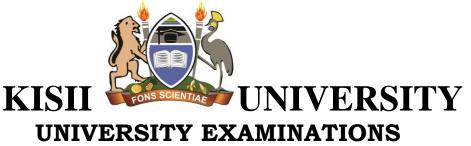
PHYS 121



FIRST YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF **BACHELOR OF EDUCATION SCIENCE / PHYSICS** SECOND SEMESTER 2021/2022 (FEBRUARY-JUNE, 2022)

PHYS 121: GEOMETRICAL OPTICS

STREAM: Y1 S2

TIME: 2 HOURS

DATE: 30/05/2022

DAY: **MONDAY, 9:00 - 11:00 AM**

INSTRUCTIONS:

- 1. Do not write anything on this question paper.
- 2. Answer question one and any other two questions

QUESTION ONE

a) Explain the following; **Physical Optics** (2mks)i) ii) **Critical Angle** (2mks)Specular Reflection iii) (2mks)b) Light moves from water into glass with the incident ray making an angle of 60° with the normal, find the direction of the reflected and refracted rays given $n_w =$ 1.33 and $n_g = 1.52$. (4mks)c) A rail bar is surrounded by water of refractive index 1.33 in the inward curved side. If the radius of the curved side is 10cm and a small object in water is

placed 32cm from glass gives an image 50cm away. Determine;

- Refractive index of the glass block. i) (3mks) (3mks)
- Its lateral magnification. ii)
- d) Describe the eye defects and explain how they can be corrected. (4mks)
- e) State Fermat's principle and hence show how it can be used to derive Snell's law of reflection.(7mks)
- f) Give conditions necessary for total internal reflection to occur.(3mks)

QUESTION TWO

- a. In a hand held optical instrument used under water, light is incident from water onto the plane surface of flint glass at an angle of incidence of 45° .
 - (i) What is the angle of reflection off the flint glass? (1mk)
 - (ii) Does the refracted ray bend toward or away from the normal?
 (2mks)
 - (iii) What is the angle refraction in the flint glass? (4mks)
 (Given refractive indices of water and flint glass are 1.33 and 1.63 respectively.)
 - When light is incident on an interface between two transparent optical media, like water and glass, state three things that can happen to the incident light. (3mks)
- b. Consider a thick lens with two refracting surfaces of separation distance t for aray of light from infinity of height h from the principal axis. Derive the thick lens formula. (10mks)

QUESTION THREE

a.	What is the significance of the index of refraction of a given	raction of a given material?	
		(2mks)	
b.	(i)Define the term chromatic aberration.	(2mks)	
	(ii) State the two types of chromatic aberrations	(2mks)	

- (iii)State the **five** types of monochromatic Seidel Aberrations (5mks)
- c. Explain **two** forms of effects that aberrations can cause to image formation. (4mks)
- d. With the aid of diagrams, distinguish between a coma and astigmatism aberration effects. (5mks)

QUESTION FOUR

- a. Determine the angle of minimum deviation for a beam of light of wavelength 5893A° passing through a 60°apex glass prism if its index of refraction is 1.65. What is its angle of incidence and refraction?(5mks)
- b. Explain why the periscope with leaked water at the bottom will not work given $n_w = 1.33$ and $n_g = 1.52$. (5mks)
- c. A cylindrical glass rod has an index of refraction of 1.67. It is surrounded by air. One end is ground to a hemispherical surface with radius 2cm. A small object is placed on an axis of the rod 6cm to the left of the vertex. Find
 - i) Image distance (3mks)
 - ii) Lateral magnification (2mks)
- d. Draw ray diagrams for converging and diverging lenses to form images. (5mks)

QUESTION FIVE

a. Draw the following forms of wavefronts.

(8mks)

- (i) Spherical diverging wavefront formed by a point source
- (ii) Spherical converging wavefront formed by a lens
- (iii) Planar wavefront
- (iv) Aberrated wavefront
- b. What is the change in antigmatism when you look through a 5D lens (n=1.5) tilted at a downward angle of 15 degrees? What is the equivalent spherical correction of the tilted lens? (6mks)
- c. With the aid of diagrams, distinguish between curvature of field and distortion aberration effects. (6mks)