

- 4 (a) A mass is undergoing oscillations in a vertical plane.

The variation with displacement  $x$  of the acceleration  $a$  of the mass is shown in Fig. 4.1.

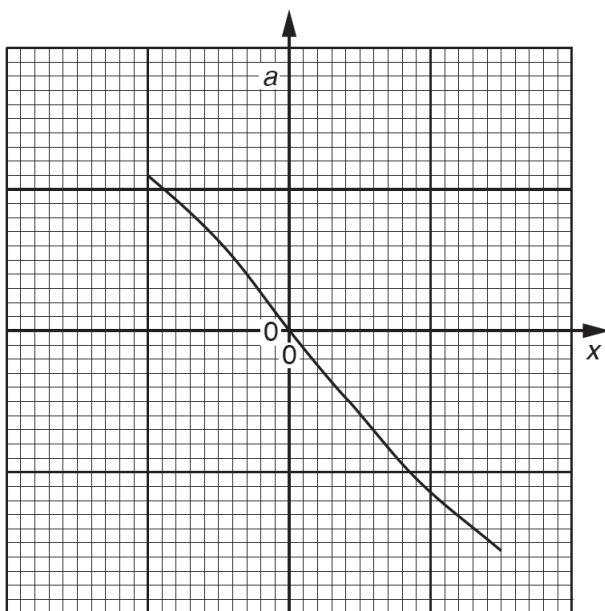


Fig. 4.1

Use Fig. 4.1 to state two reasons why the oscillations are not simple harmonic.

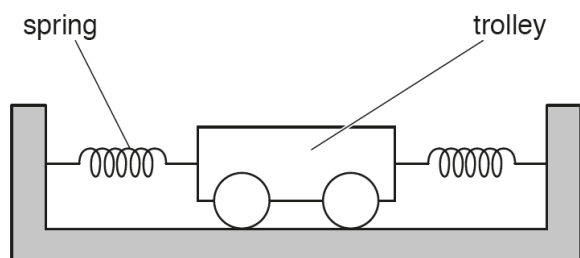
1. ....  
.....

.....

2. ....  
.....

.....[2]

- (b) To illustrate simple harmonic motion, a student attaches a trolley to two similar stretched springs as shown in Fig. 4.2.



**Fig. 4.2**

The trolley has mass  $m$  of 810 g.

The trolley is displaced along the line joining the two springs and then released. The subsequent acceleration  $a$  of the trolley is given by the expression

$$a = -\frac{2kx}{m}$$

where the spring constant  $k$  for each of the springs is  $64 \text{ N m}^{-1}$  and  $x$  is the displacement of the trolley.

- (i) Show that the frequency of oscillation of the trolley is 2.0 Hz. [2]

- (ii) The maximum displacement of the trolley is 1.6 cm.  
Calculate the maximum speed of the trolley.

maximum speed = .....  $\text{m s}^{-1}$  [2]

- (iii) As the trolley passes the position where  $x = 0$  cm, a mass is dropped vertically from a small height above the trolley and sticks to the trolley.

State and explain the change, if any, that occurs in the maximum speed and in the amplitude of the subsequent oscillations of the trolley.

speed .....

.....[2]

amplitude.....

.....[2]