A light ray is incident perpendicular to the surface of a glass prism \((n = 1.5)\) as shown in the drawing.

(a) Is it possible for any light to emerge from the glass at point A? If so, find the angle \(\theta\) at which the light leaves the glass.

Here the angle of incidence is 0°, so the light ray does not bend. By geometry, the angle of incidence at point A is 60°. Use Snell’s law to find the angle of refraction.

\[
n_1 \sin \theta_1 = n_2 \sin \theta_2
\]

\[
1.5 \sin 60° = 1.0 \sin \theta_2 \Rightarrow \sin \theta_2 = 1.3 \Rightarrow \text{no solution} \Rightarrow \text{no refracted ray} \Rightarrow \text{total reflection}
\]

(b) At least some of the light reflects at A and travels to point B. Is it possible for any light to emerge from the glass at point B? If so, find the angle \(\theta\) at which the light leaves the glass.

By geometry, the angle of incidence at B is 30°.

\[
n_1 \sin \theta_1 = n_2 \sin \theta_2
\]

\[
\sin \theta_2 = \frac{1.5}{1.0} \sin 30° \quad \text{Light emerges @}
\]

\[
\theta_2 = 48.6°
\]

(c) Repeat part (a) for a glass prism that is submerged in water \((n = 1.33)\).

\[
1.5 \sin 60° = 1.33 \sin \theta_2
\]

\[
\sin \theta_2 = 0.9767 \quad \text{Light emerges @}
\]

\[
\theta_2 = 77.6°
\]