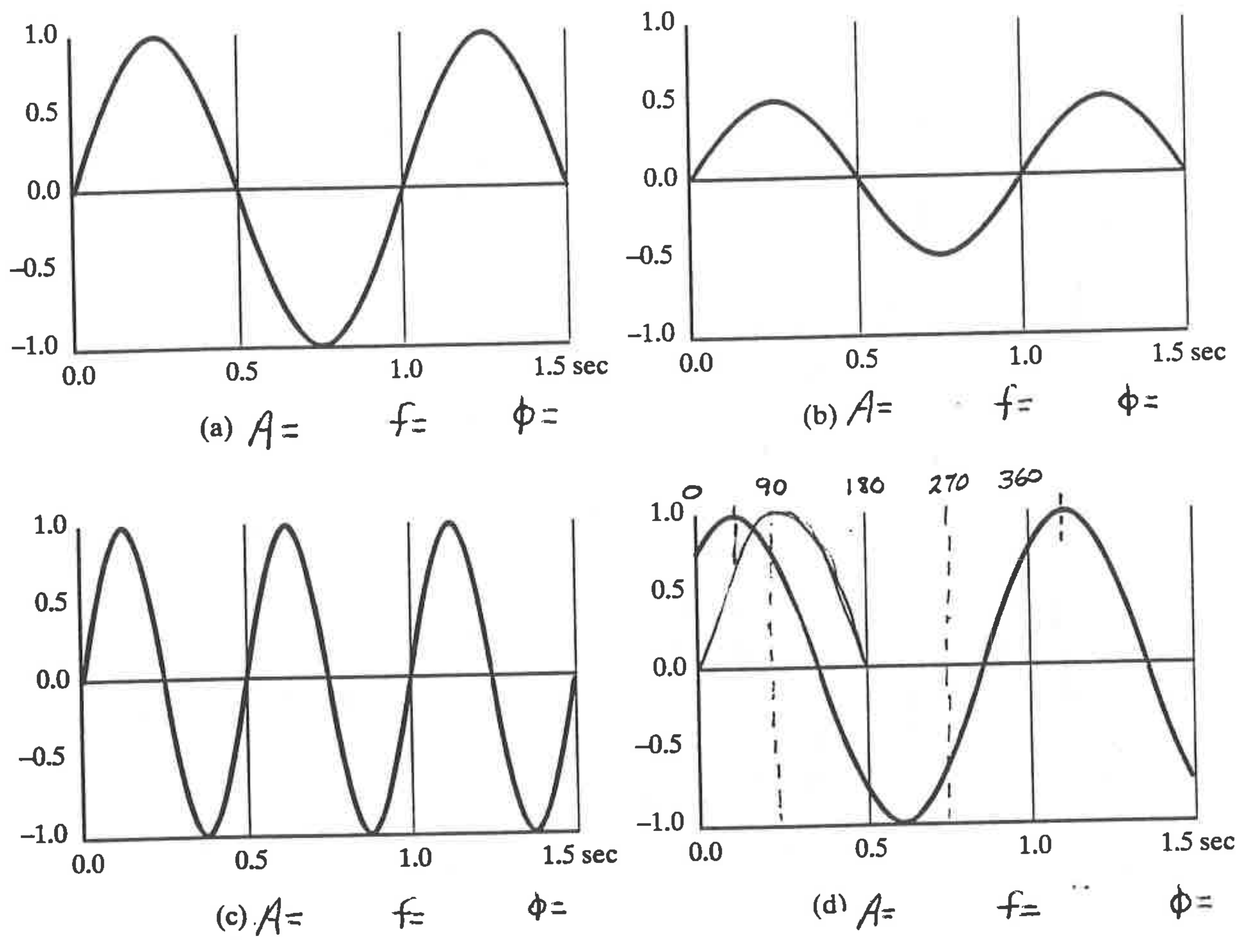

FIGURE 4.4 A sin($2\pi ft + \phi$).

- The period of the total signal is equal to the period of the fundamental frequency. The period of the component $\sin(2\pi f_1 t)$ is $T = 1/f_1$, and the period of $s(t)$ is also T, as can be seen from Figure 4.5c.

By adding together enough sinusoidal signals, each with the appropriate amplitude, frequency, and phase, any electromagnetic signal can be constructed. Put another way, any electromagnetic signal can be shown to consist of a collection of periodic analog signals (sine waves) at different amplitudes, frequencies, and phases. The importance of being able to look at a signal from the frequency perspective (frequency domain) rather than a time perspective (time domain) should become clear as the discussion proceeds.

Spectrum
Refers to an absolute, contiguous range of frequencies.

Bandwidth
The difference between the limiting frequencies of a

Several more terms need to be introduced. The **spectrum** of a signal is the range of frequencies that it contains. For the signal of Figure 4.5, the spectrum extends from f_1 to $3f_1$. The **bandwidth** of a signal is the width of the spectrum. In our example, the bandwidth of the signal is $2f_1$.

There is a direct relationship between the information-carrying capacity of a signal and its bandwidth: The greater the bandwidth, the higher the information-carrying capacity. As a very simple example, consider the square wave of Figure 4.3b. Suppose that we let a positive pulse represent binary 1 and a negative