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.
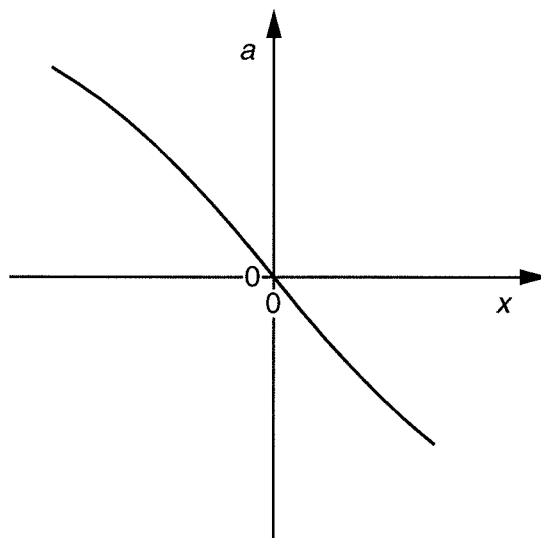

Fig. 8.1

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 5.3×10^{-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.
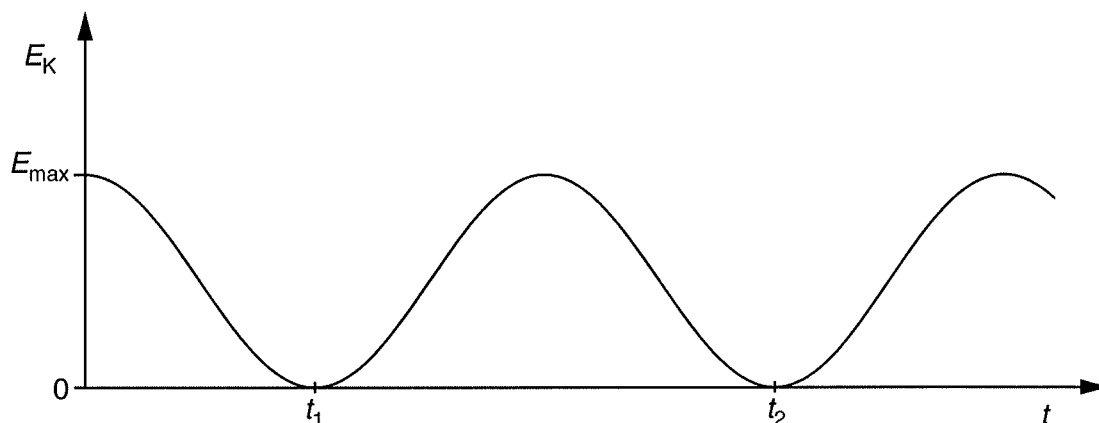

Fig. 8.2

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]

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3. the maximum speed v_{max},

$$v_{max} = \text{...} \ m\,s^{-1} \ [2]$$

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

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

(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]