

**BOWEN UNIVERSITY, IWO OSUN STATE**  
**COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE**  
**PHYSICS PROGRAMME**  
**SECOND SEMESTER EXAMINATION 2022/2023 SESSION**

**PHY 204: WAVES AND OPTICS**

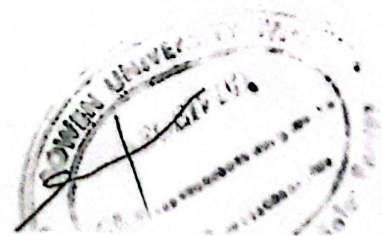
**CREDITS: 3C**

**DATE: WEDNESDAY 21<sup>st</sup> JUNE, 2023**

**TIME: 4.00 P.M. – 7. 00P.M.**

**INSTRUCTION: ANSWER ANY SIX (6) QUESTIONS**

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- 1a. (i) State the principle of superposition for wave. 2Mrks  
(ii) Differentiate between Constructive and Destructive interference using (i) above. 3Mrks  
b. (i) Using a suitable diagram illustrate the following as applicable to the wave.  
(a) Crest;  
(b) Trough;  
(c) Amplitude;  
(d) Wavelength; and  
(e) Period. 5Mrks  
(ii) Show that the general wave equation can be written as  $\frac{\partial^2 y}{\partial t^2} + v^2 \frac{\partial^2 y}{\partial x^2}$   
for a one dimensional, where all symbols has their meaning 6 1/2 Mrks
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- 2a. (i) Explain the term: dispersion as related to Light. 5 1/2 Mrks  
(ii) State the condition necessary for total internal reflection to occur. 3Mrks  
b. (i) What are Optical Instruments? Give three (3) examples. 5Mrks  
(ii) Find the focal length of a magnifying glass which produces an erect image that was magnified three times that of an object 4cm away from the lens. 3Mrks
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- 3a. (i) Explain the principle of 'reversibility of Light' (Glass Block). 6Mrks  
(ii) Define the 'resolving power of an optical instrument'. 2 1/2 Mrks  
b. (i) State the Laws of reflection and refraction. 4Mrks  
(ii) An object 0.5 cm high is placed 8 cm from a convex lens of 10 cm focal length.  
Find the position and size of the image. 4Mrks
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- 4a. (i) What is Wave interference? 2Mrks  
(ii) Two waves  
 $y_1 = A \sin[kx - \omega t + \phi]$  and  
 $y_2 = A \sin[kx - \omega t]$   
are superimposed on a string. Derive the expression for the Phase Shift and Amplitude 5Mrks  
b. (i) Write out the mathematical relation of 'Group and Phase velocity'. 2Mrks  
(ii) Derive the expression for one dimensional simple harmonic progressive Wave traveling in the direction of the positive x-axis. 7 1/2 Mrks
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- 5a. (i) What is Simple Harmonic Motion (S.H.M). 2Mrks  
(ii) Mention any four types of oscillatory system that you know. 4Mrks  
b. (i) Show that the energy of simple harmonic motion is given as  $E = \frac{1}{2} K A^2$  6 1/2 Mrks
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- (ii) A 200 g mass is attached to a spring performing Simple Harmonic Motion horizontally with an amplitude of 4 cm. If the force constant of the spring is 25 N/m, determine;
- the frequency of the Oscillation;
  - the time for one complete Oscillation;
  - the velocity; and
  - the acceleration of the mass.

4Mrks

- 6a. (i) What do you understand by the term 'Wave'.

2 1/2 Mrks

- (ii) Differentiate between the following two term:

- Progressive wave and Stationary wave
- Transverse wave and longitudinal wave.

6Mrks

- b. (i) A progressive wave is represented by the equation  $y = 7.0 \sin \left( 300\pi t - \frac{30\pi x}{19} \right)$ . The distances are measured in centimeter (cm) and t in seconds. Find the following:

- wave amplitude;
- wave frequency;
- wavelength;
- wave speed; and
- displacement at  $x = 1.9$  and  $t = 0.05$ .

5Mrks

- (ii) Mention three (3) characteristics of waves that you know

3Mrks

- 7a. (i) Derive the differential equation of a Simple Harmonic Motion

4Mrks

- (ii) List and briefly explain two (2) types of oscillating motion that you know.

5Mrks

- b. (i) Derive an expression governing the Group and Phase Velocity.

4 1/2 Mrks

- (ii) An object is Oscillating in a simple harmonic motion. The amplitude is 15cm and a period of 2 s. calculate the magnitude of its velocity and acceleration when its displacement from equilibrium position.

- $x = 0$  cm;
- $x = +7.5$  cm; and
- $x = -15$  cm;

3Mrks

- 8a. (i) Define the following as applicable to Lenses:

- Aperture;
- Optical center;
- Principal focus;
- Focal length; and
- Principal Axis.

5Mrks

- (ii) Using a suitable diagram, differentiate between the Concave and the Convex mirror.

6Mrks

- b. (i) What do you understand by Ray of Light.

2 1/2 Mrks

- (ii) A thin bi-convex lens rests on a plane mirror. It is found that a point object placed 20 cm above the lens coincides with its own image. Determine the position and nature of the image when is placed 8cm and 12cm from the lens mirror combination.

3Mrks