MENGO SENIOR SCHOOL
BEGINNING OF TERM 2 EXAMS 2003
S.5 PHYSICS P510/2
TIME: 2 HOURS

INSTRUCTIONS:
-Attempt any four questions
-All questions carry equal marks
-Assume where necessary
-Speed of light in a vacuum = 3 x 10^8 m/s
- v= f
All symbols carry their usual meanings

1(a) Define the term refraction as used in optics.

(b) Show how the index of refraction is related to the wave length of light in the media in contact.

(c) A microscope is first focused on a scratch at the bottom of an empty glass dish. When the dish was filled with water, its found necessary to raise the microscope through 1.2cm to refocus the scratch.

Chalk dust is sprinkled on top of the water and is brought into focus when the microscope is raised through an additional 3.5cm. Calculate:

(i) The real depth of this scratch.
(ii) Its apparent depth
(iii) The refractive index of the water.

d(i) Light from a source passes normally through a parallel sided glass slab of thickness S and refractive index n, source is displaced by a distance d given by

d= S(1- 1/n)

(ii) It is required to produce a sharp photograph of a small plant growing inside an aquarium tank. The plant is situated at a perpendicular distance of 13cm from the inside wall of the aquarium's flat glass window whose walls are 4cm thick.

The camera is 17cm from the outside wall of the window with its principal axis normal to the wall and in line with the plant. What distance setting will have to be made on the focusing ring of the lens to produce the required photograph.

2(a) Explain the meaning of the terms critical angle and total internal reflection.

(b) Monochromatic light is incident from air on to an equilateral prism of refractive index 1.54. The light is just totally internally reflected at the face AC of the prism as shown below. Find

(i) The critical angle for the glass-air interface.
(ii) The angle of incidence at face AB
(iii) The value of the deviation D

(c) A ray of light is incident at right angles on the face of a right angled isosceles prism of refractive index 1.6 as shown below:

Draw the path of the refracted and emergent rays.

(d) If the prism is surrounded by a liquid of refractive index 1.40 show the passage of the ray through the prism.

3(a) Derive the expression for the focal length of a diverging lens in terms of the object and image distances from the lens.

(b)(i) An illuminated object is placed d cm from the centre of a converging lens of focal length f cm. Find the lateral magnification (M) of the image.

(ii) What physical interpretation would you attach to the negative value of M?

(c) A glass prism of refractive angle 60^0 is immersed in a liquid of refractive index 1.4. When light is incident on the prism at an angle of 32.4^0. The angle of deviation is a minimum. Find:

(i) The refractive index of the prism
(ii) The angle of minimum deviation

(d)(i) State the condition under which total internal reflection occurs and illustrate your argument

(iii) Give any three applications of total internal reflection.

4(a) State the laws of refraction of light.

(b) The figure below shows a monochromatic source of light S in air that sends a narrow beam of light of perpendicular to the screen that is 2m away.

The beam strikes the screen at P. A glass block of refractive index 1.5 and thickness 0.10m is inserted as shown so that the beam strikes the block at an angle of incidence of 30^0

Calculate the:
(i) Angle of refraction at the first face.
(ii) Distance OT and the time taken to cover the distance OT
(iii) The lateral displacement of the beam
(iv) The speed of the beam through the glass

(c)(i) Give two reasons why the time to cover the path $SOTP_0$ is longer than that taken to cover SOP

(ii) What happens to the lateral displacement if the monochromatic source S above is replaced by one which radiates light of a shorter frequency.

5(a) Distinguish between the terms dispersion and deviation of light as applied to prisms.

(b)(i) What is meant by refractive index of a medium.

(ii) Monochromatic light is incident on a block of transparent material placed in a vacuum. The light is refracted through an angle . If the block has a refractive index n and is of thickness t. Show that the light takes a time.
$\frac{t \sec}{C}$ to emerge from the block, where C is the speed of light in a vacuum.

(d) The figure below shows a layer of liquid confined between two transparent plates A and B of refractive indices 1.54 and 1.44 respectively.

A ray of monochromatic light making an angle of 40^0 with the normal to the inter face between medium A and the liquid, is refracted through an angle of 50^0 by the liquid. Find

(i) The refractive index of the liquid
(ii) The angle of refraction in medium B
(iii) The minimum angle of incidence in medium A for which the light will not emerge from medium B.

END