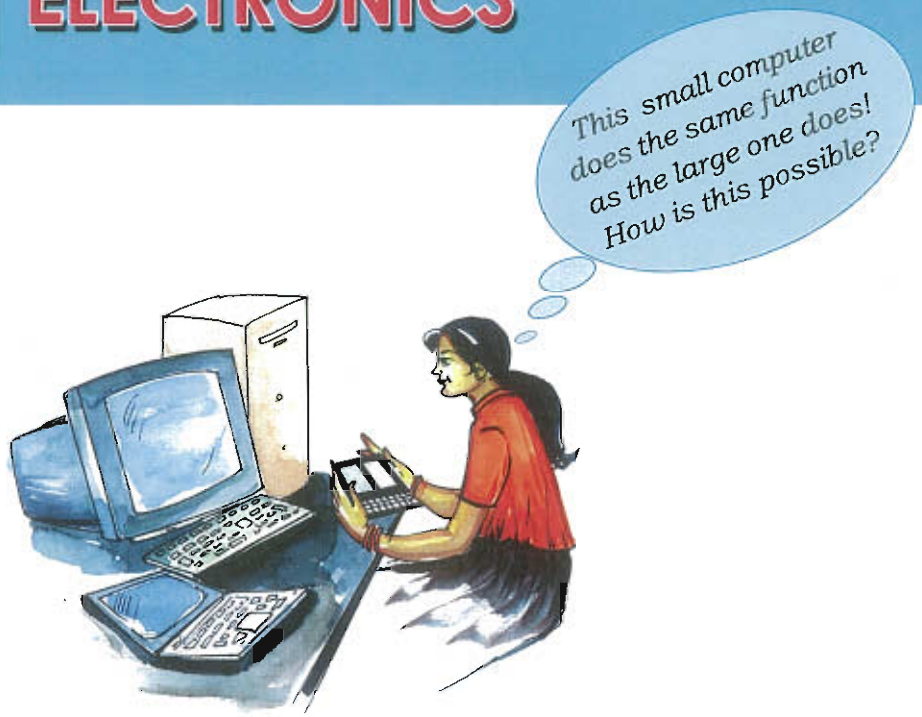
10 ELECTRONICS



Haven't you come across several devices, as shown in the figure, which have come down in size and improved in their efficiency?

Find out and list some of them.

- Radio
-

Let's examine how it was possible to reduce the size of such devices.

Open an old radio or an electronic toy or an electronic choke and examine it. With the help of Table 10.1, identify the electronic components in it and note them down.

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An electronic circuit is made by connecting such components.

Let's examine the function of each of these components in an electronic circuit.

Resistors

The function of a resistor is to supply the necessary potential difference to the components by regulating the current in a circuit. Resistance is measured in the unit ohm. Its symbol is Ω. The value of resistance is recorded directly on it or using a colour code.

Fig. 10.1
Different types of resistors

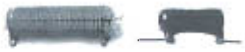
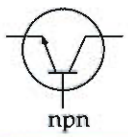
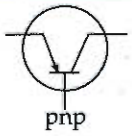
Components	Type	Figure	Symbol
1. **Resistors**	Carbon resistors		
	Wire wound resistors		
	Variable resistors		
2. **Inductors**	Fixed inductors		
	Variable inductors		
3. **Capacitors**	Fixed capacitors		
	Variable capacitors		
4. **Diodes**	Diodes		
	LED		
5. **Transistors**	npn		
	pnp		
6. **Integrated circuit (IC)**			

Table 10.1

Inductors

Inductors are coils of conducting wire which can resist variations of electric current in a circuit. The ability to resist the variation of electric current is inductance. The unit of inductance is henry (H). The practical unit is milli henry (mH).

Fig. 10.2
Different types of inductors

Haven't you studied the functions of inductors and resistors in electrical circuits?

★ Inductors and resistors are two components used in electronic circuits. What is the main difference in their functions?

Capacitors

Capacitors are components used to store electric charges and release them when necessary. A capacitor is constructed by placing a dielectric between two parallel metal plates.

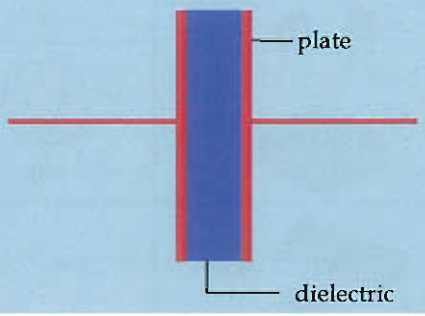


Fig. 10.3
Structure of a capacitor

The ability to store charges is its capacitance. The unit of capacitance is farad (F). But the units commonly used are microfarad (μF) or picofarad (pF).

Capacitors are commonly known by the dielectric used in them.

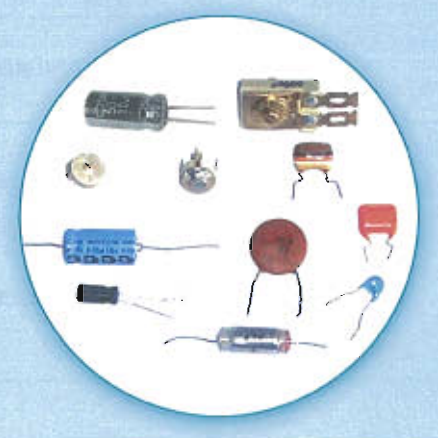


Fig. 10.4
Different types of capacitors

★ What is meant by paper capacitors?

Capacitors which use an electrolyte as a dielectric are electrolytic capacitors. In these capacitors the signs + (positive) or – (negative) will be marked near their leads. Such capacitors must be connected in a circuit strictly according to the polarity marked on their leads.

Now let's try to know the other components which have been helpful in reducing the size of electronic devices.

Semiconductors

You have understood that substances can be classified as conductors and insulators, based on their electrical conductivity. But there are substances with properties different from both of these two classes. They are semiconductors. The two main semiconductors are Germanium and Silicon.

Many electronic components are manufactured by bringing about changes in the conductivity of semiconductors by adding other elements to them. Their conductivity increases when such changes are brought about.

Diode

Fig. 10.5
Different types of diodes

See the figure of a diode and its symbol given below it in Fig.10.6.

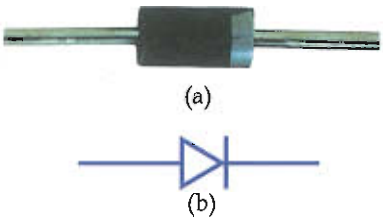


Fig. 10.6
(a) Figure of a diode
(b) The symbol of a diode

One end of a diode is marked positive and the other end, negative. A diode is to be connected to a circuit in accordance with this polarity. Isn't there a white mark on one end of the diode in the figure? This end is negative. Different types of diodes are available, the working of which ranges from high voltage and current to low voltage and current.

Now let's see how a diode works in a circuit.

Observe the two circuits given. What is the difference between them? Make a

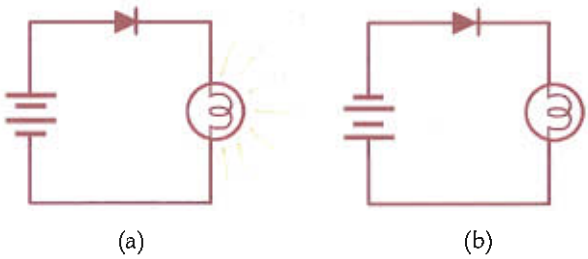


Fig. 10.7

circuit as shown in Fig. 10.7 (a) connecting two torch cells, a diode and a torch bulb in series. What do you observe?

★ Modify this circuit as shown in Fig.10.7(b). What do you observe now?

- -

★ What happens when the experiment is repeated replacing the diode with a piece of copper wire?

- -

Record the conclusion you arrived at, from these activities.

When a diode is connected in a circuit so that current flows through it, the diode is said to be forward biased and when no current flows, the diode is said to be reverse biased.

Light emitting diode (LED)

Haven't you seen light emitting from certain diodes when electric current passes through them? These diodes are made of certain semiconductor compounds. The colour of the light from

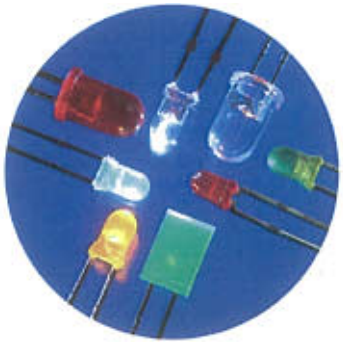


Fig. 10.8

an LED depends upon the nature of the substance used for its preparation. LEDs which emit lights of different colours like red, orange, amber, yellow, green, blue and white are available now.

Rectification

Form a circuit as shown in Fig. 10.9. T is a step down transformer. The LED is to be connected with a thin long insulated copper wire. Switch on the primary circuit of the transformer and observe the LED. What do you see? Now whirl the LED. What do you observe? Note down your observations. Why is light from the LED seen intermittently? Let's examine.

Fig. 10.10 (a) is a graphic representation of the AC given to the diode. Fig. 10.10 (b) represents the output voltage from this circuit.

Note down the peculiarities of the output voltage analysing figures 10.10 (a) and (b).

You have seen that the diode has converted the AC into a unidirectional electric current, haven't you? This is rectification. A device which makes this possible is a rectifier.

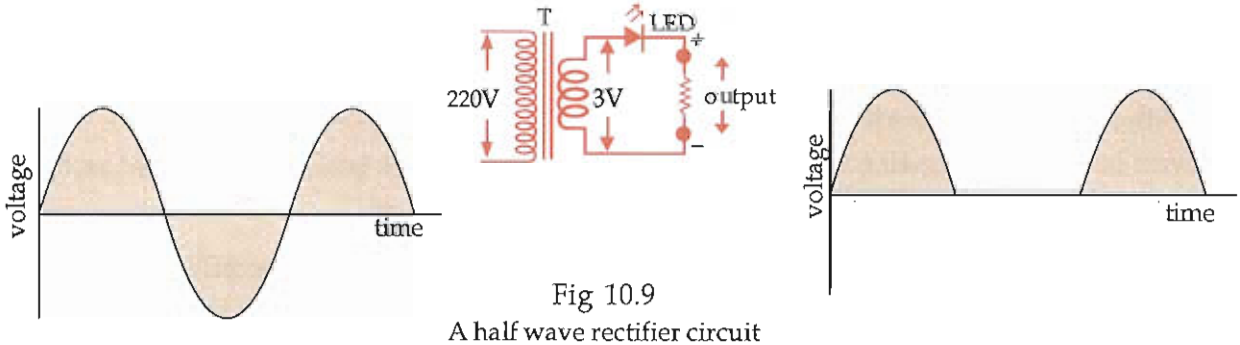


Fig 10.9
A half wave rectifier circuit

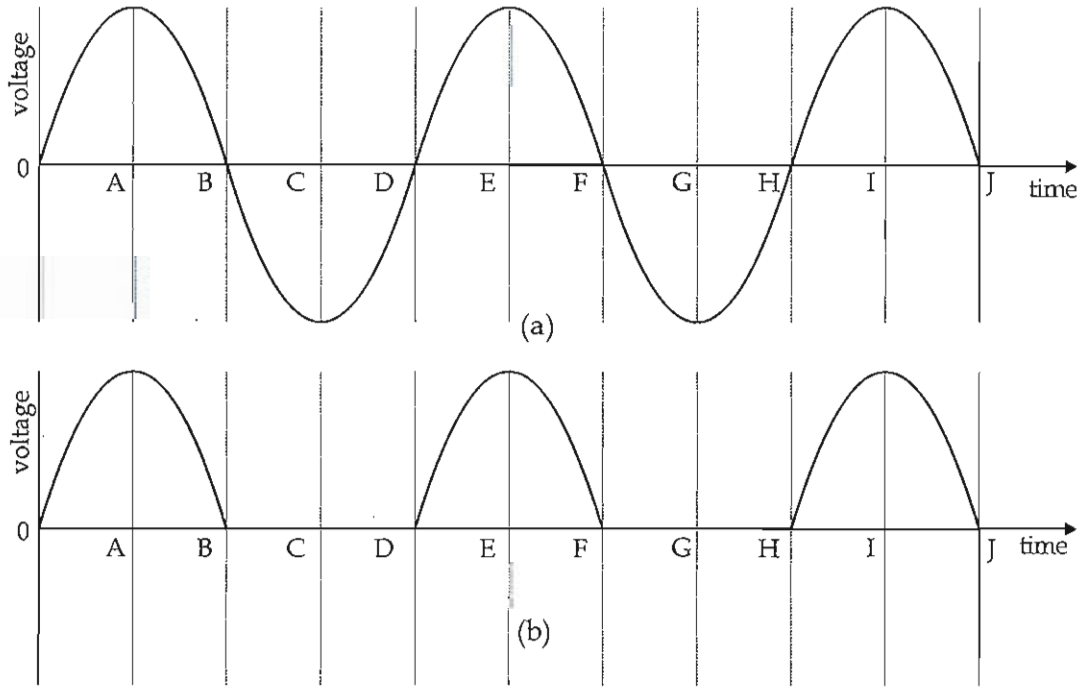
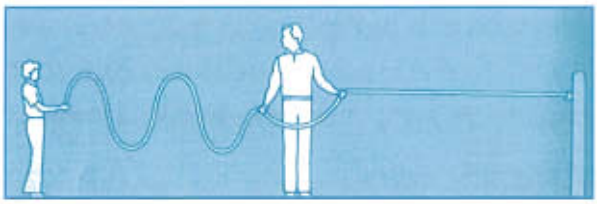


Fig 10.10
(a) Graph of voltage from an AC source (b) Graph of output voltage from a rectifier



Rectification - a symbolic representation
Fig. 10.11

The rectifier depicted in Fig .10. 9 is called half wave rectifier. Why is it called so? Discuss and record.

Can you now say why the LED glowed intermittently?

What are the similarities and dissimilarities between the electric current depicted in Fig. 10. 10 (b) and that from a battery? Note them down in your science diary.

Full wave rectifier

Haven't you understood certain facts about a half wave rectifier? Is the electricity obtained after rectification continuous? Why is its continuity lost?

Let's see whether we can retrieve the lost part of electricity which made it discontinuous. Observe Fig. 10.12.

What will be the voltage at end B of the secondary of the transformer when the end A is +3V ? Tap a connection C from the centre of the secondary (Fig. 10. 13) of such a transformer. Assume that the voltage at C is zero. Then what will be the voltage at the end A in relation to that at C? And at the end B?

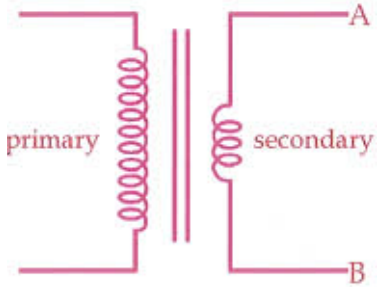


Fig. 10.12

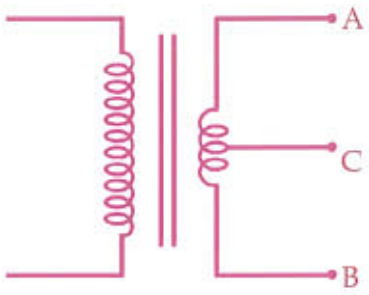


Fig. 10.13

Now observe the circuit in Fig.10.14. Which diode will be in forward bias when the end A is positive and B, negative? And when B is positive and A, negative?

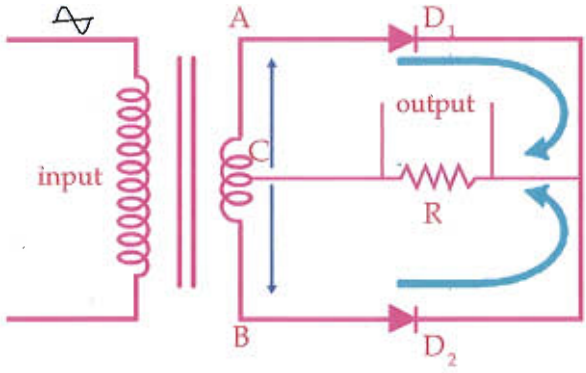


Fig. 10.14

When D_1 is in forward bias, does the current flowing through D_1 reach terminal B or terminal C? Why?

When D_2 is in forward bias how will the flow of current be? Now draw the graph of the current through resistance R.

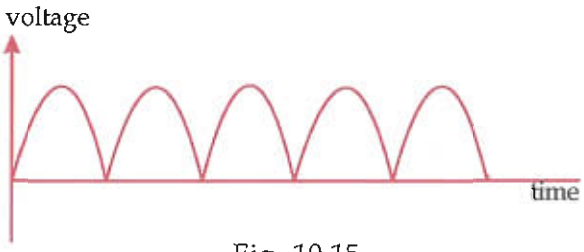


Fig. 10.15

Thus a full wave rectifier is one which is arranged to allow the AC to flow continuously in one direction through it.

Transistors

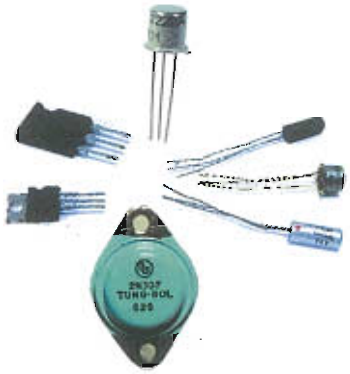


Fig. 10.16
Transistors

You have now understood the working of a diode. A transistor is another electronic component made of semiconductors. They have three terminals. Depending on the peculiarity of the substance and the method used for their manufacture, there are hundreds of types of transistors. These transistors are used to perform different functions in different electronic circuits.

Amplification

You have understood the working of a microphone in the last chapter. The electrical oscillations obtained from a microphone corresponding to the sound waves are called sound signals. These signals are not powerful enough to make the voice coil of a loudspeaker vibrate. Hence the signals from a microphone are to be strengthened. Amplification is the process of increasing the strength of electrical signals.

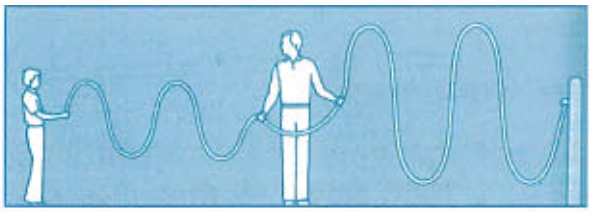


Fig. 10.17
Amplifier- a symbolic representation

Observe Fig.10.19. Do you find any difference in the number of cycles formed in a fixed time interval before and after the amplification? What conclusion can be arrived at from this?

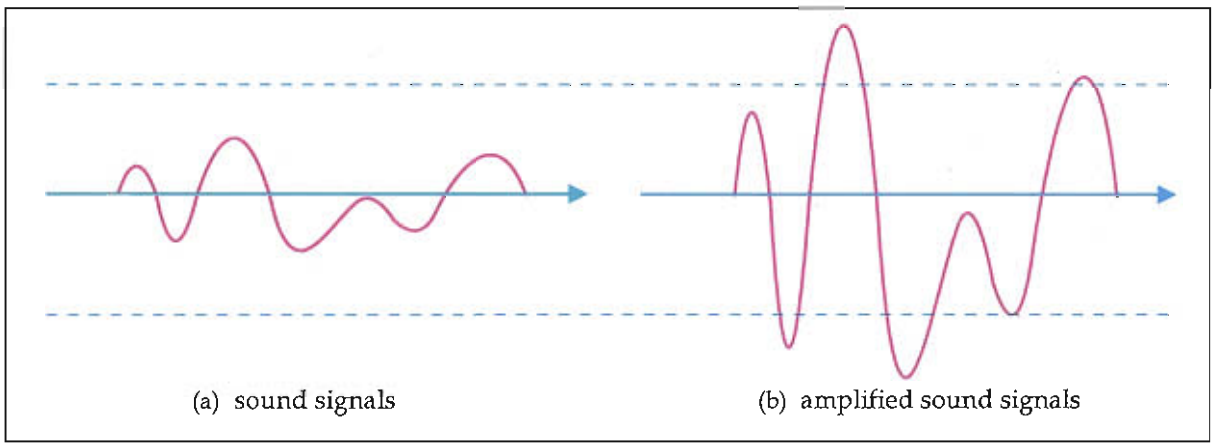


Fig. 10.18
Amplification of sound signals

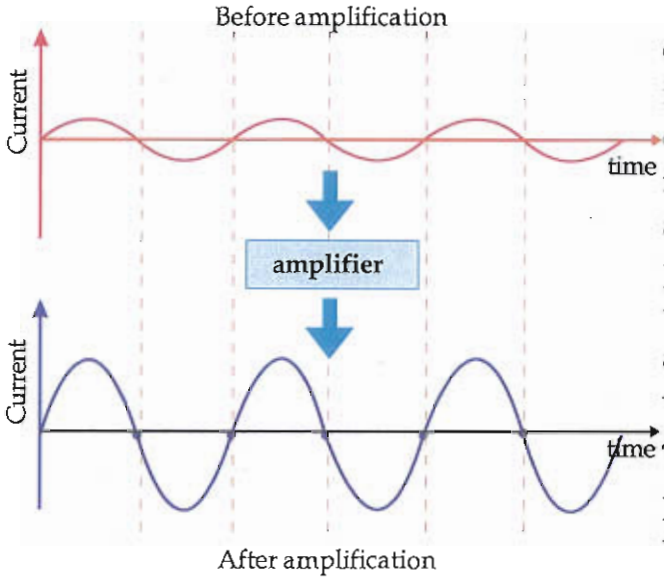
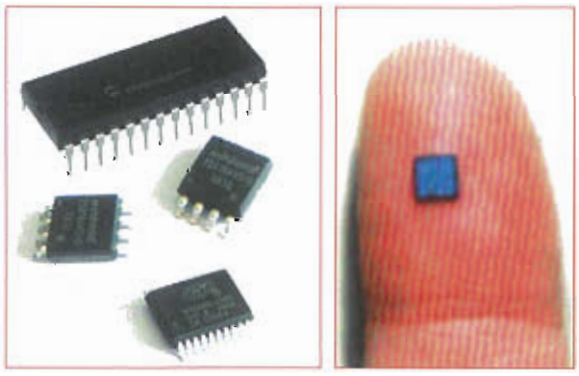


Fig. 10.19

Integrated circuits

You have familiarised yourselves with components like the resistor, capacitor, transistor and diode, used in an electronic circuit. In a complex electronic circuit, thousands of such components are likely to be used. Just imagine the size of the circuit in such a situation! However, using modern technology it has become possible to make small semiconductor chips with lakhs of such components suitably linked in them. Such a device is an integrated circuit or IC.



(a) (b)

Fig. 10.20
(a) Different types of ICs (b) The size of an IC compared to the size of the thumb

Do you know that the first electronic computer needed a huge building for its installation? And today? Pocket computers are easily available in the market. This has been achieved with the advent of integrated circuits. The processor which can be called the brain of the computer is an integrated circuit. There are millions of transistors crammed in a very small processor chip.

The number of transistors integrated in the processor 8008 which came out in 1972 was 3500. Ten years later, in 1982, came out the processor 80286, in which the number of transistors integrated was 134000. Again, ten years later in 1993, the 'Pentium' processor containing 31 lakh transistors reached the market. The size is still the same! In 2002, the processor 'Pentium- 4' which contained 550 lakh transistors found a place in the market. And today? Do you know the number of transistors integrated in 'core i7' processor of March 2010? 170 crores! From this you can understand how the size of the electronic equipment decreases.

Fig. 10.21

1. Select the correct statement from the following.

   The unit of inductance is

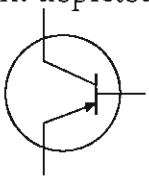
   (a) ohm

   (b) farad

   (c) henry

   (d) ampere

2. What is the electronic component depicted in the figure?



   (a) diode

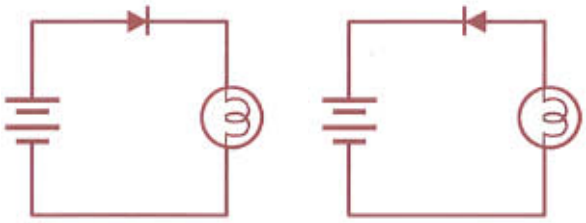
   (b) light emitting diode

   (c) npn transistor

   (d) pnp transistor

3. (a) What is meant by forward biasing of a diode?

   (b) Which of the following diagrams represent a diode in forward biasing?

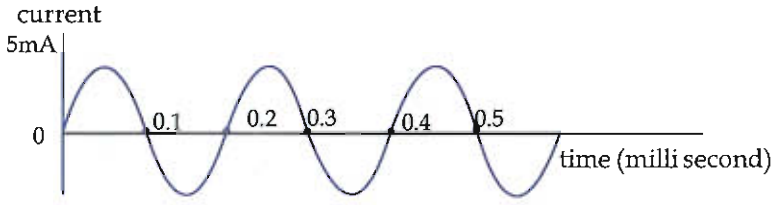


(a) (b)

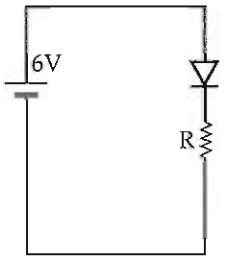
4. (a) What is the function of an amplifier?

   (b) Which is the component that performs this function in an amplifier?

5. The figure represents the graph of a current signal given to the input of a current amplifier. If the amplifier amplifies the current 10 times, draw the time-current graph of the output.



6. What change occurs in the function of the rectifier when one of the diodes of a centretap fullwave rectifier is removed from the circuit?



7. The diode shown in the circuit has a resistance of 5 Ω when forward biased. If the maximum current that can be passed through the diode is 200 mA, what is the value of resistance R?

8. (a) What is an integrated circuit?

   (b) What is the electronic component that cannot be integrated?

   (c) Write a short note to show how integrated circuits help to reduce the size of an electronic equipment .

9. What are the limitations of a centretap full wave rectifier? Using four similar diodes and the full voltage of the secondary of a transformer, a full wave rectifier can be constructed. This is a bridge rectifier. Construct a bridge rectifier , measure its output and note it down.