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.

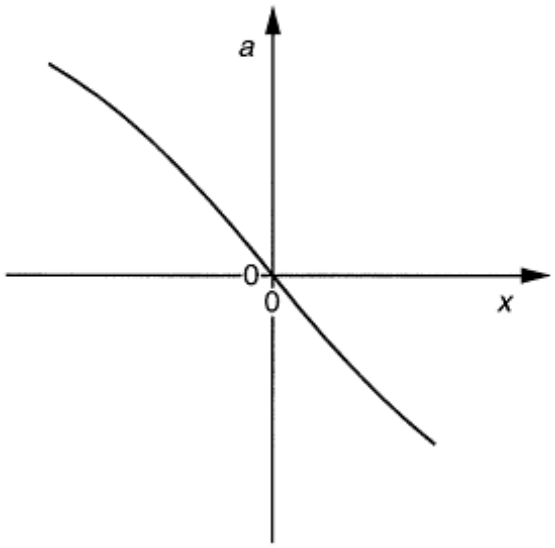

Fig. 8.1

Use Fig. 8.1 to state and explain how it can be 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 820 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.

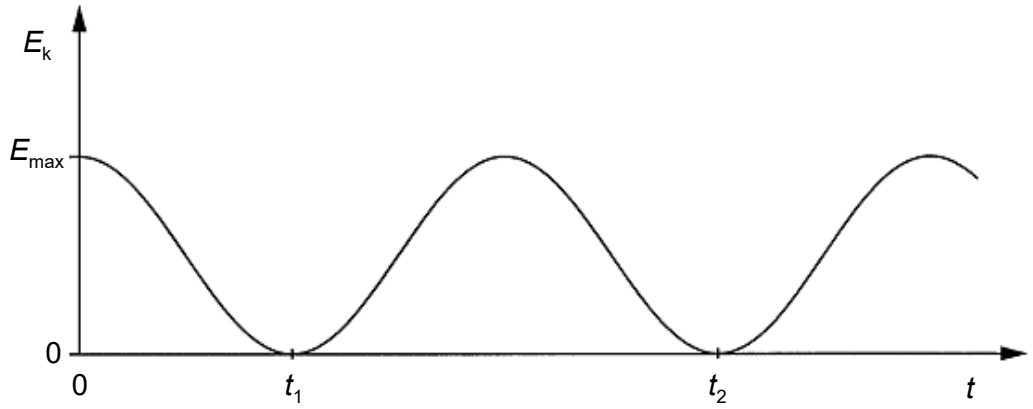

Fig. 8.2

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} = ... m s^{-1} [2]

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

E_{max} = ... 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]