

Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Further Mechanics

Name of the Student: _____

Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

(a) State what is meant by

(i) a free vibration,

(ii) a forced vibration.

(2)

(b) A car and its suspension can be treated as a simple mass-spring system. When four people of total weight 3000 N get into a car of weight 6000 N, the springs of the car are compressed by an extra 50 mm.

(i) Calculate the spring constant, k , of the system.

(ii) Show that, when the system is displaced vertically and released, the time period of the oscillations is 0.78 s.

(3)

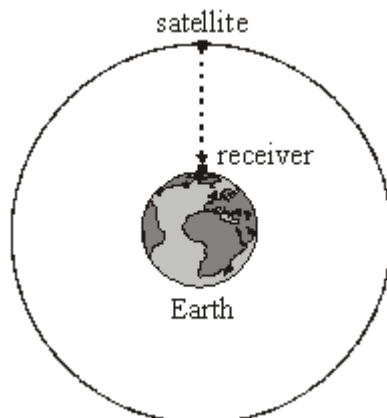
(c) The loaded car in part (b) travels at 20 m s^{-1} along a road with humps spaced 16 m apart.

(i) Calculate the time of travel between the humps.

(ii) Hence, state and explain the effect the road will have on the oscillation of the car.

Q2.

The Global Positioning System (GPS) is a system of satellites that transmit radio signals which can be used to locate the position of a receiver anywhere on Earth.



- (a) A receiver at sea level detects a signal from a satellite in a circular orbit when it is passing directly overhead as shown in the diagram above.

- (i) The microwave signal is received 68 ms after it was transmitted from the satellite. Calculate the height of the satellite.

- (ii) Show that the gravitational field strength of the Earth at the position of the satellite is 0.56 N kg^{-1} .

mass of the Earth = $6.0 \times 10^{24} \text{ kg}$
mean radius of the Earth = 6400 km

(4)

- (b) For the satellite in this orbit, calculate

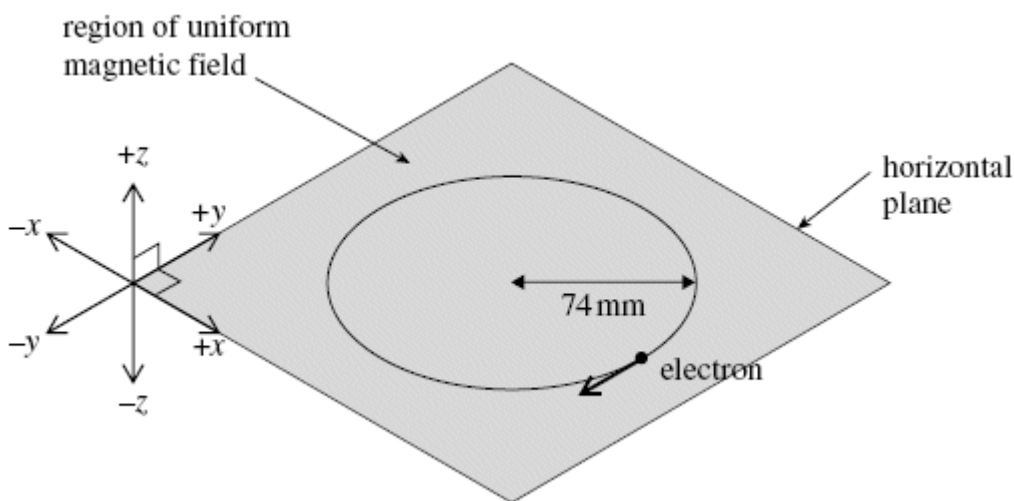
- (i) its speed,

- (ii) its time period.

(5)
(Total 9 marks)

Q3.

When travelling in a vacuum through a uniform magnetic field of flux density 0.43 m T , an electron moves at constant speed in a horizontal circle of radius 74 mm , as shown in the figure below.



- (a) When viewed from vertically above, the electron moves clockwise around the horizontal circle. In which one of the six directions shown on the figure above, $+x$, $-x$, $+y$, $-y$, $+z$ or $-z$, is the magnetic field directed?

direction of magnetic field _____

(1)

- (b) Explain why the electron is accelerating even though it is travelling at constant speed.

(2)

- (c) (i) By considering the centripetal force acting on the electron, show that its speed is $5.6 \times 10^6 \text{ m s}^{-1}$.

(2)

- (ii) Calculate the angular speed of the electron, giving an appropriate unit.

answer = _____

(2)

- (iii) How many times does the electron travel around the circle in one minute?

answer = _____

(2)

(Total 9 marks)