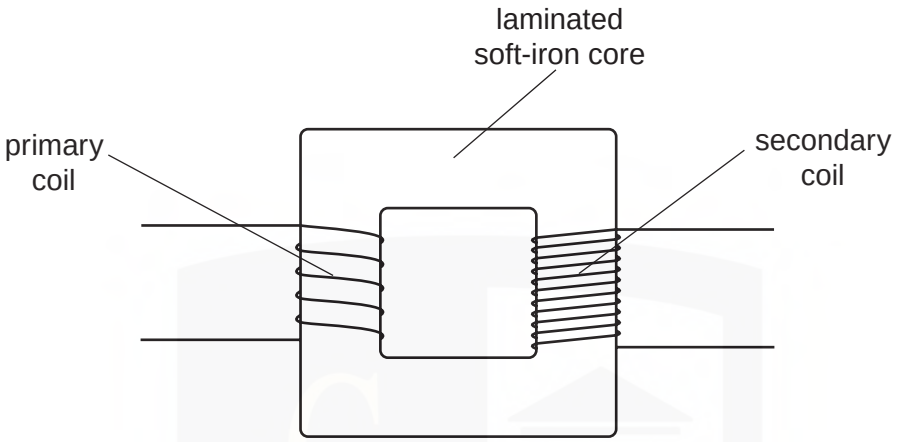

Fig. 6.1

(a) Suggest why the core is

(i) a continuous loop,

.....

..... [1]

(ii) laminated.

.....

.....

..... [2]

(b) **(i)** State Faraday's law of electromagnetic induction.

.....

.....

..... [2]

(ii) Use Faraday's law to explain the operation of the transformer.

.....

.....

.....

..... [3]

(c) State two advantages of the use of alternating voltages for the transmission and use of electrical energy.

1. .....

.....

2. .....

.....

[2]