

Revision Sheet

A-Level Physics · Unit 17 Oscillations

6 vocabulary items · 34 marks of exam questions (4 questions)

Part 1 · Vocabulary review (6 items). The terms this unit is examined on most. Mark it yourself from the answer key.

Section A · Chinese to English

Write the English word.

1.

[1]
2.

[1]
3.

[1]
4.

[1]
5.

[1]
6.

[1]

Part 2 · Exam questions (34 marks, 4 questions) begins on the next page. They are ordered easy to difficult and none of them has been set before.

- 7 A pendulum consists of a bob (small metal sphere) attached to the end of a piece of string. The other end of the string is attached to a fixed point. The bob oscillates with small oscillations about its equilibrium position, as shown in Fig. 4.1.

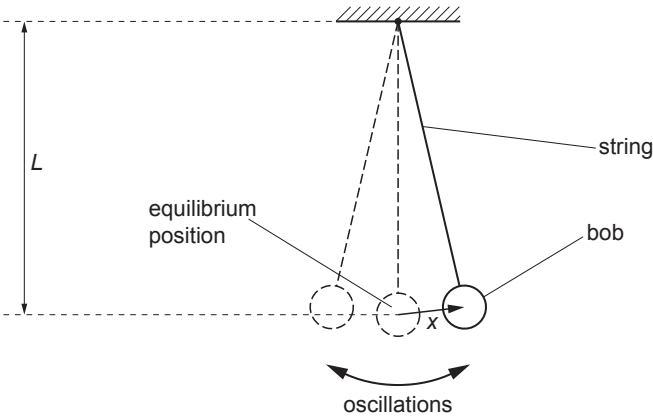


Fig. 4.1 (not to scale)

The length L of the pendulum, measured from the fixed point to the centre of the bob, is 1.24 m.

The acceleration a of the bob varies with its displacement x from the equilibrium position as shown in Fig. 4.2.

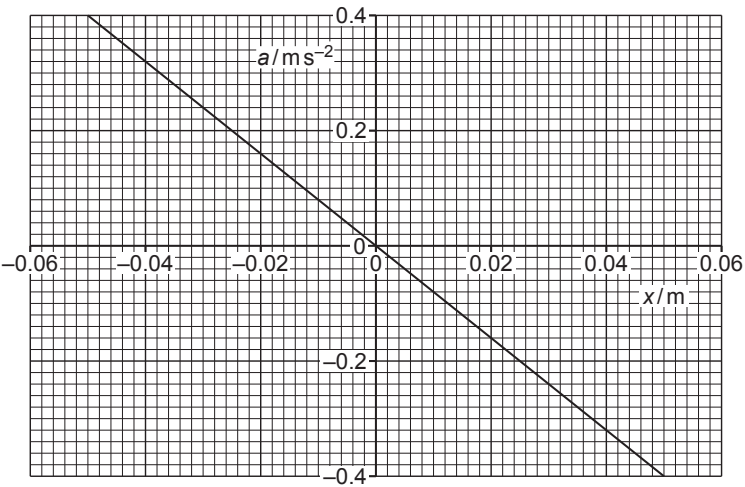


Fig. 4.2

(a) State how Fig. 4.2 shows that the motion of the pendulum is simple harmonic.

[2]

(b) (i) Use Fig. 4.2 to determine the angular frequency ω of the oscillations.

$\omega =$ rad s^{-1} [2]

(ii) The angular frequency ω is related to the length L of the pendulum by

$$\omega = \sqrt{\frac{k}{L}}$$

where k is a constant.

Use your answer in (b)(i) to determine k . Give a unit with your answer.

$k =$ unit [2]

(c) While the pendulum is oscillating, the length of the string is increased in such a way that the total energy of the oscillations remains constant.

Suggest and explain the qualitative effect of this change on the amplitude of the oscillations.

[2]

8 (a) State what is meant by *simple harmonic motion*.

[2]

(b) A trolley of mass m is held on a horizontal surface by means of two springs. One spring is attached to a fixed point P. The other spring is connected to an oscillator, as shown in Fig. 3.1.

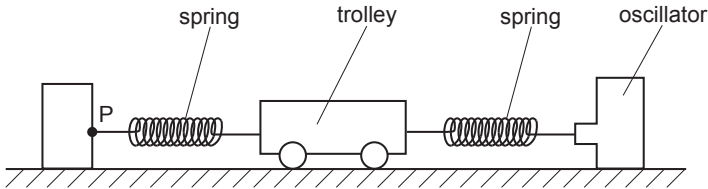


Fig. 3.1

The springs, each having spring constant k of 130 N m^{-1} , are always extended.

The oscillator is switched off. The trolley is displaced along the line of the springs and then released. The resulting oscillations of the trolley are simple harmonic.

The acceleration a of the trolley is given by the expression

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

where x is the displacement of the trolley from its equilibrium position.

The mass of the trolley is 840 g .

Calculate the frequency f of oscillation of the trolley.

$f =$ Hz [3]

(c) The oscillator in (b) is switched on. The frequency of oscillation of the oscillator is varied, keeping its amplitude of oscillation constant.

The amplitude of oscillation of the trolley is seen to vary. The amplitude is a maximum at the frequency calculated in (b).

(i) State the name of the effect giving rise to this maximum.

..... [1]

(ii) At any given frequency, the amplitude of oscillation of the trolley is constant.

Explain how this indicates that there are resistive forces opposing the motion of the trolley.

.....
.....
..... [2]

[Total: 8]

9 (a) The defining equation of simple harmonic motion is

$a = - \omega^2 x.$

State the significance of the minus (–) sign in the equation.

.....
..... [1]

(b) A trolley rests on a bench. Two identical stretched springs are attached to the trolley as shown in Fig. 4.1. The other end of each spring is attached to a fixed support.

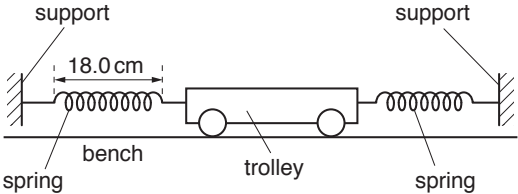


Fig. 4.1

The unstretched length of each spring is 12.0 cm. The spring constant of each spring is 8.0 N m⁻¹. When the trolley is in equilibrium the length of each spring is 18.0 cm.

The trolley is displaced 4.8 cm to one side and then released. Assume that resistive forces on the trolley are negligible.

(i) Show that the resultant force on the trolley at the moment of release is 0.77 N.

(ii) The mass of the trolley is 250 g.

Calculate the maximum acceleration a of the trolley.

$a = \text{.....} \text{ ms}^{-2}$ [1]

(iii) Use your answer in (ii) to determine the period T of the subsequent oscillation.

$T = \text{.....} \text{ s}$ [3]

(iv) The experiment is repeated with an initial displacement of the trolley of 2.4 cm.

State and explain the effect, if any, this change has on the period of the oscillation of the trolley.

.....

.....

..... [2]

[Total: 9]

10 A block of mass m oscillates vertically on a spring, as shown in Fig. 4.1.

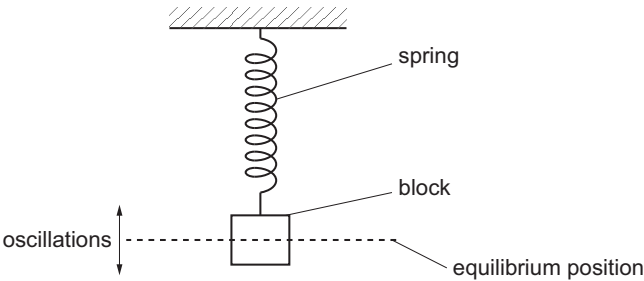


Fig. 4.1

The acceleration a of the block varies with displacement x from its equilibrium position, as shown in Fig. 4.2.

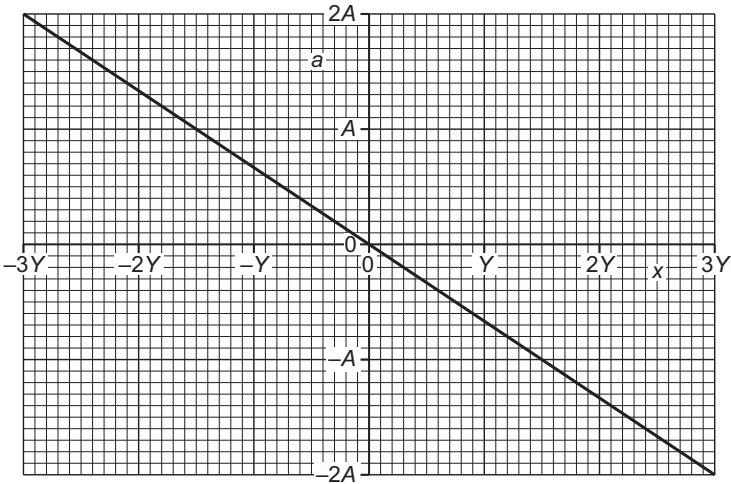


Fig. 4.2

The amplitude of the oscillations is $3Y$ and the maximum acceleration is $2A$.

(a) Explain how Fig. 4.2 shows that the oscillations of the block are simple harmonic.

.....

.....

..... [2]



(b) Deduce expressions, in terms of some or all of m , A and Y , for:

(i) the angular frequency ω of the oscillations

$\omega = \dots\dots\dots$ [1]

(ii) the maximum speed v_0 of the oscillations

$v_0 = \dots\dots\dots$ [2]

(iii) the energy E of the oscillations.

$E = \dots\dots\dots$ [2]

(c) The period of the oscillations is 0.75 s and the value of $3Y$ is 1.8 cm.

Determine an expression for x in terms of time t , where x is in cm and t is in seconds.

$x = \dots\dots\dots$ [2]

[Total: 9]