Unit 13 · Polarization

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

1 Key words [4]

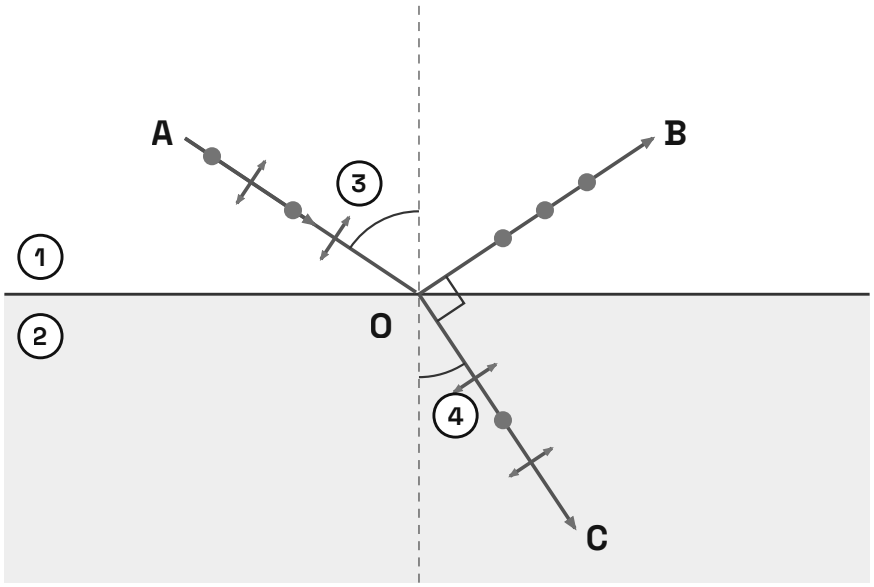
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

analyzer	**Brewster's law**	**diffraction**	**double refraction**	**interference**	**Malus's law**
optical activity	**plane-polarized**	**polarization**	**polarizing angle**		

Restricting the vibrations of light to a single direction across the ray is _____. Light that vibrates in one direction only is _____ light. The first filter, which makes the polarized light, is the polarizer; the second, turned to test it, is the _____. The intensity through the second filter falls as $\cos^2\theta$, by _____. Reflected light is completely polarized at the _____, whose tangent is the refractive index: this is _____. A crystal such as calcite, which splits a ray into two, shows _____. The turning of the plane of polarization by a sugar solution is _____.

2 Label the diagram [2]

The diagram shows polarization by reflection at Brewster's angle. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. Polarization shows that light is: [1]

a. a longitudinal wave
b. a transverse wave
c. a stream of particles
d. a sound wave

ii. Unpolarized light of intensity 64 W/m^2 passes through a polarizer and then an analyzer at 30° to it. The intensity leaving the analyzer is: [1]

a. 48 W/m^2
b. 24 W/m^2
c. 16 W/m^2
d. 32 W/m^2

iii. A plastic has a refractive index of 1.72. Its polarizing angle is about: [1]

a. 30.2°
b. 54.5°
c. 59.8°
d. 45.0°

iv. At Brewster's angle, the reflected light vibrates: [1]

a. in the plane of incidence
b. at right angles to the plane of incidence, along the surface
c. in every direction
d. along the reflected ray

v. The analyzer's axis is turned through one whole turn, 360°, in front of plane-polarized light. The light goes dark: [1]

a. never
b. once
c. twice
d. four times

4 Short answers [7]

Write short answers to the following questions.

a. Write any two differences between polarized and unpolarized light. [2]

b. Why do polarized sunglasses cut the glare from a lake, but not from the sky above it to the same extent? [2]

c. Light falls on a glass of refractive index 1.40 at the polarizing angle. Find the angle of incidence, the angle of refraction, and the angle between the reflected and the refracted rays. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

Prove Brewster's law, $\mu = \tan \theta p$, using the fact that at the polarizing angle the reflected and refracted rays are at right angles.

6 Numerical problems **[8]**

Solve the following problems. Show your working.

a. Unpolarized light of intensity 80 W/m^2 falls on a polarizer, then an analyzer. Find i. the intensity after the polarizer, ii. the intensity after the analyzer when its axis is at 35° to the polarizer's, iii. the same at 70°, and iv. the angle at which a quarter of the polarized light gets through. **[4]**

Answer:

b. A glass has a refractive index of 1.60. Find i. its polarizing angle in air, ii. the angle of refraction then, iii. its polarizing angle when the glass is under water ($\mu = 1.33$), and iv. its critical angle in air. **[4]**

Answer: _____

7 Think **[3]**

Sound can be reflected, refracted and diffracted, just as light can. Why can't sound be polarized, and what does this tell us about the difference between the two waves?

_____

_____

_____

_____

_____

8 Activity: Find the polarizing angle of a tabletop (not marked)

In a room lit by a window, look at the window's reflection in a shiny tabletop (glass or polished wood) through polarized sunglasses, held as you wear them. Look along the table at different angles, from steep to grazing.

How you look at the table	How bright is the reflection?	Tilt the glasses 90°: what changes?
Nearly straight down		
About halfway		
Nearly along the surface		

At which angle does the reflection almost disappear? Why?

_____

_____