

## Refraction

**Problem C****CRITICAL ANGLE****PROBLEM**

The critical angle for light traveling from a red spinel gemstone into air is  $35.8^\circ$ . What is the index of refraction for red spinel?

**SOLUTION**

**Given:**  $\theta_c = 35.8^\circ$        $n_r = 1.00$

**Unknown:**  $n_i = ?$

**Choose the equation(s) or situation:** Use the equation for critical angle.

$$\sin \theta_c = \frac{n_r}{n_i}$$

**Rearrange the equation(s) to isolate the unknown(s):**

$$n_i = \frac{n_r}{\sin \theta_c} = \frac{1.00}{\sin 35.8^\circ} = \boxed{1.71}$$

**ADDITIONAL PRACTICE**

- The critical angle for light traveling from a green tourmaline gemstone into air is  $37.8^\circ$ . What is tourmaline's index of refraction?
- The critical angle for light traveling from an aquamarine gemstone into air is  $39.18^\circ$ . What is the index of refraction for aquamarine?
- The critical angle for light traveling from almandine garnet into air ranges from  $35.3^\circ - 33.1^\circ$ . Calculate the range of almandine garnet's index of refraction.
- Light moves from olivine ( $n = 1.670$ ) into onyx. If the critical angle for olivine is  $62.85^\circ$ , what is the index of refraction for onyx?
- Light moves from spessartite garnet ( $n = 1.80$ )—also called spessartine—into obsidian. If the critical angle for spessartine is  $57.0^\circ$ , what is the index of refraction for obsidian?
- Light moves from a clear andalusite ( $n = 1.64$ ) crystal into ivory. If the critical angle for andalusite is  $69.9^\circ$ , what is the index of refraction for ivory?
- Find the critical angle for light traveling from ruby ( $n = 1.766$ ) into air.
- Find the critical angle for light traveling from sapphire ( $n = 1.774$ ) into air.
- Find the critical angle for light traveling from blue topaz ( $n = 1.61$ ) into air.
- Find the critical angle for light traveling from emerald ( $n = 1.576$ ) into air.