**SOUTH EASTERN KENYA UNIVERSITY**

**UNIVERSITY EXAMINATIONS 2016/2017**

**FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF**

**SCIENCE IN ELECTRONICS**

**PHY 213: GEOMETRICAL OPTICS**

**5TH DECEMBER, 2016**

**INSTRUCTIONS TO CANDIDATES**

**TIME: 1.30-3.30 P.M**

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Question one carries 30marks while the rest carry 20marks each

Answer **Question One** and any **other two** questions

Speed of light in vacuum, c = 3.0108 *m* / *s*

Refractive index of vacuum (air) = 1

**Question One (30 mks)**

**a)** What are paraxial rays as used in geometrical optics

**b)** Differentiate between the following:

**(i)** absolute and relative refractive index

**(ii)** virtual and real image

**c)** Diamond has a refractive index,*d* *2.4* . Calculate its critical angle, C

**d)** Briefly explain any two rays used in image formation on spherical surfaces

(2 mks)

(2 mks)

(2 mks)

(3 mks)

(4 mks)

**e)** Using a diagram, describe the images formed by a concave mirror when the object is at infinite

distance

**f)** A thin lens has a focal length of -20 m.

**(i)** Determine its power

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(5 mks)

(2mks)

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**(ii)** Name the type of lens

(1mk)

**g)** A diverging lens has a focal length of 20.0 *cm* . An object 2.0 cm tall is placed 30.0 cm in front of

the lens.

**(i)** Locate the image

**(ii)** Determine the image magnification and height

(3 mks)

(3 mks)

**h)** If a swimming pool is 2 m deep. When filled with water of refractive index of water, water

*4*

*3*

, how

deep does it appear when viewed from the surface?

**Question Two (20 mks)**

**a) (i)** State the Fermat’s principle

**(ii)** Using the Fermat’s principle, prove the law of reflection

(3mks)

(2 mks)

(8 mks)

**b)** A glass container has a uniform diameter of 4cm. When an observer’s eye is placed at the top edge of the

glass, the observer sees the bottom edge (A). When the glass is filled with a liquid of refractive index

 *1.33* , the observer sees the center (B) of the bottom of the glass as shown in **Fig.1** below.

*h*

*A*

**Fig. 1**

Determine the height of this container

*B*

*2 cm*

(5 mks)

**c)** Describe myopia as a defect of the eye, explaining how it is corrected

**Question Three (20 mks)**

**a)** (i) Describe the concept of total internal reflection

(ii) State two conditions necessary for total internal reflection to occur

(5 mks)

(7 mks)

(2mks)

**b)** Light travelling in air enters water with an angle of incidence of 450. If the refractive index of the

water is 1.33, find the angle of refraction

c) A certain spherical mirror has a focal length *f*10.0 *cm* .

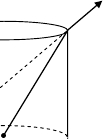
i) Locate the image for object distances of 5.0 cm.

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(3 mks)

(3 mks)

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ii) Determine the image magnification

iii) At what object distance is the magnification equal to1.0 ?

**Question Four (20 mks)**

**a)** Prove that the lens makers equation for a lens in a medium is given by

*q p*1 *r r*2

(2 mks)

(3 mks)

is the refractive index of the lens material,1 is the index of the medium the lens is placed, p is object

distance, q is image distance while *r*1 and *r*2 are the two radii of curvature.

**b)** Using the above equation, describe;

(10 mks)

**(i)**

**(ii)**

**(iii)**

**(iv)**

Lens makers equation when the lens is placed in air

Primary focal length

Secondary focal length

Gausian equation

(2 mks)

(3 mks)

(3 mks)

(2 mks)

**Question Five (20 mks)**

**a) (i)** Describe the Huygen’s wave theory

**(ii)** Using the Huygen’s theory, prove the Snell’s law

**b)** Explain the concept of chromatic aberration

(3 mks)

(7 mks)

(3 mks)

**c)** Two lenses of focal lengths 10 cm and*10* cm are placed in line 30 cm apart. An object is placed

*20* cm infront of the lenses.

**(i)** Find the Position of the final image

**(ii)** Calculate the Magnification of the final image

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(3 mks)

(4 mks)

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