KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2010/2011 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **PHYS 122**

COURSE TITLE: **GEOMETRIC OPTICS**

STREAM: **SESSION III**

DAY: **WEDNESDAY**

TIME: **9.00 – 11.00 A.M.**

DATE: **13/04/2011**

INSTRUCTIONS:

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries **30marks** while each of the other Two Questions carry 2**0marks**.*

PLEASE TURN OVER

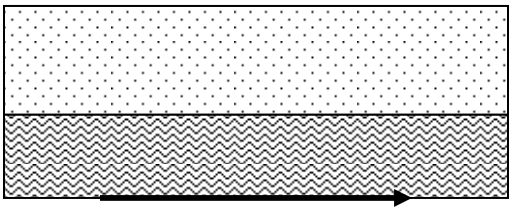
QUESTION 1 (30 marks)

a) State what is meant by rectilinear propagation of light. (1mk)
b) State three properties of real images (3mks)

c) i) State Huygen's principle. (1mk)
ii) Use Huygen's principle to derive the Snell's law of refraction. (5mks)

d) i) Define what is meant by the refractive index of a medium. (1mk)
ii) The refractive index for a ray of light traveling from glass to air is 0.67. If the speed of light in air is $3\times10^{8}\,m/s$, calculate the speed of light in glass. (3mks)

e) The diagram below shows a pin placed at the bottom of two transparent materials. The top medium is of refractive index 1.4 and the bottom is of refractive index 1.6. The thickness of the top medium is 12.5cm and that of bottom is 7.5cm.



Calculate the apparent position of the pin as seen from top. (5mks)
f) Differentiate between the following. (4mks)
i). Far point and near point of human eye
ii). Real and virtual image

g) i) What is lens aberration? (1mk)
ii) State and explain the two types of lens aberration. (4mks)
iii) State how each of the aberrations in (ii) can be reduced. (2mks)

QUESTION 2 (20 marks)

a) i) State Fermat's principle. (1mk)
ii) Use Fermat's principle to prove the law of reflection (5mks)

b) A glass plate 3mm thick of refractive index 1.5 is placed between a point source of light of wavelength 600nm and a screen. The distance from the source to the screen is 3cm. Calculate the number of waves produced; assume one wave is a single wavelength. (6mks)

c) Light strikes a transparent material at angle of incidence of 60° and part of it is reflected while the other part is refracted. It is observed that the angle between the

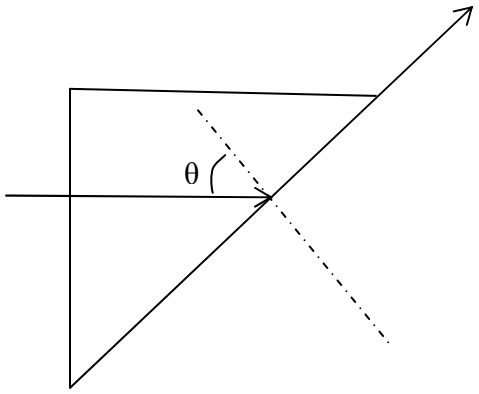
reflected and refracted rays is 90°. Calculate the refractive index of the material.
(4mks)

d) Differentiate between hypermetropia and myopia and state how each can be corrected.
(4mks)

QUESTION 3 (20 marks)

a) State what is meant by critical angle of a medium. (1mk)

b) The figure below shows a triangular prism with a ray of monochromatic light incident normal to one face and emerge on the other face as shown.



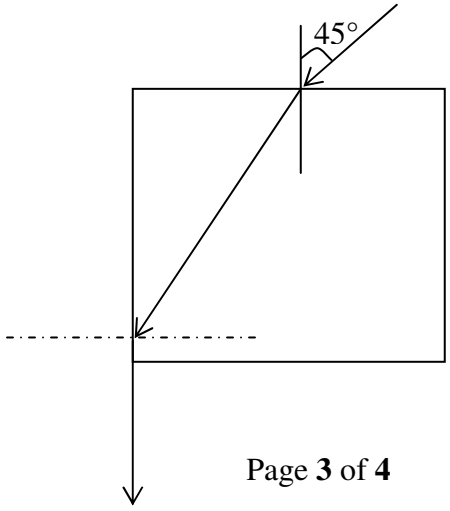
If $\theta = 45^0$

i). Calculate the refractive index of the glass (3mks)

ii). What would be the critical angle if the prism is immersed in water of refractive index 1.33 (4mks)

iii). State what is meant by monochromatic light? (1mk)

b) i) A light ray falls on a square transparent material. What must be the refractive index of this material if the ray has to traverse through it as shown?
(4mks)



ii) State two conditions for the above ray to undergo total internal reflection. (2mks)

c) An astronomical telescope has an objective lens of focal length 120cm and an eye piece lens of focal length 5cm. If the telescope is in normal adjustment, find,
i) the angular magnification (3mks)
ii) the length of the telescope. (2mks)

QUESTION 4 (20 marks)

a) i) What is refraction? (1mk)
ii) Use Fermat's principle to prove the law of refraction (6mks)

b) i) State one condition for a concave mirror to give a magnified image. (1mk)
ii) A man has a concave shaving mirror whose focal length is 80cm. How far should the mirror be held from his face in order to give an image two times magnified? (3mks)

c) An object is placed 20cm from a convex lens of focal length 15cm. Another convex lens of focal length 25cm is placed at a distance (d) from the first lens. If an image is formed 20cm from the second lens, calculate
i). the distance (d) (4mks)
ii). the final magnification of the image (3mks)

d) State two characteristics of images formed by convex mirrors. (2mks)

QUESTION 5 (20 marks)

a) State two differences between astronomical telescope and compound microscope other than their uses. (2mks)

b) State two reasons why convex mirror is used as a driving mirror. (2mks)

c) A convex lens of focal length 15cm forms an image with a magnification of 3. Find;
i). the object distance (4mks)
ii). state the nature of image formed other than being enlarged. (2mks)

d) i) Define angular magnification of an optical instrument. (1mk)
ii) Derive the expression of angular magnification of a simple microscope. (6mks)

e) Sketch a diagram to show how a compound microscope is used. (3mks)