Physics 102 (F16)

Q10A

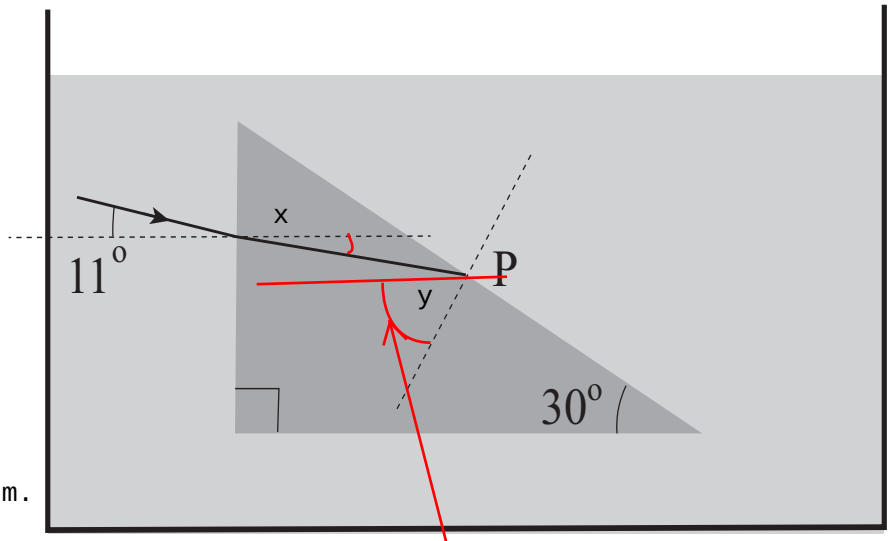
Name: _____ **Section:** _____ **Score:** _____/20

1. A triangular prism as sketched in the figure with the index of refraction $n = 1.4$ is surrounded by a liquid of index of refraction $n_L = 1.2$. Light is incident from left as illustrated in the figure (dotted lines denote normal directions of respective surfaces).

(1) The wavelength of the light **in the prism** is 385 nm. What is its wavelength in the surrounding liquid? [5]

c = f lambda
c = c0/n

The frequency does not change in different media.



Therefore, lambda in a medium is proportional to 1/n. That is,
n x lambda is common to all the media. Hence,
1.4 x 385 = 1.2 x X.
X = 385 x 1.4/1.2 = 449 nm.

You must know that the wavelength in the prism is shorter than that in the liquid

This angle is 60 deg

(2) Can the light go out from P into the surrounding liquid? [5]

Geometry: y - x = 60 deg

Snell's law: n1 sin theta1 = n2 sin theta2

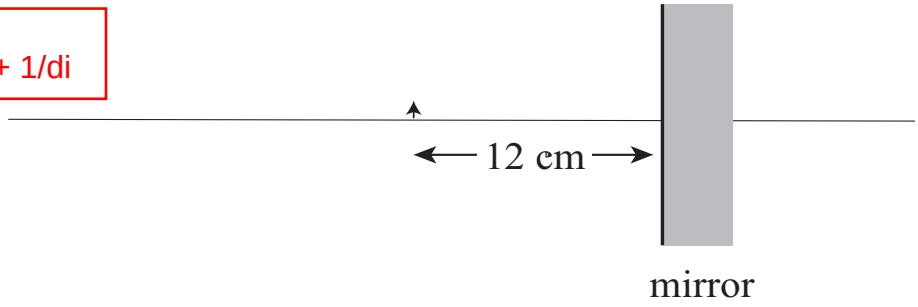
1.2 sin 11 = 1.4 sin x -> sin x = 0.21635 -> 9.41 deg.
Therefore, y = 60 + 9.41 = 69.4 deg

Apply Snell's law at P: 1.4 sin 69.4 = 1.31 = 1.2 sin theta.
Thus sin theta = 1.31/1.2 = 1.092 Hence, total reflection occurs.

If
(n1/n2)sin theta1 > 1 -> internal reflection

2. 12 cm in front of a mirror is a real object of height 24 mm whose image is formed 8 cm away from the mirror.

m = -di/do
1/f = 1/do + 1/di



(1) What is the (absolute) size of the image? [5]

|m| = |di|/|do| = 8/12 = 2/3.
Therefore, 24 x 2/3 = 10/3 = 16 mm

(2) The image is actually inverted. What is the focal length of the mirror? Is it converging or diverging? [5]

m > 0 upright
m < 0 inverted

m = -3/2 or di = 12 cm (that is 12 cm in front of the mirror.

1/f = 1/8 + 1/12 = (3+2)/24 = 5/24 Therefore f = 24/5 = 4.8 cm > 0. This means that the mirror can actually gather light energy. Thus, concave mirror. (converging)