MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF EDUCATION (SCIENCE)

SPH 303: PRACTICAL PHYSICS 1

DATE: TIME:

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section A is compulsory (30 marks).
- Answer any two questions from section B (each 20 marks)

SECTION A

Question 1 (Compulsory)

You are provided with the following; Two-meter rules, a stand, a clamp, vernier calipers, Weight hanger and weights, rubber band or cello tape, a pin (for the pointer) and a stopwatch. Set up the experiment as shown in Fig 1

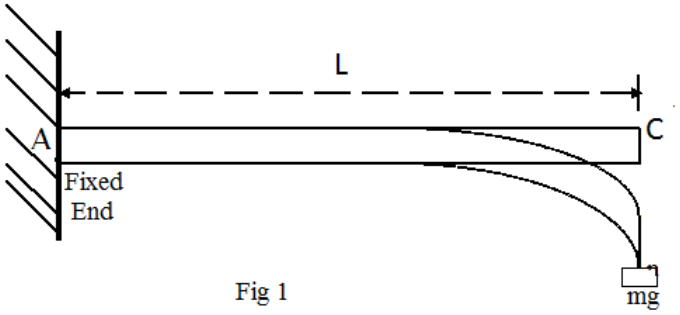

Fig 1

When the ruler is loaded and displaced, the motion represents simple harmonic motion (S.H.M) and is related to the period, T by the equation

$$T = 2\pi\sqrt{\frac{m}{K}} = 2\pi\sqrt{\frac{4mL^3}{Ebd^3}}$$

Therefore

$$T^2 = 4\pi^2 \frac{4mL^3}{Ebd^3}$$

Where,

E is the Young's modulus; m is the mass attached to the free end; g is gravitational constant (taken to be 9.8 ms^{-2}); L is the length of the beam; b, d are breadth and width of meter rule/beam respectively

a) Using the vernier calipers provided, measure b and d the breadth and width of meter rule/beam at various positions on the beam.
For each variable, take measurements at three points then determine the average and error. Fill in your results as shown in Table 1. (4 marks)

b) Now using a length, L, of 90 cm, put a mass m at the free end and displace the mass slightly. Using the stopwatch, time 20 oscillations. Repeat for each measurement then determine the average time
Repeat the experiment for other masses and fill the results in Table 2. (12 marks)

Table 1: Measurement of b and d, the breadth and width of meter rule

				Average ± error
b				
d				

Table 2: Measurement of Time t (s) for oscillations

Mass gm	Time t(s) for oscillations ±error			Period, T (s) (=time for one oscillation) ±error	T^2 (s^2)
			Average		
100					
150					
200					
250					
300					
350					

(c) Plot a graph of T^2 versus mass m. (6 Marks)

(d) Determine the Young's modulus**, E** from the graph (4 Marks)

(e) State sources of error in the experiment and ways of reducing them (4 Marks)

SECTION B

Question 2

(a) Describe a the working of a zener diode (4 marks)

(b) You are provided with a power source, decade resistor box, potentiometer, zener diode, voltmeter and a milliammeter.

(i) Using a well labelled diagram, describe how you can determine the zener voltage of the diode (8 marks)

(ii) Describe the possible sources of error and how they can be eliminated/mininised (3 marks)

(c) In a similar experiment to 2(b), a student found out that a V_{in} of 17.5 V produced a V_z= 12.0 V, for a zener voltage of 12 V at a power rating of 1W. If the maximum load current is 0.1 A, determine :-

(i) Maximum zener current (2 marks)

(ii) The series dropping resistance, R (3 marks)

Question 3

(a) From the disintegration law, show that $N = N_o e^{-\lambda t}$, where N_o and N are the undecayed nuclides at the start and at the time *t* respectively, λ is the decay constant (4 marks)

(b) From the equation $N = N_o e^{-\lambda t}$, show that half-life is given by $T = \frac{0.693}{\lambda}$ (4 marks)

(c) Table 3 shows the number of undecayed nuclides against time

Table 3

Time, t						
Number of Nuclides N						

Using the data in Table 3, draw a suitable graph to determine the

(i) Decay constant (6 marks)

(ii) Half-life of the sample (2 marks)

(d) State four applications of radioactivity (4 Marks)

Question 4

(a) State the Stoke's law of viscosity (2 marks)

(b) Based on the forces acting on a body of radius *r* flowing through a fluid, show that the terminal velocity is proportional to the square of *r* (4 marks)

(c) (i) You are provided with a long tube, metal ball, glycerine, tape measure, stopwatch and a marker pen. Outline the procedure (steps) one would follow to determine the viscosity of glycerine (5 marks)

(ii) How would the data collected in c(i) be used to determine the viscosity of glycerine (4 marks)

(d) Outline two possible sources of error and how they can be minimized (4 marks)

(d) (i) State the D'Alembert's principle (2 marks)

(ii) Use the D'Alembert's principle, derive an expression for the acceleration of the of the masses in (c) above (6 marks)

Question 5

(a) Define the specific heat capacity of a liquid (2 marks)

(b) You are provided with a complete copper calorimeter, an unknown liquid, zinc granules, a thermometer and a beam balance. Determine the procedure you would use to determine the specific heat capacity of the unknown liquid (8 marks)

(c) The data below was obtained in the experiment in 5 (b)

	Reading	Error
Mass of calorimeter	50.00 g	
Mass of calorimeter + liquid	150.00 g	
Mass of calorimeter + liquid + zinc granules	250.00	
Temperature of cold liquid	25.5 ^{o}C	
Temperature of hot Zinc	95,5 ^{o}C	
Final temperature of mixture	60.0 ^{o}C	

Take: Specific heat capacity of copper = 400 $JKg^{-1}K^{-1}$

Specific heat capacity of zinc = 387 $JKg^{-1}K^{-1}$

Use the data to determine the Specific heat capacity of the unknown liquid (7 marks)

(d) Identify three weaknesses of the method of mixtures for determining the specific heat capacities (3Marks)