

## Problem Set 2 Exercise #29: Hourglass

**Reference:** Lecture 4 notes

**Learning objective:** Algorithm design

**Estimated completion time:** 60 minutes

### Problem statement:

Write a program **PS2\_Ex29\_Hourglass.java** to read in 3 positive integers: **a** and **b** which are the durations of two hourglasses, and **c** which is the duration you want to measure. All values are in minutes. The program then determines if you can measure **c** exactly using the hourglasses, and if so, the **number of times** you need to flip the two hourglasses such that the total number of flips is the **minimum**.



You may assume that  $a < b < c$ , and that you can only use one hourglass at a time, as the desk is too small to accommodate two hourglasses at the same time.

For example, if you have 4-minute and 7-minute hourglasses, and you want to measure 28 minutes, you need only flip the 7-minute hourglass 4 times. If you want to measure 29 minutes, the solution is to flip the 4-minute hourglass twice and the 7-minute hourglass thrice, giving a total of 5 flips. If you want to measure 9 minutes, then it is impossible to solve.

As another example, if you have 6-minute and 9-minute hourglasses, and you want to measure 42 minutes. There are two ways:

- 1) flip the 6-minute hourglass once and the 9-minute hourglass four times, hence a total of 5 flips.
- 2) flip the 6-minute hourglass four times and the 9-minute hourglass twice, hence a total of 6 flips.

The first solution is better as it gives the minimum total number of flips.

(The above description uses symbols such as **a**, **b**, and **c**. In your program, you should use more descriptive variable names.)

A tip is given at the end of the next page.

**Sample run #1:**

```
Enter 3 inputs: 4 7 29
2 flip(s) for 4-minute hourglass and 3 flip(s) for 7-minute
hourglass.
```

**Sample run #2:**

```
Enter 3 inputs: 4 7 9
Impossible!
```

**Sample run #3:**

```
Enter 3 inputs: 6 9 42
1 flip(s) for 6-minute hourglass and 4 flip(s) for 9-minute
hourglass.
```

**Useful tip:**

Intuitively, we should utilize the hourglass of longer duration as much as possible, right?