Name: ____________________________ BU ID: ______________ Lab Section: ______

Partner's name: _____________________ BU ID: _____________ Date: ____________

TF's signature: ______________________

Fill all the blanks and submit this to your TF in the end of the lab.

Fluids

The format of this experiment will be a little different from what you are used to. Instead of spending all your time at one station playing with a single apparatus you will be spending 10-15 minutes at each of six different stations doing a number of shorter activities. It does not matter what order you do these in, so you can start with whichever one you like. But once you pick a place to start, you should proceed in order from there (e.g., if you start with activity E you would then move on to F, followed by A, etc.).

PROCEDURE

Activity A: A floating block. For this activity you should have a block of wood, a beaker of water, and a scale. Start with nothing on the scale. **(1.2 points total)**

1. [0.2 point] Record the mass of the block of wood: ________________

2. [0.2 point] Record the mass of the beaker of water (without the block): ______________

3. [0.2 point] After removing the beaker from the scale, place the block in the water. What is the percentage of the volume of block below the water's surface? ______________%

4. Predict what the scale will read when you measure the mass of the beaker of water with the block floating in it: ________________

5. [0.2 point] Measure the mass of the beaker with the block floating in it: _______________

6. [0.4 point] Is your prediction correct? Explain the observation.

Activity B: Big block vs. Small block. For this activity you should have two blocks of the same type of wood, with one block being noticeably larger than the other. You will also have a beaker of water. **(2 points total)**

1. [0.2 point] Take the small block of wood and place it in the beaker of water. Estimate the percentage of its volume which is below the water's surface: ______________%

2. [0.2 point] Sketch a free-body diagram for one of the blocks in the space at right. [0.1 point] How does the buoyant force, F_B, compare to the force of gravity, mg, exerted on the block by the Earth?

   [ ] $mg > F_B$ [ ] $mg = F_B$ [ ] $mg < F_B$

   Free body diagram:

3. [0.2 point] Compared to the small block, how many times larger is the big block? ______________

4. Predict the percentage of the big block's volume that is going to go below the water surface when you place it into the beaker._______________%

5. [0.2 point] Place the big block into the water, estimate the value you saw._____________%

6. [0.2 point] (a) Compare your result between 1 and 4. Does the buoyant force depend on the volume of the block? (Y/N)_________

   [0.2 point] (b) Explain the results of 1 and 4.

7. Push the smaller block further under water and then let go. What happens? [0.1 pt] Why? [0.2 pt]

8. Pull up a bit on the smaller block so it sits a little higher in the water and then let it go. What happens? [0.1 point] Why? [0.1 point]

9. [0.2 point] This activity showed us the buoyant depends on __________________________.

Activity C: Aluminum vs. wood. In this case you should have one object made from aluminum and another made from wood, a scale, and a beaker of water**. (1 + 0.3 bonus points)**

1. [0.2 point] Measure the mass of the block of wood. ______________

2. [0.2 point] Place the block of wood in the beaker of water. It … [   ] sinks   [   ] floats

3. [0.2 point] Measure the mass of the aluminum object.______________

4. Predict what will happen when you place the aluminum object into the beaker. [0.1 point] What do you base your prediction on?

5. Place the aluminum object into the beaker. Is your prediction correct? What, if anything, can you conclude from this? [0.3 point]

Bonus Question 1: Determine the density of the aluminum cylinder and the block of wood. (0.1 + 0.1 bonus point)

Bonus Question 2: A Japanese yen, which is a solid disk of aluminum, can be placed carefully on a water surface and remain there without sinking. Is this consistent with what you observed in activity C? How can you explain this? (0.1 bonus point)

Activity D: Tossing an anchor overboard. In this activity you get to answer a classic conceptual question in physics, which is generally posed something like the following. You are in your boat floating around a reservoir when you notice that the water in the reservoir is dangerously close to spilling over the dam that holds the water back from flooding the village in the valley below. You have a heavy anchor in your boat. If you throw the anchor overboard into the water will the water level in reservoir go up, down, or remain the same? **(1.0 points total)**

1. Start with the heavy weight (the anchor) inside the container (the boat) floating in the tub of water (the reservoir). If you carefully lift the anchor out of the boat and place it at the bottom of the reservoir, **predict** the change, if any, in the water level of the reservoir.

The water level will …. [ ] go up [ ] go down [ ] remain the same

2. Try this and watch carefully what happens to the water level in the process. Was your prediction correct? (Y/N) ____________________

3. [0.2 point] When the anchor is submerged in the reservoir how much water does it displace? We're not looking for a number here, just a qualitative statement. Provide your answer by completing the following statement: The amount of water displaced by the anchor has a **volume** equal to ____.

4. [0.2 point] When the anchor is inside the boat, and the boat is floating, how much water does it displace? Again, we're after a qualitative statement: The amount of water displaced by the anchor has a **weight** equal to the ______________________________________.

5. [0.2 point] Based on your answers to 3 and 4, in which case does the anchor displace more water? In the case where the anchor is …

   [ ] in the boat [ ] outside the boat and in the water.

6. [0.4 point] Explain your observation reported in 5.

Activity E: A Cartesian Diver. A Cartesian diver is an object (like a toy squid, an eye-dropper, or a sealed ketchup or soy sauce packet from a fast food restaurant) of an appropriate density that it just floats in water that is at atmospheric pressure. This object is then placed into a plastic bottle and the bottle is sealed. **(1.1 point total)**

1. Predict what will happen to the diver when you squeeze the bottle (or pressurize it with the special fizz-keeper pump). It will …

   [ ] go up [ ] go down [ ] remain at the same level

2. [0.1 point] Try this out. When you increase the pressure on the bottle, you observe that the diver …

   [ ] go up [ ] go down [ ] remain at the same level

3. What happens inside the Cartesian diver when you squeeze the bottle?[0.2 point] Try to explain this in terms of Archimedes' principle, which says that the buoyant force is proportional to the volume of fluid displaced by the object. [0.4 point]

4. [0.2 point] Make the diver come to a stop in the middle of the bottle, what does this tell you about how the average density of the diver when it is at rest at the center compares to the density of the water? [0.2 point] Explain your answer.

Activity F: A ping-pong ball in a funnel. **(1.4 point total)**

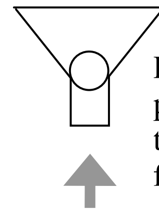

Fig. 1

1. Place the ping-pong ball in the funnel and hold the funnel upright so the narrow stem points vertically down.

2. [0.2 point] Predict what the ball will do when you turn on the air supply, bringing air up through the funnel from under the ball as in Fig. 1. The ball will ….

[   ] shoot out of the funnel.

[   ] shoot out but remain in mid-air in the air stream.

[   ] remain in the funnel.

3. [0.4 point] Turn <u>FULLY</u> on the air supply and see what happens. Explain what you saw.

4. With the air still going FULLY, invert the funnel slowly. What happens to the ball?

[0.2 point] (a) When the funnel is inverted, the ball ….

[   ] shoots out of the funnel.

[   ] shoots out but remain in mid-air in the air stream.

[   ] remains in the funnel.

[0.4 point] (b) Does this make sense in terms of the explanation you came up with in part 3?

Now hold the ping-pong ball in your hand and, with the air blowing through the funnel, try to place the ball into the air stream so that the ball hovers in the air. You may need to reduce the air flow to achieve this. While the ball is hovering in air, slowly vary the angle of the funnel and air stream to see how far off vertical these can be and still support the ball. Roughly, what angle, measured from the vertical, can you get to?

____________________ degrees [0.2 point]

Additional Questions (0.3 points)

These are the same questions we used for the pre-lab, but your answers may be different now that you have done the experiment.

[0.1 point] Question 1: Object A sinks in a container of fluid. If the mass of object B is larger than the mass of object A, what will object B do when you put it in the container?

[ ] Sink [ ] Float

[ ] There is not enough information given to answer this question

[0.1 point] Question 2: A block of wood floats partly submerged in a beaker of water. A block of lead, of exactly the same dimensions as the block of wood, is placed in the same beaker and sinks to the bottom. Which block experiences the largest buoyant force?

[ ] The wooden block [ ] The lead block [ ] The forces are equal

[ ] There is not enough information given to answer this question

[0.1 point] Question 3: A large beaker of water is placed on a scale, and the scale reads 40 N. A block of wood with a weight of 10 N is then placed in the beaker. It floats with exactly half of its volume submerged. Assuming that none of the water spilled out of the beaker when the block was added, what does the scale read now?

[ ] 40 N [ ] 45 N [ ] 50 N

Pre-lab: ____________________________ (10 (20% = 2 points)

Lab: _____________________________________ (10 (80% = 8 points)

Punctuality (1 ponint)+ performance(1point): ________________ (2 points)

Report sheet ______________________________ (8 points)

Total: _________________________________

TF: __________________________________

Grader: ________________________________