

### Unit 1 Lab 4: The Leaky Bucket

**Object:**

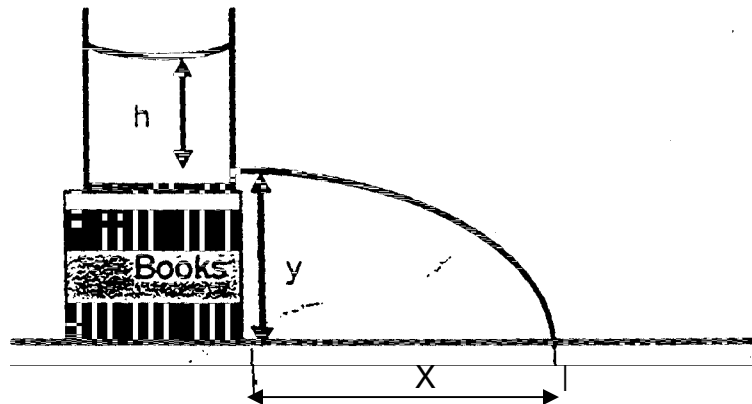
The object of this lab is to analyze a single event, the initial speed of water exiting from a hole at the bottom of a container. You will use three different methods and compare the results. Each method utilizes different data collected from the same event and each method has its own assumptions, inherent flaws and its strengths. You will find also find the speed when the 2 L is filled to 4 different heights.

**Equipment:**

- 2 Liter Bottle
- Blue buckets
- Meter stick
- Stopwatch
- Graduated cylinder
- Beaker

**Theory:**

**NOTE: All three methods require that the level of the water be held constant & constant from one experiment to the other so you can compare answers.**



### Method I - Projectile motion

- 1) What do you need to measure/record for this experiment?

## Method 2 - The Equation of Continuity

The equation of continuity is:  $A_1v_1 = A_2v_2$

Remember that the product  $A_1v_1$  is also called the Flow rate which is the volume of water that comes out in a specified amount of time. The amount of water needs to be in  $\text{m}^3$ .

- 2) What do you need to measure/record for this experiment?

## Method 3 - Bernoulli's equation

Bernoulli's equation is:  $P_0 + \rho gh + \frac{1}{2}\rho v_0^2 = P_1 + \rho gh_1 + \frac{1}{2}\rho v_1^2$

- 3) What assumptions do you need to make and what is constant on both sides that can be cancelled out? After you list these re-write the equation after you take out the pieces listed in your answer.

- 4) What do you need to measure/record for this experiment?

Procedure:

1. For each of the methods repeat the procedure for each height (4 different ones).
2. If not already done, use a sharpie to mark these different heights.
3. Record the needed data in the proper units
4. Show all calculations

Data: Method 1

| Height | y<br>(m) | x<br>(m) |
|--------|----------|----------|
| 1      |          |          |
| 2      |          |          |
| 3      |          |          |
| 4      |          |          |

Method 2

The diameter of the hole is \_\_\_\_\_

| Diameter<br>(m) | Area<br>(m <sup>2</sup> ) |
|-----------------|---------------------------|
|                 |                           |

| Height | Time<br>(s) | Volume<br>(ml) | Volume<br>(m <sup>3</sup> ) |
|--------|-------------|----------------|-----------------------------|
| 1      |             |                |                             |
| 2      |             |                |                             |
| 3      |             |                |                             |
| 4      |             |                |                             |

### Method 3

| Height | h<br>(m) |
|--------|----------|
| 1      |          |
| 2      |          |
| 3      |          |
| 4      |          |
| 5      |          |

## Analysis and questions:

1. Record the results below for each method below

| Height | Method 1<br>(m/s) | Method 2<br>(m/s) | Method 3<br>(m/s) |
|--------|-------------------|-------------------|-------------------|
| 1      |                   |                   |                   |
| 2      |                   |                   |                   |
| 3      |                   |                   |                   |
| 4      |                   |                   |                   |
| 5      |                   |                   |                   |

2. Use one of your methods and graph a velocity vs. height graph and then explain the relationship between the two.

