I. Block that floats when released

A cubical block is observed to float in a beaker of water. The block is then held near the center of the beaker as shown and released.

A. Describe the motion of the block after it is released.

B. Draw a free-body diagram for the block at the instant that it is released. Rather than drawing a single force by the water on the block, show the forces that the water exerts on each of the six surfaces of the block.

C. Rank the magnitudes of the vertical forces in your free-body diagram. If you cannot completely rank the forces, explain why you cannot.

Free-body diagram for block at instant it is released

Check that your answer is consistent with the motion of the block:

Check that your answer is consistent with how pressure varies with depth in a liquid:

D. Did you draw any forces acting downward on the top surface of the block? Explain.

E. In the box at right, draw a vector to represent the vector sum of the forces exerted on the block by the surrounding water.

1. Is this vector equal to the net force on the block? (Recall that the net force is defined as the vector sum of *all* forces acting on an object.)

2. Is the magnitude of the sum of the forces exerted on the block by the water *greater than, less than,* or *equal to* the weight of the block? Explain.

II. Block that sinks when released

A second block has the same volume and shape as the original block.

A. Is it possible for such a block to sink when released from the center of the beaker? Explain.

B. Draw a free-body diagram to support your answer. As before, draw the forces exerted on each surface of the block by the nearby water.

Compare the free-body diagram for the block that sinks to the one you drew in part A for the block that floats. Which forces are the same and which are different? Explain.

Free-body diagram for block at instant it is released

C. In the box at right, draw a vector to represent the sum of the forces exerted on the block by the surrounding water.

Compare the sum of the forces exerted on the block by the surrounding water for the block that sinks to the sum for the block that floats.

The sum of the forces exerted on an object by the surrounding water is called the *buoyant force.*

D. In general, does the buoyant force on a completely submerged object depend on the mass of the object? Explain.