ALUPE UNIVERSITY COLLEGE
...Bastion of Knowledge...
P. O.Box 845-50400 Busia(K)
principal@auc.ac.ke
Tel: +254 741 217 185
+254 736 044 469
off Busia- Malaba road

OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2017 /2018 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **PHY 121**

COURSE TITLE: **GEOMETRIC OPTICS**

DATE: 30th, APRIL, 2018 **TIME: 9AM – 12.00 NOON**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

THIS PAPER CONSISTS OF 6 PRINTED PAGES **PLEASE TURN OVER**

PHY 121: GEOMETRIC OPTICS

STREAM: Bed Sc. **DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

i. *Answer Question **ONE** and **TWO** in **SECTION A** and any other **THREE** questions in **SECTION B**.*

ii. *Where necessary the following constants maybe used:*

Refractive index of air=1
Refractive index of water = 1.33
Refractive index of glass = 1.5
Velocity of light in vacuum/air $= 3 \times 10^8 \, m/s$

SECTION A (24 MARKS)

Question One

a) State the laws of refraction of light (2 Marks)

b) Explain the conditions that must be fulfilled in order for total internal reflection to occur. (2 Marks)

c) A ray of light strikes a glass plate ($n = 1.50$) at an angle of incidence of 50°. Determine the angles of reflected and refracted rays (2 Marks)

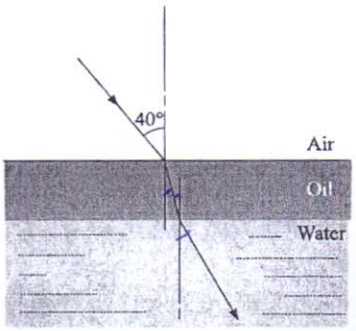
d) Describe the image of an object positioned 20cm from a concave mirror, whose radius of curvature is 60cm. (3 Marks)

e) Calculate the angle of minimum deviation of a prism if its refracting angle is 60°. The refractive index of the material of the prism is 1.632. (3 Marks)

Question Two

a) Two thin lenses of focal length +9.0cm and -6.0cm are placed in contact. Calculate focal length of the combination. (1 Mark)

b) A layer of oil (η_a =1.45) floats on water (η_o =1.33). A ray of light shines onto the oil with an incidence angle of 40.0°. Find the angle the ray makes in the water. (4 Marks)



c) Differentiate between continuous spectra and line spectra. Give example of each spectrum.

(4 Marks)

di) What is meant by angular magnification of an optical instrument? (1 Mark)

ii) Calculate the angular magnification of a simple astronomical telescope in normal adjustment which has an objective of focal length 120 cm and an eyepiece of 6 cm and also determine the distances between the two lenses (2 Marks)

SECTION B (36 MARKS)

Question Three

a) Draw diagrams to indicate qualitatively the position, nature and size of image formed by converging lens for the following object distances.

i) At 2f (3 Marks)

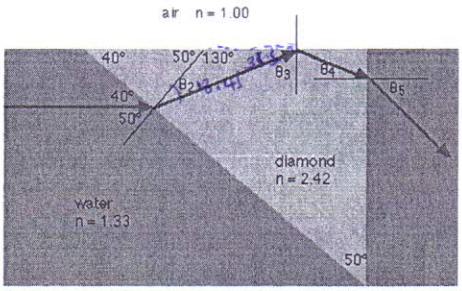
ii) At f (3 Marks)

iii) Between f and the lens (3 Marks)

b) An object 9.0cm high is 27cm in front of convex lens of focal length -18cm. Calculate position and height of its image. (3 Marks)

Question Four

A beam of light travels from water into a piece of diamond in the shape of a triangle, as shown in the diagram below.



Given that the speed of light in air is, $3\times10^{8}\,m/s$ determine;

(a) The speed of light traveling inside the piece of diamond (2 Marks)

(b) The critical angle for the diamond-air interface? (2 Marks)

(c) The angle between the normal and the beam of light inside the diamond at the water-diamond interface (θ_2) (3 Marks)

(d) The beam travels up to the air-diamond interface. What is θ_3, the angle between the normal and the beam of light inside the diamond at the air-diamond interface? (2 Marks)

(e) What happens to the light at the diamond-air interface? (3 Marks)

Question Five

a) Derive an expression of the focal length of the lens in terms of radii of curvature of its faces and its refractive index: $\frac{1}{f} = (\eta - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$ (6 Marks)

b) A double convex lens has radii of 18cm and 20cm. When an object is 24cm from the lens, a real image is formed 32cm from the lens. Determine

i) The focal length of the lens (1 Mark)

ii) Refractive index of the lens material (2 Marks)

c) A glass lens ($\eta = 1.5$) has focal length of +10cm in air. Calculate its focal length in water.

(3 Marks)

Question Six

a) Differentiate between refractor telescope and reflector telescope (2Marks)

b) What are the advantages of reflector telescope over normal astronomical telescope?

(4 Marks)

c) Define the term eye-ring of a telescope. Show with a ray diagram, how the eye ring is formed in an astronomical telescope. (4 Marks)

d) Terrestrial Telescope has an erecting lens placed between the objective and eye lens such that that the centre of curvature of its faces coincides with the focus of the object lens. What's the importance of this particular arrangement? (2 Marks)

Question Seven

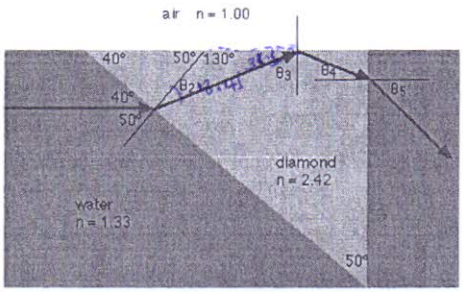
a) i)Sketch welllabelled ray diagrams to explain what is meant by long sightedness (hyperopia) and how this eye defect can be corrected (6 Marks)

ii) A far sighted person cannot see objects clearly that are closer to the eye than 60.0cm. Determine the focal length and power of the spectacle lenses that will enable her to read a book at a distance of 25.0cm. (2 Marks)

b) In a compound microscope, the focal lengths of the objective and eye piece are +0.8cm and +2.5cm respectively. The instrument is focussed on an object and the image distance is 16.0cm from the objective lens. Compute the magnifying power of the microscope if the virtual image is viewed by the eye at a distance of 25cm. (2Marks)

Question Four

A beam of light travels from water into a piece of diamond in the shape of a triangle, as shown in the diagram below.



Given that the speed of light in air is, $3\times10^{8}\,m/s$ determine;

(a) The speed of light traveling inside the piece of diamond (2 Marks)

(b) The critical angle for the diamond-air interface? (2 Marks)

(c) The angle between the normal and the beam of light inside the diamond at the water-diamond interface (θ_2) (3 Marks)

(d) The beam travels up to the air-diamond interface. What is θ_3, the angle between the normal and the beam of light inside the diamond at the air-diamond interface? (2 Marks)

(e) What happens to the light at the diamond-air interface? (3 Marks)

Question Five

a) Derive an expression of the focal length of the lens in terms of radii of curvature of its faces and its refractive index: $\frac{1}{f} = (\eta - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$ (6 Marks)

b) A double convex lens has radii of 18cm and 20cm. When an object is 24cm from the lens, a real image is formed 32cm from the lens. Determine

i) The focal length of the lens (1 Mark)

ii) Refractive index of the lens material (2 Marks)

c) What is the magnifying power of a lens focal length +2.0cm when it is used as magnifying glass (or simple microscope). The lens is held close to the eye and virtual image forms at near point, 25cm from the eye. (2 Marks)

****

120