ALUPE UNIVERSITY COLLEGE
...Bastion of Knowledge...

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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS
2020/2021 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: 21/07/2021   **TIME: 1300 – 1600HRS**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

THIS PAPER CONSISTS OF 5 PRINTED PAGES   **PLEASE TURN OVER**

MAIN EXAMINATION
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 (c)* $= 3 \times 10^8 m/s$

SECTION A (28 MARKS)

Question One (14 Marks)

a. Using illustrations, distinguish between chromatic and spherical aberration (4 Marks)

b. Show that for curved mirrors $r = 2f$.   (3 marks)

c. An object is located 20.0 cm to the left of a diverging lens of focal length $-32.0cm$.
   Determine:

    i.   The location of the image   (2 marks)

    ii. Magnification of the image.   (2 Marks)

d. Define the term reflectivity as used in reflection   (2 marks)

e. Explain the term "ray" as used in rectilinear propagation of light.   (1 mark)

Question Two (14 Marks)

a. State and illustrate with diagrams any three types of convex lenses   (3 marks)

b. Define the following terms as relating to thin lenses   (2 marks)

    i.   Optical Centre

    ii.   Focal point

c. Deduce the relation $n_1 sin i = n_2 sin r$.   (5 marks)

d. A near sighted person cannot see objects clearly that are beyond 50cm from his eye.
   Determine:

    i.   The focal length of glasses that will enable him see distant objects clearly. (2
           marks)

ii.   The power of glasses that will enable him see distant objects clearly. (2 marks)

SECTION B (42 MARKS)

Question Three (14 Marks)

a. Two thin lenses of focal length + 9.0cm and - 6.0cm are placed in contact. Calculate focal length of the combination.   (2 Marks)

b. The Figure below shows a refracted light beam in linseed oil making an angle of $\phi = 20°$ with the normal line NN'. The index of refraction of linseed oil is 1.48.
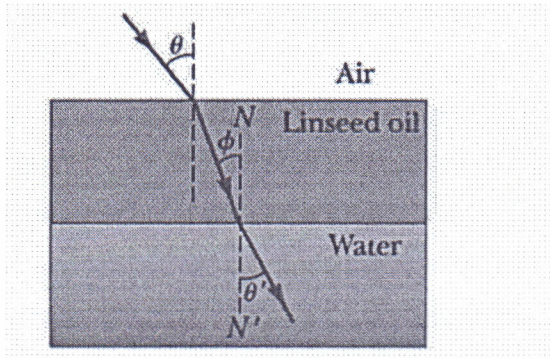
Determine the angles

   i. θ (2 marks)

   ii. θ'.   (2 marks)

c. By use of ray diagrams, locate the position of the image of an object placed at the principal focus of a convex lens, thus explain the nature of the image.   (3 marks)

d. In a compound microscope shown below the objective and eye piece lenses have fixed focal lengths +0.80cm and +2.5cm respectively. The real image $A'B'$ formed by the objective is 16cm from the objective.
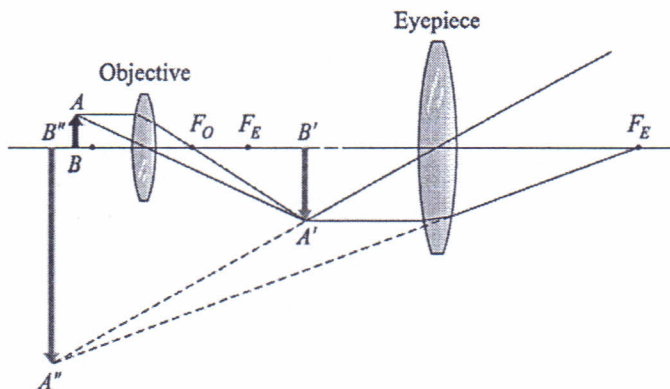
i. Calculate the object distance from the objective lens (2 Marks)

ii. Determine total magnification, if the eye is held close to the eye piece and views virtual image AB at a distance of 25cm. (3 Marks)

Question Four (14 Marks)

a. Using relevant diagrams explain how images are formed in plane mirrors (3 marks)

b. With an appropriate illustration explain how a concave mirror can be used as a shaving or make-up mirror (3 marks)

c. An object is placed beyond the centre of curvature of a convex mirror;

i. By ray diagrams determine the position of the image (3 marks)

ii. State two characteristics of the image formed (2 marks)

d. A candle 4.85cm tall is placed 39.2cm in front of a plane mirror.

i. Determine the location and height (2 Marks)

ii. Describe the nature of the image (1 mark)

Question Five (14 Marks)

a. Draw a well labeled ray diagram explaining short sightedness and how it can be corrected. (6 Marks)

b. A ray of light of wavelength 500nm is incident on a transparent surface from air. If the incident ray makes an angle of 55° with the normal and the refracted ray makes an angle of 40° with the normal. Calculate the refractive index of the material. (4 marks)

c. With relevant examples distinguish between geometric and quantum optics. (4 marks)

Question Six (14 Marks)

a. Give any three applications of concave mirrors (3 marks)

b. Write down the expression for the resolving power of a telescope, explaining all the terms used. (3 marks)

c. Determine the resolving power of a telescope, if its objective lens has a diameter of 300mm. The mean wavelength of light from the stars is $6 \times 10^{-7} m$. (2 marks)

d. State any three advantages optical fiber over copper wire in transmission of signals (3 marks)

e. A ray of light traveling in water is incident on an interface with a flat piece of glass. The wavelength of light in water is 726 nm and its wavelength in glass is 544 nm. If

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the ray in water makes an angle of 42°with respect to the normal to the interface, what angle does the refracted ray in the glass make with respect to the normal (3 marks)

Question Seven (14 Marks)

a. Give three advantages of using a reflector telescope in astronomy   (3 marks)

b. Using appropriate diagrams/illustrations explain the functioning of a terrestrial telescope   (7 marks)

c. A certain prism is found to produce a deviation of 51°, while it produces a deviation of 62.8° for two values of the angle of incidence namely 40.1° and 82.7° respectively. Determine the refracting angle of the prism.   (4 Marks)