

8 (a) (i) Define *simple harmonic motion*.

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

(ii) A ball is hanging on an extensible cord. The ball is displaced vertically and then released. The variation with displacement  $x$  of the acceleration  $a$  of the ball is shown in Fig. 8.1.

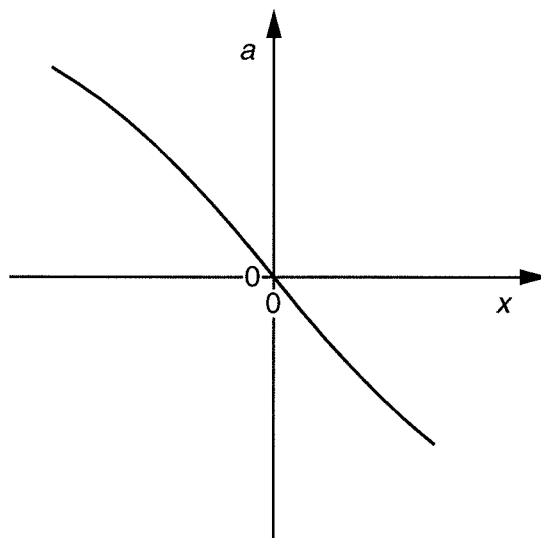


Fig. 8.1

Use Fig. 8.1 to state and explain how it can deduced that

1. the ball is oscillating,

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

2. the oscillations are not simple harmonic.

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

(b) A longitudinal sound wave is travelling through a gas causing oscillations of gas molecules that are simple harmonic.

(i) Explain what is meant by

1. a *longitudinal wave*,

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

2. the *speed of the wave*.

.....  
 .....  
 .....[1]

(ii) The gas molecules, each of mass  $5.3 \times 10^{-26}$  kg, are vibrating at a frequency of 835 Hz and have an amplitude of vibration of 610 nm.

The variation with time  $t$  of the vibrational kinetic energy  $E_K$  of a molecule is shown in Fig. 8.2.

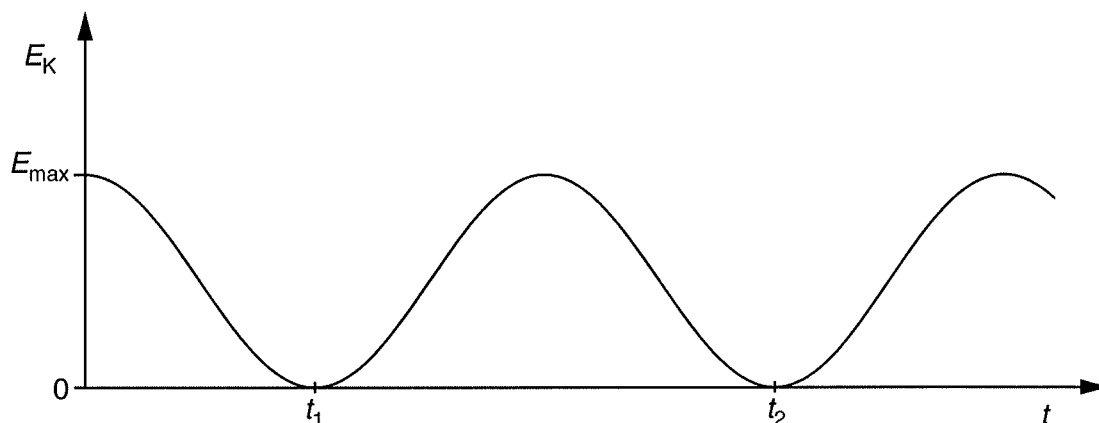


Fig. 8.2

Determine, for one vibrating molecule,

1. the period  $T$  of the vibrations,

$T =$  ..... s [2]

2. the time interval  $(t_2 - t_1)$ ,

time interval = ..... s [1]





3. the maximum speed  $v_{\max}$ ,

$$v_{\max} = \dots\dots\dots \text{ms}^{-1} [2]$$

4. the maximum vibrational kinetic energy  $E_{\max}$ .

$$E_{\max} = \dots\dots\dots \text{J} [2]$$

(iii) By reference to the speed of sound in a gas at room temperature, comment on your answer in (ii)3.

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

(c) For the sound wave in the gas, state the origin of

(i) the energy of the wave,

.....  
 .....[1]

(ii) the restoring force on a molecule as it vibrates.

.....  
 .....[1]

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