 (12) (12) is needed to be done

Frequency and angular frequency

The frequency f of s.h.m. is equal to the number of oscillations per unit time. As we saw earlier, f is related to the period T by

$$f = \frac{1}{T}$$

We can think of a complete oscillation of an oscillator or a cycle of s.h.m. as being represented by 2π radians. (This is similar to a complete cycle of circular motion, where an object moves round through 2π radians.) The phase of the oscillation changes by 2π rad during one oscillation. Hence, if there are f oscillations in unit time, there must be $2\pi f$ radians in unit time. This quantity is the **angular frequency** of the s.h.m. and it is represented by the symbol ω.

The angular frequency ω is thus related to frequency f by the following equation:

$$\omega = 2\pi f$$

Since $f = \frac{1}{T}$, the angular frequency ω is related to the period T of the oscillator by the equation:

$$\omega = \frac{2\pi}{T} \qquad \text{or} \qquad T = \frac{2\pi}{\omega}$$

In Figure 5.17, a single cycle of s.h.m. is shown, but with the x-axis marked with the phase of the motion in radians.

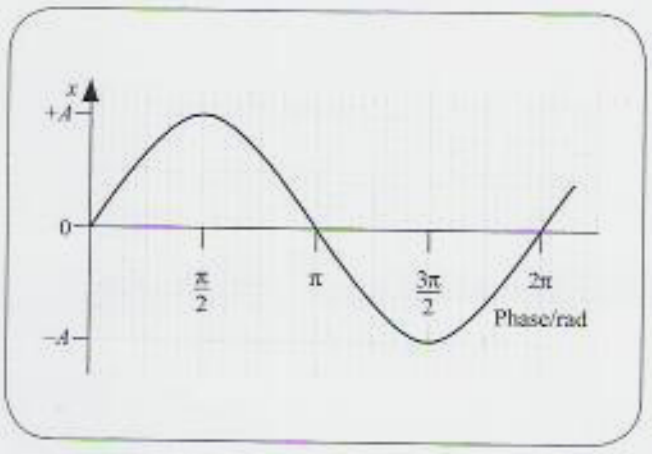

Figure 5.17 The phase of an oscillation varies from 0 to 2π during one cycle.

(Not needed)

SAQ

11 An object moving with s.h.m. goes through two complete cycles in 1.0 s. Calculate:

a the period T

b the frequency f

c the angular frequency ω.

Answer

12 Figure 5.18 shows the displacement against time graph for an oscillating mass. Use the graph to determine the following:

a amplitude

b period

c frequency

d angular frequency

e displacement at A

f velocity at B

g velocity at C.

Hint

Answer

Extension

The gradient of a displacement against time graph = to velocity
You can also use
$V_{max} = (2\pi f) A$

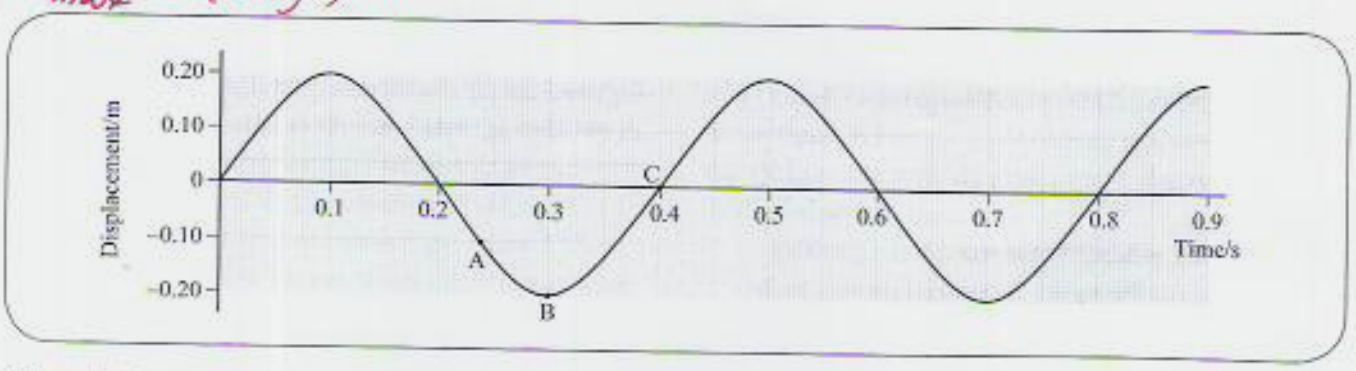

Figure 5.18 A displacement against time graph – see SAQ 12.