SIR ARTHUR LEWIS COMMUNITY COLLEGE

ACADEMIC YEAR (2024/2025) – SEMESTER TWO

END OF SEMESTER EXAMINATION

Alternate

COURSE CODE	:	**PHY102**
COURSE TITLE	:	**Introduction to Physics**
LECTURER(S)	:	**Mr Ozzy King**
DATE	:	
TIME	:	
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 derived quantities and their corresponding SI units [2]

   b. An equation for uniformly accelerated motion is given as:

   $$v^2 = u^2 + 2as^2$$

   where v is the final velocity, u is the initial velocity, a is the acceleration, and s is the displacement. Using either units or dimensions, determine if the equation is homogeneous.

   [3]

   c. The speed v of a transverse wave on a string depends on the tension T in the string and the mass per unit length μ. Use dimensional analysis to determine the form of the equation for v [5]

   [10 marks]

2. a. Differentiate between accuracy and precision of measurements and identify how each may be increased [4]

   b. A student conducts an experiment to determine the kinetic energy E_k of a rolling ball. She measures the mass m of the ball using a digital scale and records it as 3.50 kg ± 0.05 kg. She then uses a motion sensor to measure the velocity v, obtaining 4.20 m/s ± 0.15 m/s.

   Calculate:

   i. the percentage uncertainty in the mass measurement. [1]
   ii. the percentage uncertainty in the velocity measurement. [1]
   iii. the kinetic energy and its percentage uncertainty given that [4]

   $$E_k = \frac{1}{2}mv^2$$

   [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. An object of mass 0.80 kg is attached to a string and spun in a vertical circle of radius 0.90 m with a constant speed of 9 m s^{-1} s . Calculate:
   i. the minimum tension in the string [3]
   ii. the maximum tension in the string [3]
   iii.

   b. A car travels over a humpback bridge of radius of curvature 45 m. Calculate the maximum speed of the car if its wheels are to stay in contact with the bridge [2]

   c. identify what provides the centripetal force in each case:
   i. airplane making a turn [1]
   ii. stone attached to string and swung in horizontal circle [1]

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

   [10 marks]

4. a. With the aid of appropriate graphs differentiate between a critically damped and a heavily damped oscillatory system [4]

   b. By drawing resonance curves for three different degrees of light damping of an oscillating system, illustrate the effect of increased damping on the shape of the resonance curve [3]

   c. Explain what is meant by resonance [2]

   d. Identify one (1) technological application of the principle of resonance [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. Identify two differences between stationary and progressive waves. [2]

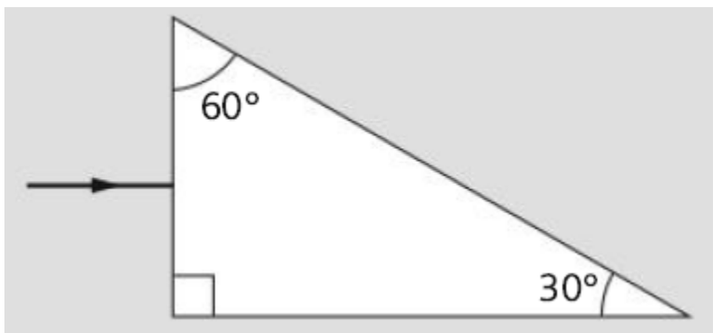
   b. Explain what is meant by a node and an antinode on a stationary wave. [2]

   c. A stationary wave is formed on a stretched string. There are four nodes present. The distance between the four nodes is 1.40 m. The speed of the waves on the string is 220 m s^{-1}. Calculate:
      i. the wavelength of the waves on the string. [2]
      ii. the frequency of vibration. [2]
      iii. the period of the vibration. [2]

[10 marks]

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

   b. The speed of light in air is 3.00×10^8 m s^{-1}. The speed of light in glass is 1.99×10^8 m s^{-1}. Consider a ray incident on a face of a prism as shown below.



      i. Calculate the refractive index of the glass used to make the prism. [2]
      ii. Calculate the critical angle for a glass/air interface. [2]
      iii. Sketch a diagram to show what happens to the ray inside the prism and as it leaves the prism. [3]

   c. Identify one (1) application of total internal reflection. [1]

[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 the term electric field strength. [2]

   b. Sketch the electric field pattern:
      i. for an isolated negative charge [1]
      ii. between two oppositely charged parallel metal plates. [2]

   c. Two horizontal metal plates are situated 1.5 cm apart. The electric field between the plates is 2.5×10^4 N C^{-1}.
   Calculate:
      i. the potential difference between the plates [2]
      ii. the electric force on an electron placed between the plates [2]

   d. Determine the direction of the acceleration of an electron placed in electric field [1]

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

   [10 marks]

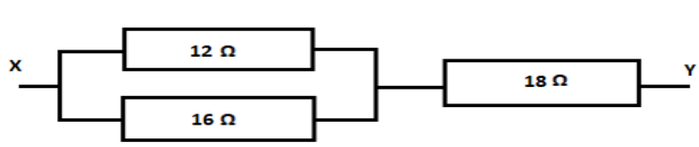
8. a. Define the coulomb. [2]

   b. A current of 2.1 A flows through a 75 W light bulb for a period of 480 s.
   Determine:
      i. the charge that flowed through the bulb [2]
      ii. the energy dissipated in the lamp [2]
      iii the potential difference across the lamp [2]
      iv the number of electrons that flowed through the lamp. [2]

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

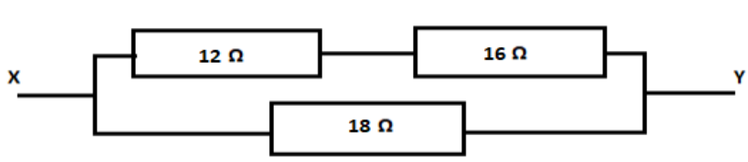
   [10 marks]

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 i., calculate the power dissipated in the resistor combination if a 15 V power source is connected across the points X and Y. [2]

   c. An electronics student requires a 45 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 marks]