JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN EDUCATION

1ST YEAR 2ND SEMESTER 2013/2014 ACADEMIC YEAR

CENTRE: MAIN

COURSE CODE: SPH 103

COURSE TITLE: OPTICS

EXAM VENUE: AH **STREAM: BSc. .Education**

DATE: 10/12/2013 **EXAM SESSION: 2.00 – 4.00 PM**

TIME: 2 HOURS

Instructions:

1. **Answer question 1(Compulsory) and ANY other 2 questions.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

You may use the following information:

$\varepsilon_0 = 8.85 \times 10^{-12}$ F/m
$c = 3.0 \times 10^{8}$ m/s

Q1. a) (i) Mention **four** characteristics of the image formed by a plane mirror. (4 marks)

(ii) State **two** differences between real and virtual images. (4 marks)

b) A curved mirror forms a virtual image, three times the size of the object and at a distance 50 cm from the mirror.

(i) How far is the object from the mirror ? (3 marks)

(ii) What is the focal length of the mirror ? (4 marks)

c) (i) State the conditions under which total internal reflection occurs. (2 marks)

(ii) Clearly distinguish between optical scattering and optical activity. (4 marks)

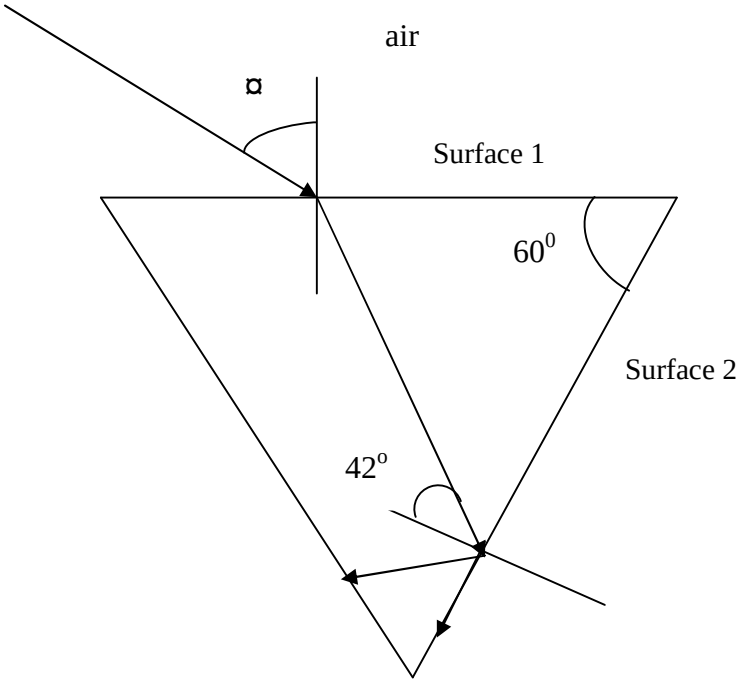
d) A screen is separated from a double slit source by 1.20 m. The distance between the two slits is 0.03 mm. The second order bright fringe, (m = 2), is measured to be 450 cm from the centerline. Determine

(i) the wavelength of the light. (3 marks)

(ii) the distance between adjacent bright fringes. (6 marks)

Q2. a) What is meant by rectilinear propagation of light? (2 marks)

b) The light beam below is incident on surface 1 at an angle ¤ and on surface 2 of the prism at the critical angle. Determine the incidence angle ¤ . (8 marks)



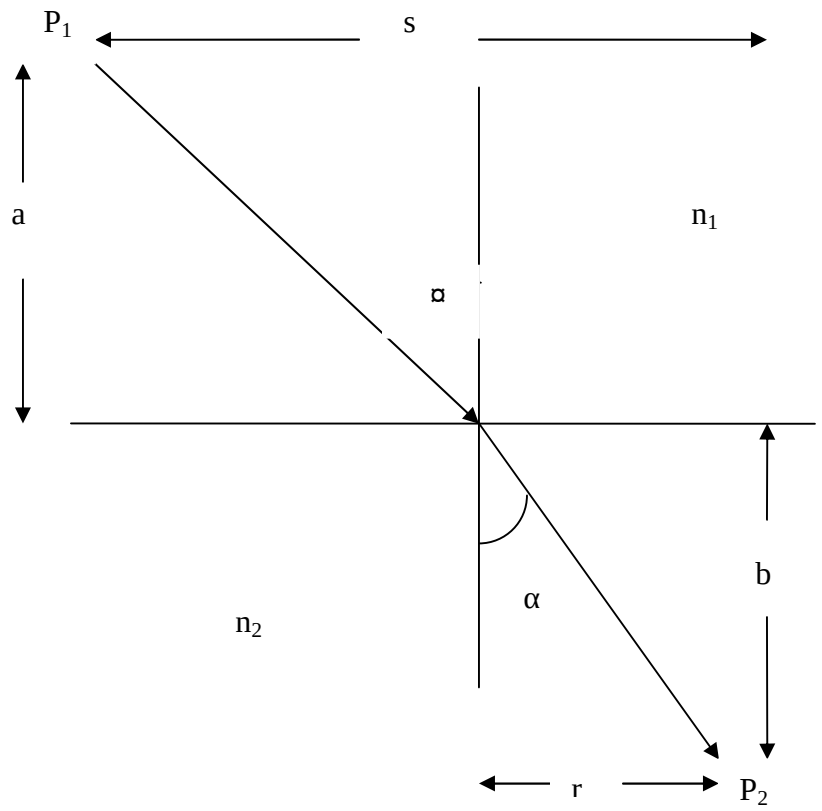
c) The angle of incidence of a light beam in air onto a reflected surface is continuously variable. The reflected ray is found to be completely polarized when the angle of incidence is 48.0^o. Determine

(i) the refractive index of the reflecting material. (3 marks)

(ii) if some of the incident light passes into the material below the surface, what is the angle of refraction (4 marks)

d) State three techniques of polarizing light. (3 marks)

Q3. a) The diagram below shows the path of a light ray as it moves from medium 1 to medium 2 of refractive indices n_1 and n_2 respectively



By applying Fermat's principle show that

$$\frac{\sin ¤}{\sin \sim} = \frac{n_1}{n_2} = \frac{v_1}{v_2}$$

where v_1 and v_2 are the velocities of light in medium 1 and 2 respectively.
(10 marks)

b) (i) State two defects of vision and explain how they are corrected. (4 marks)
(ii) The walls of a filled aquarium are made of glass of refractive index 1.51. If a ray strikes the glass from inside at an angle of 45^o , what is the angle at which the ray emerges into the air? Given that the refractive indices of air and water are 1.00 and 1.33 respectively. (6 marks)

Q4. a) (i) State the principle of superposition. (2 marks)

(ii) Explain how standing waves are produced? (4 marks)
b) A compound microscope has an eye lens of focal length 62.5 mm placed 150 mm from the objective lens. The instrument gives a final image at 250 mm (least distance of distinct vision) and it is found that in this adjustment the magnifying power is 50 X. What is the focal length of the objective lens? (6 marks)

c) (i) Define chromatic aberration and explain how it is caused. (4 marks)

(ii) A diffraction grating is fitted on a spectrometer with monochromatic light incident normally on it. State two ways in which the spectra observed will be affected if a grating of larger spacing was used. (4 marks)

Q5. a) (i) State Huygen's principle. (2 marks)

(ii) Two identical light waves of wavelength start out in phase, travel distances d_1 and d_2 respectively,(where $d_1 > d_2$) , write down the condition for constructive and destructive interference. (2 marks)

b) A diffraction grating with 500 lines / mm is illuminated normally with a monochromatic light of wavelength 589 nm.

(i) How many diffraction maxima may be observed. (2 marks)

(ii) Calculate their angular positions. (6 marks)

c) Show that the minimum angle of deviation ∂ of a ray passing through a prism is related to its refracting angle ~ and refractive index n of the prism material as given below

$$\partial = (n-1)\sim$$

(8 marks)