KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER
SUPLIMENTARY EXAMINATIONS

FOR THE DEGREE OF B.SC (PHYSICS)

COURSE CODE: SPC 112

COURSE TITLE: GRAVITATION AND OSCILLATORY MOTION

DATE: 22/07/2022   **TIME: 2:00PM-4:00PM**

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

QUESTION ONE (30 marks) Compulsory

(a) Two simple harmonic motions of same angular frequency, ω

$$x_1 = a_1 \sin \omega t$$

$$x_2 = a_2 \sin(\omega t + \phi)$$

Act on a particle along the x-axis simultaneously. Find the resultant motion (6mks)

(b) In an electric shaver, the blade moves back and forth over a distance of 2.0mm in a simple harmonic motion, with a frequency 120Hz. Find the amplitude, the maximum blade speed and the magnitude of the maximum acceleration (6mks)

(c) A 7kg mass is hung from the bottom end of a vertical spring fastened to an overhead beam. The mass is set into vertical oscillations having a period of 2.60s. find the force constant of the spring (5mks)

(d) A particle executes simple harmonic motion with an amplitude 3.0cm. At what displacement from the midpoint of its motion does its speed equal one half of its maximum speed? (12mks)

(e) State the condition for the motion of an oscillator to be critically damped (1mk)

QUESTION TWO (20 marks)

Show that paths traced by planets around the sun are elliptical in shape (20mks)

QUESTION THREE (20 marks)

(a) A 100g mass vibrates horizontally without friction at the end of an horizontal spring for which the spring constant is 10N/m. The mass is displaced 0.5cm from its equilibrium and released. Find:

(i) Its maximum speed (5mks)

(ii) Its speed when it is 0.3cm from equilibrium (3mks)

(iii) What is its acceleration in each of these cases? (4mks)

(b) A particle is subjected to two SHM$_s$ represented by the following equations

$$x = a_1 \sin \omega t$$

$$y = a_2 \sin(2\omega + \delta)$$

In a plane acting at right angles to each other. Discuss the formation of Lissajous figures due to the superposition of these two vibrations (8mks)

QUESTION FOUR (20 marks)

Obtain an expression for the displacement of the damped harmonic oscillator where the damping force is proportional to the velocity. Discuss the effect of the damping on the displacement and the frequency of the oscillator. (20mks)

QUESTION FIVE (20 marks)

(a) A mass m attached to a spring oscillates with a period of 2s. If the mass is increased by 2kg, the period increases by 1s. Find the initial mass, m assuming that Hooke's law is obeyed. (7mks)

(b) Find the time period of a simple pendulum (13mks)