CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN PHYSICS, BACHELOR OF SCIENCE IN MATHEMATICS, BACHELOR OF SCIENCE IN CHEMISTRY AND BACHELOR OF EDUCATION SCIENCE

PHYS 151: GEOMETRICAL OPTICS

STREAMS: BSc Physics, BSc Maths, BSc Chemistry, BeD Science Y1S2

TIME: 2 HOURS

DAY/DATE: THURSDAY 21/4/2023 **2.30 P.M. – 4.30 P.M.**

Instructions;
Answer question ONE and any other TWO questions.

Question One

a. In what two positions will a converging lens of focal length +9cm form images of a luminous object on a screen located 40cm from the object? (4 marks)

b. State the laws of refraction. (3 marks)

c. .State the Fermat's principle. (2 marks)

d. Using a ray sketch diagram, explain the dispersion of light. (4 marks)

e. Using a ray sketch diagram, differentiate between real and apparent depth. (3 marks)

f. using a ray sketch diagram, differentiate between a myopic and hyperopic eye. (4 marks)

g. List six aberrations of lenses. (3 marks)

h. List six optical instruments. (3 marks)

i. State the Huygens principle. (2 marks)

j. List four characteristics of electromagnetic waves.. (2 marks)

Question Two

a. A narrow beam of light is incident from air onto a glass surface with index of refraction 1.56. Find the angle of incidence for which the corresponding angle of refraction is one-half the angle of incidence. [*Hint:* You might want to use the trigonometric identity $\sin 2\theta = 2 \sin \theta \cos \theta$.] (6 marks)

b. For a lens with focal length *f* find the smallest distance possible between the object and its real image. (4 marks)

c. A concave spherical mirror with a radius of curvature of 15.0 cm produces a virtual image one-third the size of the real object. Where is the object? Use geometrical costruction and the mirror equations separately, then compare the answers. (10 marks)

Question Three

a. An object of height 4cm is placed 20cm in front of a thin convex lens of focal length +12cm. Determine the location and characteristics of the image by (i) geometrical construction and (ii) computation. (8 marks)

b.Differentiate between a myopic and a hyperopic eye using a ray diagram. (4 marks)

c. Write the lens' makers equation. (2 marks)

d. Explain total internal reflection using a sketch ray diagram? Hence draw the structure of a fiber optic cable and list three of its applications. (6 marks)

Question Four

a. Use the Fermats' principle to derive the laws of refraction. (10 marks)

b. Copy and draw rays to figure out the final image. in figure 1 below.. .

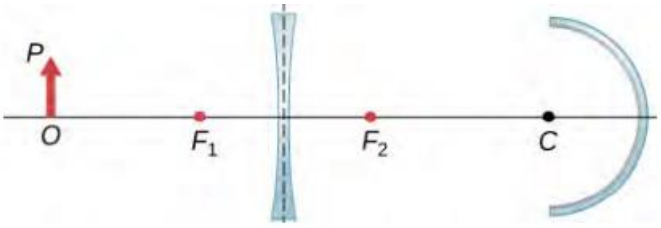

Figure 1

(10 marks)

Question Five.

a. Draw a ray diagram for an object reflected by a convex mirror. Hence derive the following equation for a convex mirror: 1 /VO − 1 /VI = − 1 /VF , where VO is the distance to the object O from vertex V, VI the distance to the image I from V, and VF is the distance to the focal point F from V using the ray diagram. (10 marks)

b. (i) Draw rays to form the image of a vertical object on the optical axis and farther than the focal point from a converging lens. (ii) Use plane geometry in your figure and prove that the magnification m is given by m = hi /ho = − di /do (o is object and I is image) (10 marks)

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