2 **(a)** The defining equation of simple harmonic motion is

$$a = -\omega^2 x.$$

(i) Identify the symbols in the equation.

a .....

ω .....

x .....

(ii) State the significance of the negative (–) sign in the equation.

.....

.....

[3]

(b) A frictionless trolley of mass m is held on a horizontal surface by means of two similar springs, each of spring constant k. The springs are attached to fixed points as illustrated in Fig. 2.1.

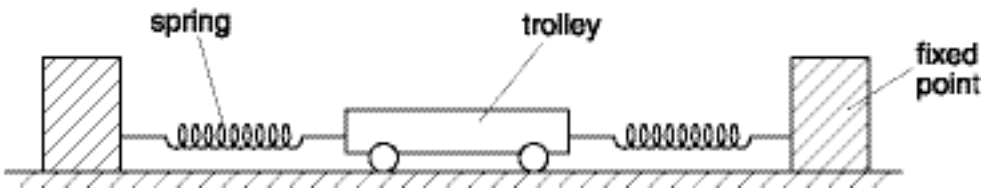

Fig. 2.1

When the trolley is in equilibrium, the extension of each spring is e.

The trolley is then displaced a small distance x to the right along the axis of the springs. Both springs remain extended.

(i) Show that the magnitude F of the restoring force acting on the trolley is given by

$$F = 2kx.$$

[2]

(ii) The trolley is then released. Show that the acceleration a of the trolley is given by

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

[2]

(iii) The mass m of the trolley is 900 g and the spring constant k is 120 N m^{-1}. By comparing your answer to **(a)(i)** and the equation in **(b)(ii)**, determine the frequency of oscillation of the trolley.

frequency = …….…….. Hz [3]

(c) Suggest why the trolley in **(b)** provides a simple model for the motion of an atom in a crystal.

.....

.....

..... [2]

[Turn over