

(III) Many sailboats are moored at a marina 4.4km away on the opposite side of a lake. You stare at one of the sailboats because, when you are lying flat at the water's edge, you can just see its deck but none of the side of the sailboat. You then go to that sailboat on the other side of the lake and measure that the deck is 1.5m above the level of the water. Using Fig. 1, where $h = 1.5$ m, estimate the radius R of the Earth.

Solution

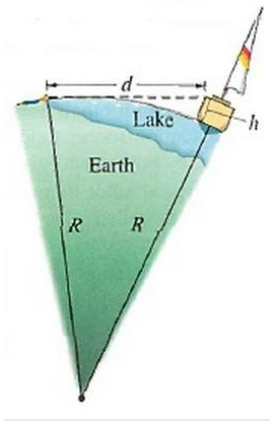


Fig. 1

The equation is the Pythagorean theorem $d^2 + R^2 = (R + h)^2$ where d = distance from you to the boat's deck, R = Earth's radius, and $(R+h)$ = Earth's radius + height of the boat from the surface of the lake.

$$R^2 + d^2 = (R + h)^2 \rightarrow R^2 + d^2 = R^2 + 2Rh + h^2 \rightarrow 2Rh = d^2 - h^2$$

$$R = \frac{d^2 - h^2}{2h} = \frac{4.4^2 * 10^6 - 1.5^2}{2 * 1.5} = 6.453 * 10^6 m = 6453 km$$

Answer: $R = 6453 km$.