Unit 13 · Light

WORKSHEET

Full marks 44

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 44

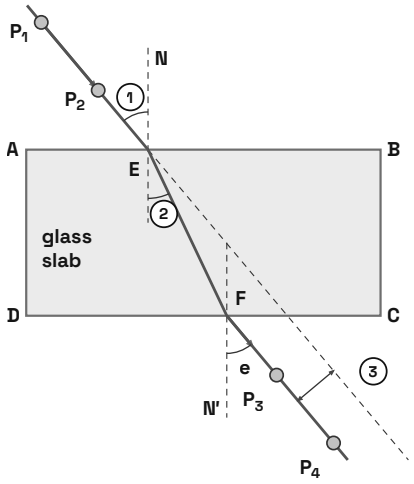
1 Key words [3]

Match each word in Column A with its description in Column B. Write the letter in the box. One description in Column B is not needed. Each match carries 0.5 mark.

Column A		Column B
1. optically denser	☐	**a.** the distance below the surface at which an object seems to be
2. normal	☐	**b.** the angle of incidence in the denser medium for which the angle of refraction is 90°
3. refractive index	☐	**c.** the angle between the incident ray and the surface
4. critical angle	☐	**d.** a medium in which light travels more slowly
5. lateral shift	☐	**e.** a line at right angles to the surface at the point of incidence
6. apparent depth	☐	**f.** speed of light in a vacuum ÷ speed of light in the medium
		g. the perpendicular distance between the emergent ray and the incident ray produced

2 Label the diagram [3]

The diagram shows the pin method with a glass slab. Name the numbered angles (angle of incidence or of refraction), and name the numbered distance. Each carries 1 mark.



1. _____ **2.** _____

3. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. When light passes from air into glass at a slant, it: [1]

a. speeds up and bends away from the normal **b.** slows down and bends toward the normal

c. slows down and goes on in a straight line **d.** speeds up and bends toward the normal

ii. The critical angle of glass is 42°. Light inside glass meets the glass–air surface at 50°. It will be: [1]

a. refracted into the air, bent toward the normal

b. refracted into the air, bent away from the normal

c. totally reflected back into the glass

d. absorbed at the surface

iii. Which relation is correct for a medium of refractive index μ in air, with critical angle c? [1]

a. $\mu = \sin c$ **b.** $\mu = \dfrac{1}{\sin c}$

c. $\mu = \dfrac{1}{\cos c}$ **d.** $\mu = \tan c$

iv. The refractive index of water is 4/3. A coin at the bottom of a tank of water 2 m deep appears, from straight above, to be at a depth of: [1]

a. 2.67 m **b.** 2 m

c. 1.5 m **d.** 0.67 m

v. Optical fibers carry light by: [1]

a. refraction at their ends only

b. repeated total internal reflection at the edge of their core

c. reflection from a silver coating

d. diffraction round the bends

4 Very short answers [4]

Write very short answers to the following questions.

a. A ray strikes a surface at 30° to the surface. What is its angle of incidence? [1]

b. Kerosene floats on water. Which of the two is optically denser? [1]

c. What is the critical angle of diamond? [1]

d. What does a relative refractive index of less than 1 tell you? [1]

5 Short answers [8]

Write short answers to the following questions.

a. A pond looks shallower than it really is. [2]

b. A diamond sparkles much more than a glass copy of the same shape. [2]

c. Total internal reflection cannot happen when light goes from air into water. [2]

d. Why are prisms used in binoculars and periscopes instead of mirrors? **[2]**

6 Long answers **[8]**

Write long answers to the following questions.

a. Derive the relation between the critical angle and the refractive index of a medium. **[4]**

b. Show that real depth ÷ apparent depth = μ for an object under water seen from straight above. **[4]**

7 Numerical problems **[10]**

Solve the following problems. Show your working.

a. A ray of light passes from air into a block of glass. The angle of incidence is 45° and the angle of refraction is 28°. Find the refractive index of the glass. **[2]**

Answer:

b. Light travels at 2.25×10^8 m/s in a liquid. Find the refractive index of the liquid and its critical angle. ($c = 3 \times 10^8$ m/s) **[3]**

Answer: _____

c. A mark on paper, seen through a glass slab 3.6 cm thick laid on it, seems to be raised by 1.2 cm. Find the refractive index of the glass. **[2]**

Answer: _____

d. Anisha uses a traveling microscope to find the refractive index of a liquid. Focused on a scratch on the bottom of an empty beaker, it reads 1.12 cm. With liquid poured in, it must be raised to 2.08 cm to see the scratch clearly. Focused on a little powder floating on the liquid's surface, it reads 4.90 cm. Find the refractive index of the liquid. **[3]**

Answer: _____

8 Think **[3]**

A small lamp lies on the bottom of a swimming pool 2 m deep (μ of water = 1.33). Light from it gets out of the water only through a circle on the surface. Explain why, and find the circle's radius. ($\tan 48.8^\circ = 1.14$)

9 Activity: Find the refractive index of glass (Practical 25) (not marked)

Trace rays through a glass slab with four pins, at each angle of incidence below. Measure r on your drawing, and find the ratio, sin i ÷ sin r, with a calculator or tables.

i	r	sin i	sin r	ratio
30°				
40°				
50°				
60°				

The average of the ratios is your refractive index. How does the emergent ray compare with the incident ray?