

AC Basics

Question paper

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Alternating Currents
Sub Topic	AC Basics
Paper Type	Theory
Booklet	Question paper

Time Allowed: 52 minutes

Score: /43

Percentage: /100

CHEMISTRY ONLINE

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

- 1 (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.

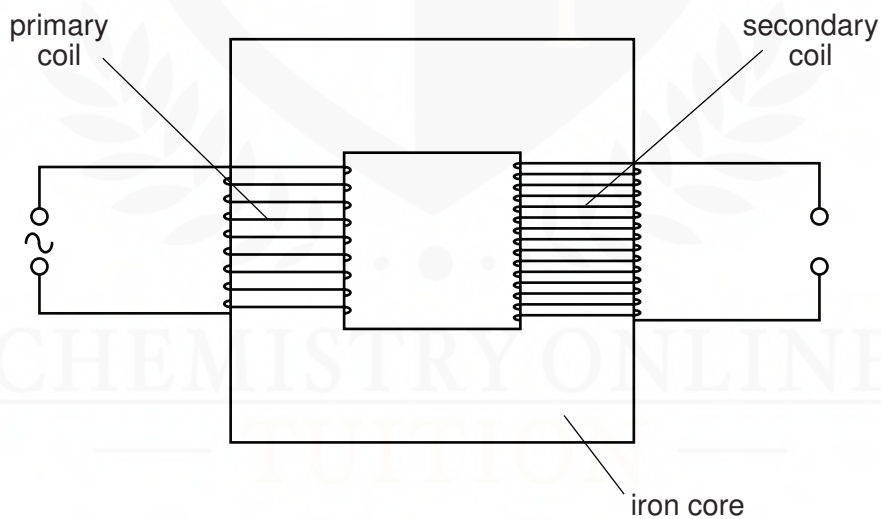


Fig. 7.1

- (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.

.....

.....

.....

.....

..... [3]



- 2 The variation with time t of the output V of an alternating voltage supply of frequency 50 Hz is shown in Fig. 6.1.

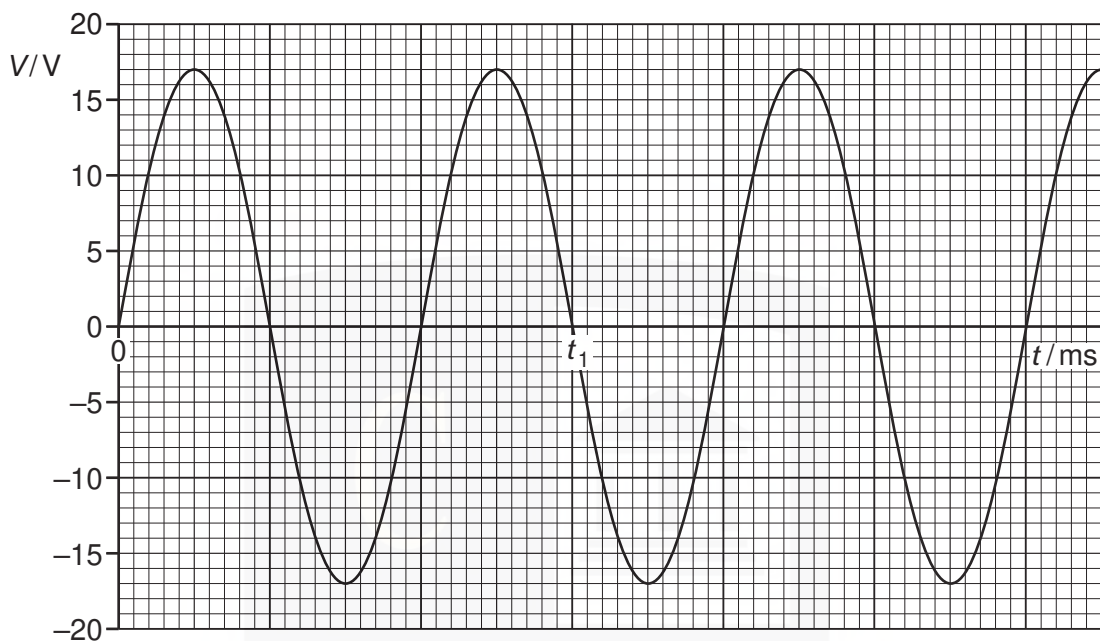


Fig. 6.1

(a) Use Fig. 6.1 to state

(i) the time t_1 ,

$$t_1 = \dots\dots\dots \text{ s [2]}$$

(ii) the peak value V_0 of the voltage,

$$V_0 = \dots\dots\dots \text{ V [1]}$$

(iii) the root-mean-square voltage V_{rms} ,

$$V_{\text{rms}} = \dots\dots\dots \text{ V [1]}$$

(iv) the mean voltage $\langle V \rangle$.

- (b) The alternating supply is connected in series with a resistor of resistance $2.4\ \Omega$. Calculate the mean power dissipated in the resistor.

power = W [2]



- 3 An alternating current supply is connected in series with a resistor R, as shown in Fig. 6.1.

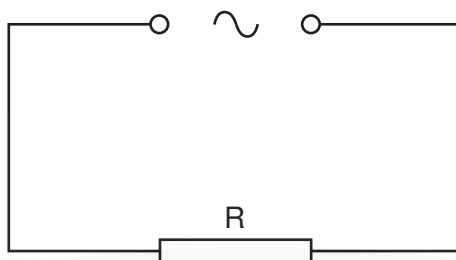


Fig. 6.1

The variation with time t (measured in seconds) of the current I (measured in amps) in the resistor is given by the expression

$$I = 9.9 \sin(380t).$$

- (a) For the current in the resistor R, determine

- (i) the frequency,

frequency = Hz [2]

- (ii) the r.m.s. current.

r.m.s. current = A [2]

- (b) To prevent over-heating, the mean power dissipated in resistor R must not exceed 400W.

Calculate the minimum resistance of R.

resistance = Ω [2]

CHEMISTRY ONLINE
— TUITION —

- 4 The variation with time t of the current I in a resistor is shown in Fig. 6.1.

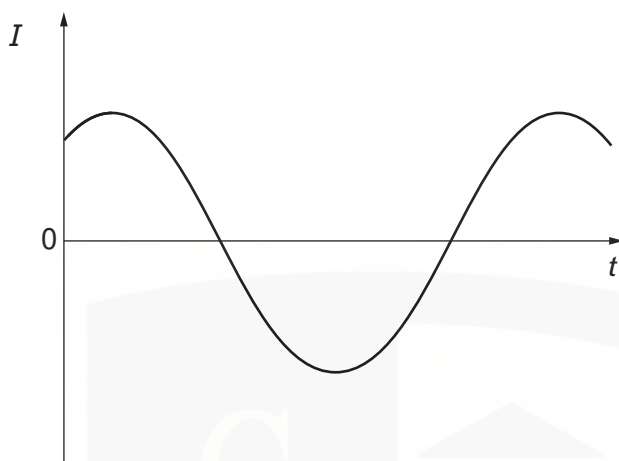


Fig. 6.1

The variation of the current with time is sinusoidal.

- (a) Explain why, although the current is not in one direction only, power is converted in the resistor.

.....
.....
..... [2]

- (b) Using the relation between root-mean-square (r.m.s.) current and peak current, deduce the value of the ratio

$$\frac{\text{average power converted in the resistor}}{\text{maximum power converted in the resistor}} .$$

ratio = [3]

- 5 (a) Explain what is meant by the *root-mean-square* (r.m.s.) value of an alternating voltage.

.....
.....
..... [2]

- (b) An alternating voltage V is represented by the equation

$$V = 220 \sin(120\pi t),$$

where V is measured in volts and t is in seconds.

For this alternating voltage, determine

- (i) the peak voltage,

peak voltage = V [1]

- (ii) the r.m.s. voltage,

r.m.s. voltage = V [1]

- (iii) the frequency.

frequency = Hz [1]

- (c) The alternating voltage in (b) is applied across a resistor such that the mean power output from the resistor is 1.5 kW.

Calculate the resistance of the resistor.

resistance = Ω [2]

- 6 (a) Explain, in terms of heating effect, what is meant by the *root-mean-square (r.m.s.) value* of an alternating current.

.....
.....
..... [2]

- (b) State the relation between the peak current I_0 and the r.m.s. current I_{rms} of a sinusoidally-varying current.

..... [1]

- (c) The value of a direct current and the peak value of a sinusoidal alternating current are equal.

- (i) Determine the ratio

$$\frac{\text{power dissipation in a resistor of resistance } R \text{ by the direct current}}{\text{power dissipation in the resistor of resistance } R \text{ by the alternating current}}$$

ratio = [2]

- (ii) State one advantage and one disadvantage of the use of alternating rather than direct current in the home.

advantage
.....

disadvantage
..... [2]

(d) A current I varies with time t as shown in Fig. 5.1.

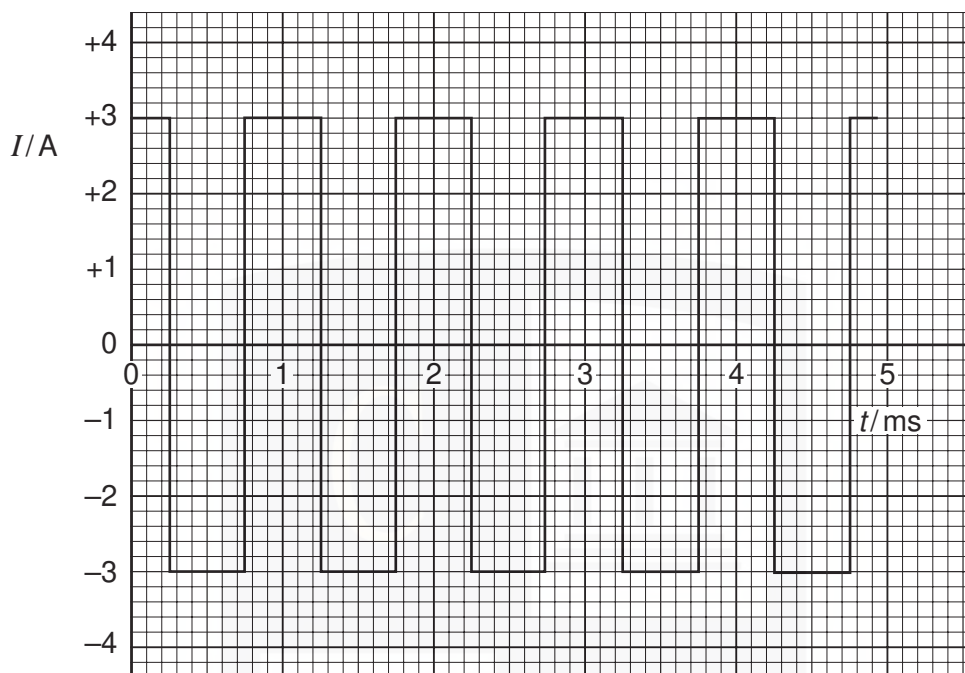


Fig. 5.1

For this varying current, state

(i) the peak value,

peak value = A [1]

(ii) the r.m.s. value.

r.m.s. value = A [1]

CHEMISTRY ONLINE
— TUITION —