

- 4 (a) State two conditions necessary for a mass to be undergoing simple harmonic motion.

1. ....

2. ....

[2]

- (b) A trolley of mass 950 g is held on a horizontal surface by means of two springs attached to fixed points P and Q, as shown in Fig. 4.1.

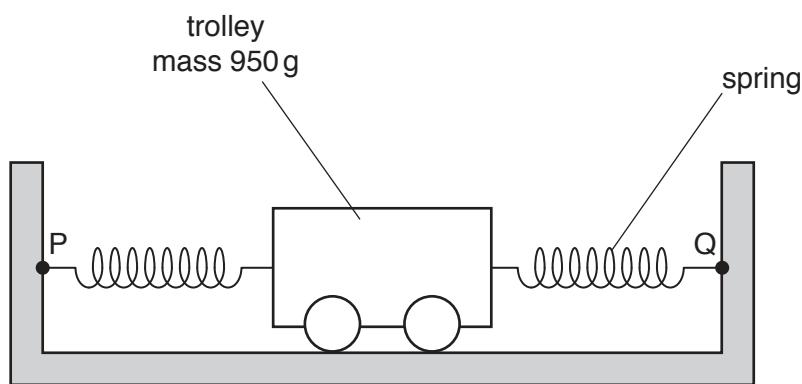


Fig. 4.1

The springs, each having a spring constant  $k$  of  $230 \text{ N m}^{-1}$ , are always extended.

The trolley is displaced along the line of the springs and then released.

The variation with time  $t$  of the displacement  $x$  of the trolley is shown in Fig. 4.2.

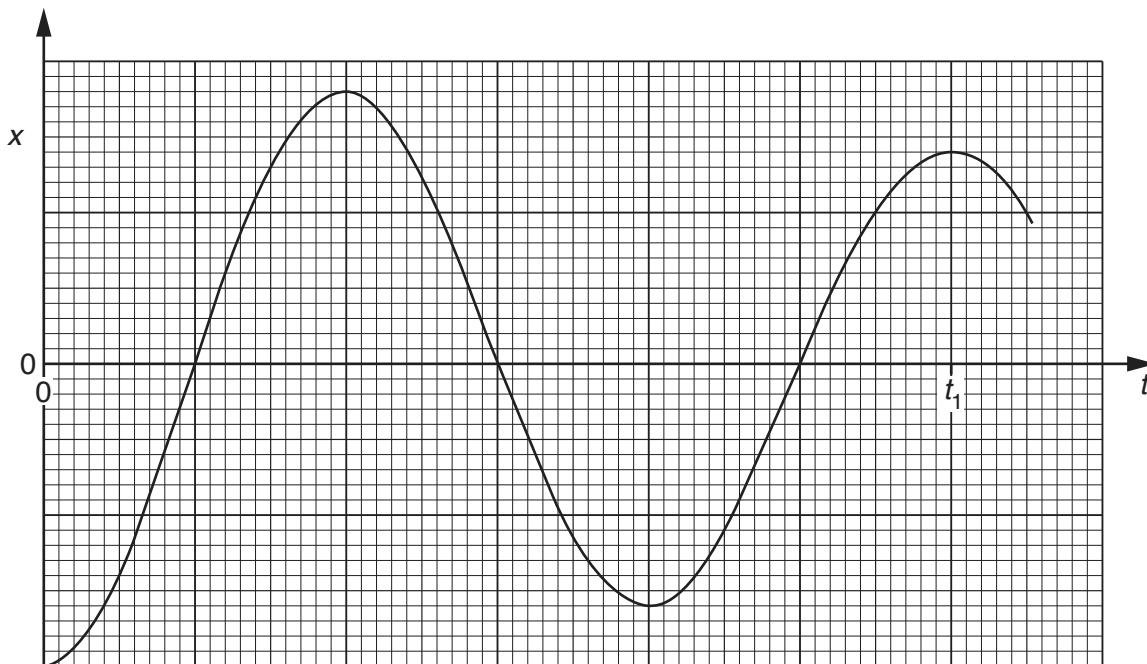


Fig. 4.2

- (i) 1. State and explain whether the oscillations of the trolley are heavily damped, critically damped or lightly damped.

.....  
.....

2. Suggest the cause of the damping.

.....  
.....  
.....

[3]

- (ii) The acceleration  $a$  of the trolley of mass  $m$  may be assumed to be given by the expression

$$a = -\left(\frac{2k}{m}\right)x.$$

1. Calculate the angular frequency  $\omega$  of the oscillations of the trolley.

$$\omega = \dots \text{ rad s}^{-1} [3]$$

2. Determine the time  $t_1$  shown on Fig. 4.2.

$$t_1 = \dots \text{ s} [2]$$

[Total: 10]