Oscillators

Questions

Here is the displacement–time graph of an oscillator.



1. Consider the speed of the oscillator at the four times labelled *A*, *B*, *C*, and *D*. Arrange the times *A*, *B*, *C*, *D* in order of decreasing speed.

2. How does the velocity at time *B* compare with that at time *E*?

3. How does the velocity at time *D* compare with that at time *F*?

4. At which of the times 0 to *F* is the acceleration at its largest value?

5. At which of the times 0 to *F* is the displacement equal in size to the amplitude of the motion?

6. Consider the time intervals 0–*B*, 0–*D*, 0–*F*, *B*–*E*, *D*–*F*. If the periodic time of the oscillator is *T*, write down each interval in terms of *T*. (0–*F* = 3 *T* is the sort of answer expected, though this particular answer would be wrong.)

Here are three things which would oscillate in a laboratory on Earth.

(a)



(b)



(c)



7. Which, if any, would oscillate in a spacecraft going at steady speed a long way from the Earth and from any planet or star?

Explain your answer.

Sketch a large displacement–time graph for two periods of a simple harmonic motion.

8. Mark with M any instant where the speed is a maximum

9. Mark with Z any instant when the speed is zero.

10. Mark places where the acceleration is high H and where it is low L.

Answer each of the following, giving reasons:

11. Does a tuning fork, used by musicians, vibrate with simple harmonic motion?

12. Is the bouncing of a ball a simple harmonic motion?

13. If a pendulum were taken to the top of a mountain, would it gain or lose time?

4.4 - Energy and pendulums

Questions

A body of mass 100 g undergoes simple harmonic motion with amplitude of 20 mm. The maximum force which acts upon it is 0.05 N. Calculate:

1. Its maximum acceleration.

2. Its period of oscillation.

A baby in a ‘baby bouncer’ is a real-life example of a mass-on-spring oscillator. The baby sits in a sling suspended from a stout rubber cord, and can bounce himself up and down if his feet are just in contact with the ground. Suppose a baby of mass 5.0 kg is suspended from a cord with spring constant 500 N m–1. Assume *g* = 10 N kg–1.

3. Calculate the initial (equilibrium) extension of the cord.

4. What is the value of  (= 2/*T*)?

5. The baby is pulled down a further distance, 0.10 m, and released. How long after his release does he pass through his equilibrium position?

6. What is the maximum speed of the baby?

A simple pendulum has a period of 4.2 s. When it is shortened by 1.0 m the period is only 3.7 s.

7. Without assuming a value for g, calculate the original length of the pendulum.

8. Calculate the acceleration due to gravity *g* suggested by the data.