PHYS 121

KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

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**

DAY: MONDAY, 9:00 – 11:00 AM **DATE: 30/05/2022**

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;
   i) Physical Optics (2mks)
   ii) Critical Angle (2mks)
   iii) Specular Reflection (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;
   i) Refractive index of the glass block. (3mks)
   ii) Its lateral magnification. (3mks)

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 45^0.
   (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.)
   iii) 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 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)