Unit 16 · Refraction through Prisms

WORKSHEET

Full marks 37

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 37

1 Key words [4]

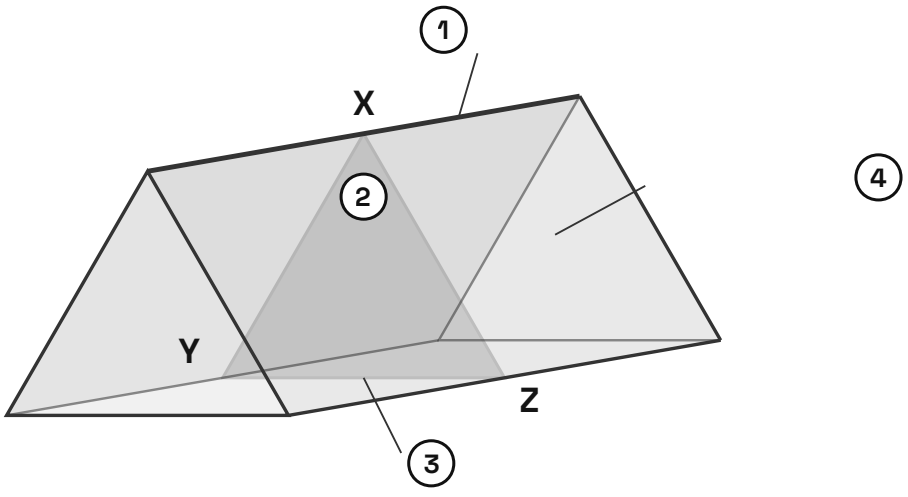
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

base	**critical angle**	**deviation**	**emergence**	**lateral shift**	**minimum deviation**
principal section	**refracting angle**	**refracting faces**	**thin prism**		

A prism has two plane _____ that meet along a straight line, the refracting edge; the face opposite this edge is the _____. The angle between the two faces is the _____ of the prism. A plane cut at right angles to the edge gives a triangle, the _____. The angle between the emergent ray and the normal at the second face is the angle of _____, and the angle between the directions of the incident and emergent rays is the angle of _____. As the angle of incidence grows, the deviation falls to a least value, the angle of _____, and rises again. A prism of small angle that turns every nearly normal ray by the same angle is a _____.

2 Label the diagram [2]

The diagram shows the parts of a prism. Write the words or letter that belong 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. A ray passes through a prism of refracting angle A. The angles of refraction r_1 at the first face and r_2 at the second face are related by: [1]

a. $r_1 = r_2$ always
b. $r_1 + r_2 = A$
c. $r_1 - r_2 = A$
d. $r_1 + r_2 = 180° - A$

ii. A ray falls on a 60° prism at 45° and leaves at 35°. Its deviation is: [1]

a. 20°
b. 10°
c. 80°
d. 140°

iii. A ray passes through an equilateral prism at minimum deviation. Its angle of refraction at the first face is: [1]

a. 60°
b. 30°
c. 45°
d. equal to the angle of incidence

iv. A thin prism of refracting angle 5° and refractive index 1.6 deviates a ray falling nearly normally on it by: [1]

a. 8°
b. 5°
c. 3°
d. 1.6°

v. A glass prism in air always turns light, overall: [1]

a. towards its refracting edge
b. towards its base
c. by the same angle, whatever the angle of incidence
d. by twice its refracting angle

4 Very short answers [3]

Write very short answers to the following questions.

a. Define the angle of deviation of a prism. [1]

b. Write the deviation produced by a thin prism in terms of its angle and refractive index. [1]

c. Why is the refractive index of a prism measured at minimum deviation? [1]

5 Short answers [6]

Write short answers to the following questions.

a. With a diagram, show that $r_1 + r_2 = A$ for a ray passing through a prism. **[2]**

b. Use the reversibility of light to explain why, at minimum deviation, the angle of incidence equals the angle of emergence. **[2]**

c. Write any two uses of thin prisms. **[2]**

6 Long answer [4]

Write a long answer to the following question.

Show that the refractive index of the material of a prism is $\mu = \sin((A + \delta_m)/2) \div \sin(A/2)$, where A is the angle of the prism and δ_m its angle of minimum deviation.

7 Numerical problems [10]

Solve the following problems. Show your working.

a. A ray falls at 55° on one face of a 60° glass prism of refractive index 1.52. Find the angle of emergence and the deviation. **[3]**

Answer: _____

b. In a laboratory, an equilateral prism gives a minimum deviation of 39.0° for yellow light. Find the refractive index of its glass for yellow light, and the angle of incidence at minimum deviation. **[3]**

Answer: _____

c. A prism of refracting angle 45° is made of glass of refractive index 1.6. **[4]**

i. Find its angle of minimum deviation.

ii. A ray falls normally on its first face. Show that this ray cannot come out of the second face.

Answer: _____

8 Think [3]

Light passing through a parallel-sided glass slab comes out parallel to the way it went in, but light passing through a glass prism is always turned. Explain the difference, and say which way the prism turns the light.

9 Activity: The deviation produced by a prism (Activity 16.1) (not marked)

Trace rays through a 60° glass prism with pins, as in the activity, for each angle of incidence in the table. Plot the deviation against the angle of incidence.

Angle of incidence i	30°	35°	40°	45°	50°	55°	60°
Angle of emergence e							
Deviation δ							

What is the least deviation, and at what angle of incidence? Compare i and e there.