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MAIN EXAMINATION

JANUARY – APRIL 2015 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES (PHYSICS)

PHY 104: GEOMETRICAL OPTICS

Date: April 2015	**Duration: 2 Hours**
Instructions: Answer Question ONE and any other TWO Questions	

Q1 a) i) Define the terms
Luminous flux and Luminous intensity.

(2 marks)

ii) Using a mathematical relationship state the relationship between luminous flux and Luminous intensity.

(1 marks)

iii) State the SI units of luminous flux and luminous intensity.

(2 marks)

b) A point object is placed infront of a plane mirror as shown in figure 1.

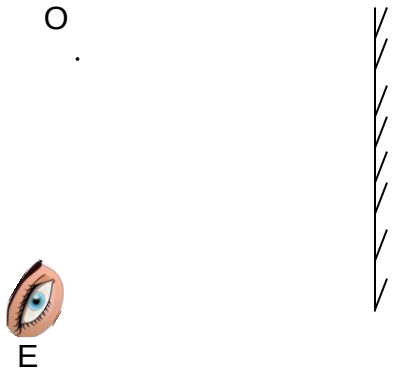

Fig.1

By use of ray diagram, indicate the position of the image I as seen by the eye E

(3 marks)

c) i) State the law of refraction

(2 marks)

ii) Given that the speed of light, c, is $3.0 \times 10^8 ms^{-1}$ and the refractive index of glass is $^4/_3$, calculate the speed of light as it travels through the glass.

(3 marks)

d) i) State and explain the two defects of vision

(2 marks)

ii) Explain how each of the above defects can be corrected by use of spectacles.

(4 marks)

e) An object is placed 12cm infront of a biconvex lens of focal length 18cm. Determine the position and nature of the image formed using the lens formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

f) i) Define the term "total internal reflection."

(3 marks)

ii) A show that the displacement of an object below a transparent material is given by $d = t(1 - {}^1\!/_n)$

(4 marks)

Q2. a) A glass prism of angle 72^0 and refractive index of 1.66 is immersed in a liquid of refractive index 1.33. Calculate the minimum angle of deviation D for a parallel beam of light passing through the prism

Take $n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin({}^A\!/_2)}$

Where n is the relative refractive index of glass with respect to the liquid.

(2 marks)

b) A ray of light AO is incident on a plane mirror, M, at a glancing angle x. The mirror is then rotated through an angle θ. If the direction of the incident ray is kept constant, show that the angle of rotation of the reflected ray is twice the angle of rotation of the mirror.

(8 marks)

c) Using illustrations, explain how a mirror galvanometer optical lever uses the above described principle to measure small changes in length due to expansion and contraction of a solid.

(8 marks)

Q3. a) i) By use of a ray diagram, illustrate how a concave mirror can be used to produce an upright, virtual and magnified image.

(3 marks)

ii) Use ray diagram to illustrate how a convex mirror produces a upright, vertical but diminished image.

(3 marks)

b) An illuminated object placed infront of a concave mirror produces a sharp image on the screen. Table 1 shows the results obtained from various distances and the calculated value of magnification, m.

Table 1

Image distance, V from the mirror (cm)	15.0	26.7	30.0	35.5	43.3	60.0
Magnification m	0.5	1.7	2.1	2.5	3.3	5.0

i) On the grid provided plot a graph of magnification against image distance.

(4 marks)

ii) Using the graph, determine the focal length, f, of the mirror given that $m = \frac{v}{f} - 1$ **(4 marks)**

c) A small object is placed on the principal axis of a concave mirror of radius 20cm at a distance of 30cm. By how much will the position and the size of the image alter when a parallel sided slab of glass of thickness 6cm and refractive index 1.5 is introduced between the centre of the curvature and the object?

(6 marks)

Q4. a) i) A 2.0m high object is placed 0.50 m on the left side of a biconvex lens of focal length 0.20m. Determine the size of the image.

(6 marks)

ii) If a biconcave lens of focal length 0.10m is placed 0.5m to the right of the biconvex lens above, using an illustration calculate the size of the image formed by the combination of the lenses.

(8 marks)

iii) Show that a real image can only be formed by a convex lens when the distance between the object and the screen is greater than four times the focal length of the lens.

(6 marks)

Q5. a) Using a well labeled diagram, explain how an image of a far off distant object is formed by a Galileo's telescope.

(9 marks)

b) The focal length of the eyepiece of a certain microscope is 18.0 mm. The focal length of the objective is 8.00mm. The distance between the eye piece and the objective is 19.7cm. The final image formed by the eyepiece is at infinity. If all the lenses are very thin, calculate:

i) The distance between the objective and object being viewed.

(3 marks)

ii) The magnitude of the linear magnification produced by the objective.

(2 marks)

ii) The overall angular magnification of the microscope.

(4 marks)

c) State the difference between a simple microscope and a compound microscope.

(2 marks)

END