Light enters the prism shown parallel to the base. The index of refraction of the prism is 1.55.

(a) Calculate the angle in air, measured with respect to the normal, of the light path when it leaves the prism.

(b) At what minimum angle, with respect to the normal of side A, should the light enter the prism such that there is total internal reflection at side B?

\[ \text{a) Let } \theta \text{ be the initial angle in the air on side A.} \]

Snell's law: \[ \frac{\sin \theta}{\sin \varphi} = n \Rightarrow \sin \varphi = \frac{\sin \theta}{n} \Rightarrow \varphi_1 \approx 29.14^\circ \]

We may have two different possibilities: 1) light strikes side B after entering the prism. 2) Light strikes side C.

1) Light strikes side B:
\[ \alpha_2 = 180 - 90 - \alpha_1 \approx 62.86^\circ \]

The critical angle is: \[ \sin \alpha_c = \frac{1}{n} \Rightarrow \alpha_c \approx 40.2^\circ \]

\[ \alpha_3 = 90 - (180 - 45 - \alpha_2) \approx 17.86^\circ \Rightarrow \text{light goes out of prism from side C.} \]

\[ \frac{\sin \alpha_3}{\sin \theta} = \frac{1}{n} \Rightarrow \sin \theta' = n \sin \alpha_3 \Rightarrow \theta' \approx 28.38^\circ \]

2) Light strikes side C.

It is obvious that goes out with the same angle with respect to normal of side B, as it entered on side A:

\[ \alpha_2 = 90 - (180 - 135 - \alpha_1) = 45 + \alpha_1 \Rightarrow \theta' = 45^\circ \]

\[ \alpha_3 = 180 - 135 - \alpha_2 = \alpha_1 \]

\[ \sin \theta' = n \sin \alpha_1 = \sin \theta \]
We already know that critical angle is \( \alpha_c \approx 40.2^\circ = \alpha_2 \)
\[ \alpha_1 = 90 - \alpha_2 \approx 49.8^\circ \]
But the maximum of \( \alpha_1 \) is 40.2° (when \( \theta \) is close to 90°).
It means that if light enters prism from side A and then strikes side B, total internal reflection always occurs.
Hence the maximum angle is the maximum available

\[
\text{That is } 90^\circ
\]