

MARINE ENGINEERING/PHYSICS

Buoyancy Activity 1

Materials needed:

Empty film canister, salt water tank, three-arm balance, graduated cylinder.

1. Using the three-arm balance, find the mass of the empty film canister.

Mass of film canister: _____grams

2. Find the mass of the film canister full of salt water

Mass of film canister full of salt water: _____grams

3. Pour the water from the canister into the graduated cylinder and record the volume of the water.

Volume of salt water: _____ml

4. Find the mass of the salt water by subtracting the full and empty weights of the film canister.

Mass of salt water: _____grams

5. How does the difference in mass of the film canister relate to buoyancy?

6. How many pennies do you think it will take to make the canister neutrally buoyant (i.e. does not sink or float if placed in mid-water)?

Predicted number of pennies: _____

7. Add pennies, a few at a time, until the canister is neutral in the water.

Actual number of pennies: _____

8. A penny weighs about 3 grams. Why does this make sense?

9. The umbilical cable for your ROV will weigh more than the water it displaces. Will it sink or float? _____

10. Can you come up with a method to solve this problem before putting the ROV in the water? Explain: _____

MARINE ENGINEERING/PHYSICS

Buoyancy Activity 2

1. Using the results from Buoyancy Activity 1, copy the Mass and Volume of salt water in the canister.

Mass of salt water: _____ grams

Volume of salt water: _____ mL

Based on these numbers, calculate the density of salt water in grams per milliliter (i.e. divide the mass by the volume)

Density of salt water: _____ g/mL

2. Using the following conversion factors, convert g/ml to lbs/cu ft:

1 cubic foot = 7.4805 gallons

12 inches = 1 foot

1 liter = 1000 mL

1 quart = 0.94635 liters

1 meter = 3.280 feet

1 mL = 1 cubic centimeter

1 gallon = 4 quarts

100 centimeters = 1 meter

$$\frac{\text{g}}{\text{mL}} \times \quad \times \quad \times \quad \times \quad \times \quad \times \quad \times \quad = \frac{\text{lbs}}{\text{cu ft}}$$

3. What do you notice about this number?

MARINE ENGINEERING/PHYSICS

Name: _____

Buoyancy Activity 3

1. Figure out how many pennies will make your film canister neutrally buoyant in salt water(see Buoyancy Activity 1), and test this by experimentation.

Number of pennies – salt water: _____

2. How many pennies do you think it will take to create neutral buoyancy in fresh water?

Hypothesis: Number of pennies – fresh water: _____

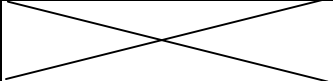
3. Now test your theory. How many pennies did it actually take to create neutral buoyancy in fresh water?

Actual: Number of pennies – fresh water: _____

4. What is the difference in mass between the two?

Difference in mass: _____ grams

5. Make the hydrometer with a straw and clay described on the handout (“BUILD A HYDROMETER” Courtesy of Kevin Hardy at University of California San Diego http://www.mpcfakulty.net/tami_lunsford/SI_02_ROV_Institute/Hydrometer.jpg).
6. Complete the table below:

	Salt Water	Fresh Water
Height of waterline (mm)		
Weight of hydrometer (grams)		
Radius of straw (mm)		
HtDifference:Fr-Salt (cm)		
Volume of space between waterlines (cm ³)		
Density of water (g/ cm ³)		
Weight of fresh water between waterlines (grams)		

7. How far into the water would your hydrometer sink if it weighed an extra gram?