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Phys 122-401
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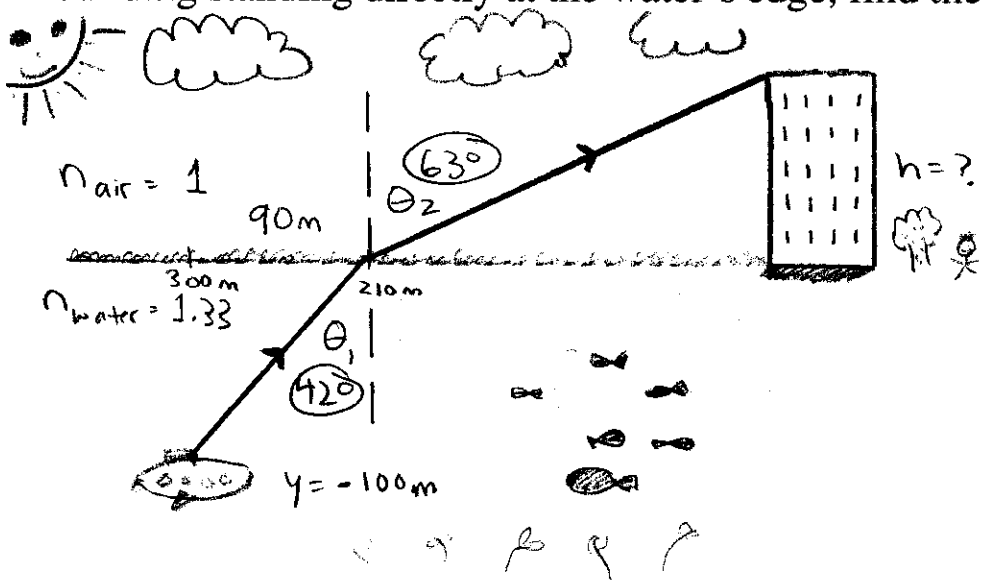
**QUIZ 9½ Refraction**

A submarine is 300 m horizontally out from the shore and 100 m beneath the surface of the water. A laser beam is sent from the sub so that it strikes the surface of the water at a point 210 m from the shore. If the beam just strikes the top of a building standing directly at the water's edge, find the height of the building.




$$\tan\theta_1 = \frac{90}{100} \Rightarrow \theta_1 = \arctan\frac{90}{100} = 42^\circ$$

$$n_1 \sin\theta_1 = \cancel{n_2}^{1} \sin\theta_2$$

$$\Rightarrow \theta_2 = \arcsin[1.33 \sin(42^\circ)]$$

$$= 63^\circ$$

$$\tan\theta_2 = \frac{210\,m}{h}$$

$$\Rightarrow h = \frac{210\,m}{\tan 63^\circ} = \boxed{107\,m}$$