16.7: Archimedes' Principle

The most important thing about Archimedes' principle is to get the apostrophe in the right place and to spell principle correctly.

Archimedes was a Greek scientist who lived in Syracuse, Sicily. He was born about 287 BC and died about 212 BC. He made many contributions to mechanics. He invented the Archimedean screw, he is reputed to have said "Give me a fulcrum and I shall move the world", and he probably did not set the Roman invading fleet on fire by focussing sunlight on them with concave mirrors – though it makes a good story. The most famous story about him is that he was commissioned by King Hiero of Sicily to determine whether the king's crown was contaminated with base metal. Archimedes realized that he would need to know the density of the crown. Measuring its weight was no problem, but – how to measure the volume of such an irregularly-shaped object? One day, he went to take a bath, and he had filled the bath full right to the rim. When he stepped into the bath he was much surprised that some of the water slopped over the edge of the bath on to the floor. Suddenly, he realized that he had the solution to his problem, so straightway he raced out of the house and ran absolutely starkers through the streets of Syracuse shouting " $\epsilon\upsilon\rho\eta\kappa\alpha!$ $\epsilon\upsilon\rho\eta\kappa\alpha!$", which is Greek for "Eureka, Eureka" meaning "I found it, I found it."

When a body is totally or partially immersed in a fluid, it experiences a hydrostatic upthrust equal to the **weight** of fluid displaced.

Figure XVI.8 is a drawing of some water or other fluid. I have outlined with a dashed curve an arbitrary portion of the fluid. It is subject to hydrostatic pressure from the rest of the fluid. The small pressure of the fluid above it is pushing it down; the larger pressure of the fluid below it is pushing it up. Therefore there is a net upthrust. The portion of the fluid outlined is in equilibrium between its own weight and the hydrostatic upthrust. If we were to replace this portion of the fluid with a lump of iron, we wouldn't have changed the hydrostatic forces. Therefore the upthrust is equal to the **weight** of fluid displaced.

FIGURE XVI.8

If a body is *floating* on the surface, the hydrostatic upthrust, as well as being equal to the **weight** of fluid displaced, is also equal to the weight of the body.