SIR ARTHUR LEWIS COMMUNITY COLLEGE

ACADEMIC YEAR (2024/2025) – SEMESTER TWO

END OF SEMESTER EXAMINATION

COURSE CODE	:	**PHY102**
COURSE TITLE	:	**Introduction to Physics**
LECTURER(S)	:	**Mr Ozzy King**
DATE	:	**April 28, 2025**
TIME	:	**1 p.m.**
DURATION	:	**2 Hours**
STUDENT ID #	:	_____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- This paper has four (4) Sections.
- Answer one question each of Section A to C and two questions from Section D.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Section A: Physical quantities and measurement

Instruction: This section contains two (2) structured questions each worth 10 marks. Attempt any one (1) question

1. a. Identify two (2) SI base quantities and their corresponding SI units [2]

   b. A student is given this equation for the displacement of a freely falling object:

   $$s = u^2 + \frac{1}{2}at^2$$

   where s is displacement, u is initial velocity, a is acceleration, and t is time. Using either units or dimensions, determine if the equation is homogeneous. [3]

   c. Suppose the period T of a simple pendulum depends on the length L and the acceleration due to gravity g. Use dimensional analysis to determine the form of the equation for T. [5]

[10 marks]

2. a. Differentiate between systematic and random errors and for each type of error, identify one technique which may be used to minimize that error [4]

   b. A student performs a free-fall experiment by dropping a ball from a heigh. He measures the distance fallen s using a meter ruler, obtaining 2.00 m ± 0.05 m. Using a stopwatch, he records the time taken t as 0.64 ± 0.02 s.

   Calculate:

   i. the percentage uncertainty in the distance measurement. [1]
   ii. the percentage uncertainty in the time measurement. [1]
   iii. the acceleration a and its percentage uncertainty given that [4]

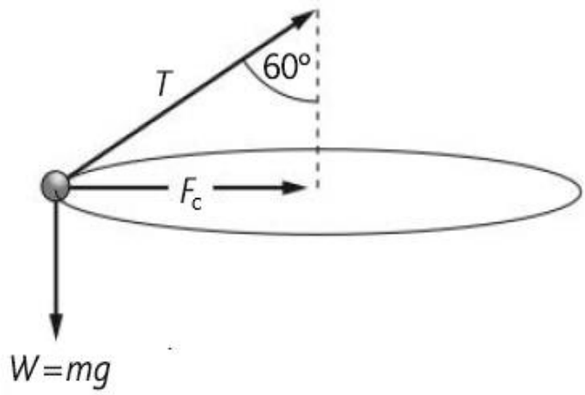
   $$a = \frac{2s}{t^2}$$

[10 marks]

Section B: Circular motion and oscillations

Instruction: This section contains two (2) structured questions each worth 10 marks. Attempt any one (1) question

3. a. A small mass of 60 g is attached to a string. One end of the string is fixed to a rigid support .as shown below



The mass is made to travel in a horizontal circle of radius 0.18 m. The string makes an angle of 60° to the vertical. The mass takes 0.65 s to complete one revolution. Calculate:

i. the angular velocity of the mass [2]
ii. the centripetal acceleration of the mass [2]
iii. the centripetal force acting on the mass [2]
iv. the tension in the string. [2]

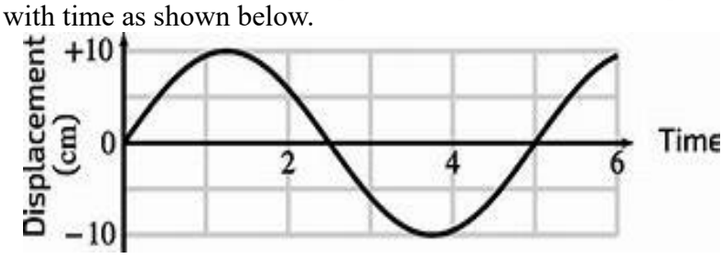
b. identify what provides the centripetal force in each case:

i. vehicle making a turn on level road [1]
ii. vehicle making a turn on embanked road [1]

(acceleration due to gravity, g = 10 m s^{-1})

[10 marks]

4. a. Differentiate between free and damped oscillations [2]
b. A pendulum bob oscillates with simple harmonic motion. Its displacement varies with time as shown below.



Determine:

i. the amplitude of the oscillation [1]
ii. the period of the oscillation [1]
iii. the frequency of the oscillation [1]
iv. the angular frequency of the oscillation [1]
v. the acceleration when the displacement is zero [1]
vi. the acceleration when the displacement is at a maximum [2]
vii. the point at which the velocity of the pendulum bob is maximum [1]

[10 marks]

Section C: Waves

Instruction: This section contains two (2) structured questions each worth 10 marks. Attempt any one (1) question.

5. A string of length 80 cm is stretched between two fixed points. It is plucked at its centre and the string vibrates to form a stationary wave. A single antinode is formed at the centre of the string.
   a. Explain:
      i. what is meant by a stationary wave [2]
      ii. what is meant by an antinode [1]
      iii. why nodes are formed at the ends of the string. [1]
   b. Determine the wavelength of the wave. [2]
   c. The frequency of vibration of the string is 340 Hz. Calculate:
      i. the period of the wave. [2]
      ii. the speed of the wave [2]

   [10 marks]

6. a. State the two (2) laws of refraction [2]

   b. The refractive index of glass for red light is 1.51. Red light travelling at 3.00×10^8 m s^{-1} is incident at an angle of 32° on an air–glass boundary.

   Calculate:
      i. the angle of refraction for red light [2]
      ii. the speed of red light in glass [2]
      iii. the critical angle for the air–glass interface [2]

   c. Identify two conditions for total internal reflection [2]

   [10 marks]

Section D: Electricity

Instruction: This section contains three (3) structured questions each worth 10 marks. Attempt any two (2) questions

7. a. Explain what is meant by an electric field. [1]

   b. Sketch the electric field pattern:
      i. between a positive and negative charge [2]
      ii. between two oppositely charged parallel metal plates. [2]

   c. Two flat metal plates are separated by a distance of 1.2 cm. A potential difference of 100 V between the plates provides a uniform electric field in the region between the plates. High speed electrons enter this region at right angles to the field.

   Calculate:
      i. the electric field strength between the plates [2]
      ii. the force on an electron due to the electric field [2]

   d. Describe the motion of an electron in part c. as it enters the electric field [1]

   (charge of an electron, e = – 1.60 × 10^{-19} C)

   [10 marks]

8. a. Differentiate between resistance and resistivity. [2]

   b. A potential difference of 3 V is applied across a piece of copper wire of length 0.65 m and cross-sectional area 2.2×10^{-9} m^2. Calculate:
      i. the resistance of the copper wire [3]
      ii. the current flowing through the wire [2]

iii. the power dissipated in the wire. [2]

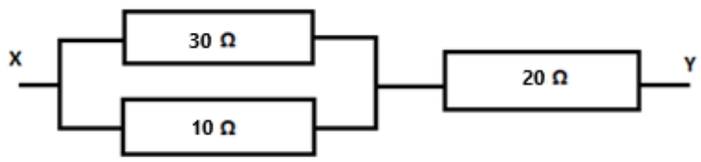
c. What is the form of the energy dissipated in the wire? [1]

(Resistivity of copper, $\rho = 1.7 \times 10^{-8}$ Ω m)

[10 marks]

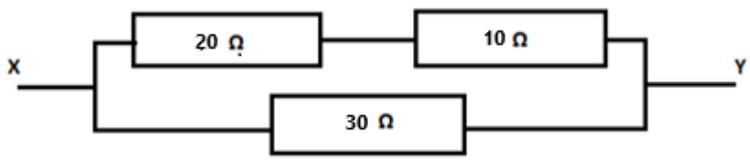
9. a. Calculate the effective resistance between points X and Y in each case:

i.



[3]

ii.



[3]

b. For the resistor combination in part a ii, calculate the circuit current if a power source of 12 V is connected across the points X and Y. [2]

d. An electronics student requires a 10 Ω resistor to replace a defective one in his prototype circuit. The electronics technician presents him with a box full of 30 Ω resistors as a means of solving his problem. Draw a diagram to show how the student might configure a set of 30 Ω resistors to yield an effective resistance of 10 Ω.

[2]

[10 mark]

END OF EXAMINATION