# KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS**
**2021/2022 ACADEMIC YEAR**

**FIRST YEAR SECOND SEMESTER**
**MAIN EXAMINATIONS**

**FOR THE DEGRE OF BSc (PHYSICS)**

**COURSE CODE: SPC 122**

**COURSE TITLE: WAVES & GEOMETRICAL PHYSICS**

**DURATION: 2 HOURS**

**DATE: 29/07/2022** **TIME:8:00AM-10:00AM**

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**INSTRUCTIONS TO CANDIDATES**

Answer QUESTION ONE (Compulsory) and any other two (2) Questions.
Indicate answered questions on the front cover.
Start every question on a new page and make sure question's number is written on each page
This paper consists of 3 printed pages. Please Turn Over

**QUESTION ONE (30mks)**

1. a) Define the following as used in geometrical optics (5mks)
   (i) Principal axis
   (ii) Principal focus
   (iii) The near point
   (iv) Focal length
   (v) Linear magnification

   b) Explain the following classification of waves. (3mks)
   i) Mechanical waves
   ii) Electromagnetic waves
   iii) Matter waves

   c) Give the equation of a harmonic wave and explain the meaning of each term. (3mks)

   d) Making use of the law of reflection, draw the image of the letter L positioned above a plane mirror as shown below. (3mks)

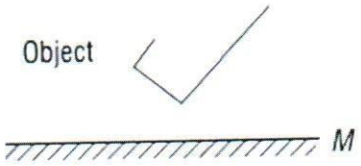


**Figure: 1**

   e) A concave mirror has a radius of curvature of 25 cm. A 2 cm tall object is placed 20 cm from the mirror along its axis. Find the location of the image and its size (3mks)

   f) A passenger side-view car mirror is convex with a radius of curvature of 150 cm. If a car that is viewed in the mirror is actually 20 m away, describe the image in the mirror. (3mks)

   g) Use a ray diagram to show how a convex lens can be used as a Magnifying glass (Simple microscope). (4mks)

   h) An object is placed 20cm from (a) a converging lens, (b) a diverging lens, of focal length 15cm. calculate the image position and magnification in each case. (6mks)

**QUESTION TWO (14MKS)**

2. . A particular wave is given by $y = (0.200m)\sin[(0.500m^{-1})x - (8.20rad/s)t]$. Find; (i) Amplitude (ii) wave vector (iii) wavelength (iv) frequency (v) period (vi) speed (vii) y at x=10m and t=0.5 seconds (14mks)

**QUESTION THREE (14MKS)**

3. Using a well labeled diagram, derive the expression for the magnifying power of a compound microscope. (6mks)

b) Briefly describe the Defects of Lenses shown below and state how they can be corrected.

i) Spherical aberration (4mks)

ii) Chromatic aberration (4mks)

**QUESTION FOUR (14MKS)**

a) A double-convex thin lens can be used as a simple "magnifier." It has a front surface with a radius of curvature of 20 cm and a rear surface with a radius of curvature of 15 cm. The lens material has a refractive index of 1.52.

i) What is its focal length in air? (2mks)

ii) What is its focal length in water (n= 1.33)? (2mks)

iii) Does it matter which lens face is turned toward the light? (2mks)

iv) How far would you hold an index card from this lens to form a sharp image of the sun on the card? (2mks)

b) A two-lens system is made up of a converging lens followed by a diverging lens, each of focal length 15 cm. The system is used to form an image of a short nail, 1.5 cm high, standing erect, 25 cm from the first lens. The two lenses are separated by a distance of 60 cm as shown in Fig. 2.

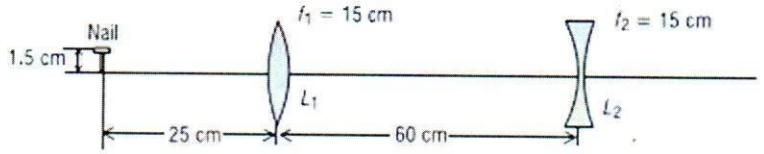


**Fig.2**

Locate the final image, determine its size, and state whether it is real or virtual, erect or inverted. (6mks)

**QUESTION FIVE (14mks)**

5. a) Define the term Doppler effect (2mks)

b) What happens to velocity of the wave, wavelength and frequency by moving a source in the absence of dispersion. (3mks)

c) What is a standing wave and how does it come about. (2mks)

b) As you stand by the side of the road, a car approaches you at a constant speed, sounding its horn, and you hear a frequency of 76 Hz. After the car goes by, you hear a frequency of 65 Hz. What is the speed of the car? The speed of sound in air is 343 m/s.

(7mks)

**QUESTION SIX (14mks)**

6. a)Use Fermat's principle to derive the law of reflection and refraction (8mks)

b) A double-convex thin lens can be used as a simple "magnifier." It has a front surface with a radius of curvature of 20 cm and a rear surface with a radius of curvature of 15

cm. The lens material has a refractive index of 1.52. Answer the following questions to learn more about this simple magnifying lens.

(i) What is its focal length in air? (2mks)

(ii)What is its focal length in water (n= 1.33)? (2mks)

(iii)Does it matter which lens face is turned toward the light? (2mks)

(iv)How far would you hold an index card from this lens to form a sharp image of the sun on the card? (2mks)