CSC 115
Midterm Exam #2:
Sections: A01 and A02
Monday, June 29th, 2020

Name:____(please print clearly!)

UVic ID number:____

Signature:____

Exam duration: 60 minutes

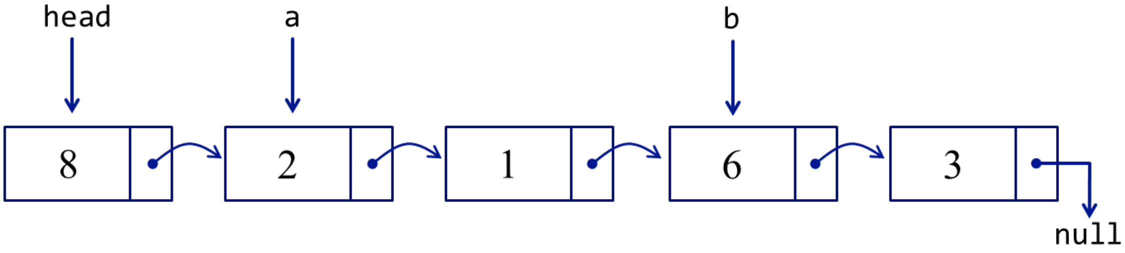
Instructor: Anthony Estey

Students must check the number of pages in this examination paper before beginning to write, and report any discrepancy immediately.

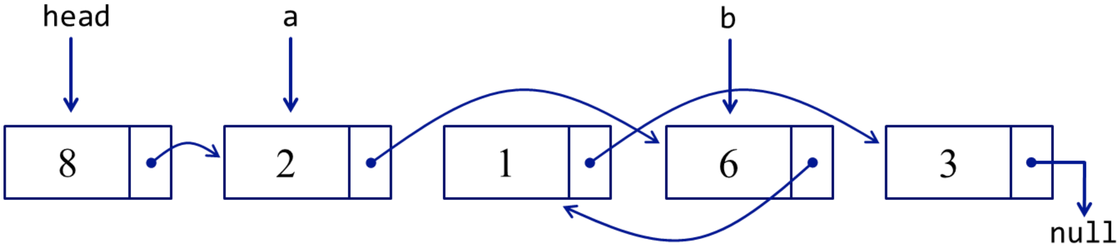
- We will not answer questions during the exam. If you feel there is an error or ambiguity, write your assumption and answer the question based on that assumption.
- Answer all questions on this exam paper.
- The exam is closed book. No books or notes are permitted.
  No electronic devices of any type are permitted.
- The marks assigned to each question and to each part of a question are printed within brackets. Partial marks are available.
- There are eleven (11) pages in this document, including this cover page.
- Page 11 is left blank for scratch work. If you write an answer on that page, clearly indicate this for the grader under the corresponding question.
- Clearly indicate only one answer to be graded. Questions with more than one answer will be given a **zero grade**.
- It is strongly recommended that you read the entire exam through from beginning to end before beginning to answer the questions.
- Please have your ID card available on the desk.

Part 1: Linked Lists (14 marks)

1. Examine the following Nodes linked together, with Node pointers **head**, **a**, and **b**:



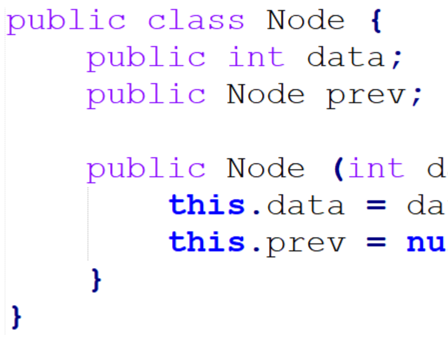
Write code to update next reference arrows to the following:



a) Write your code to in the box below:

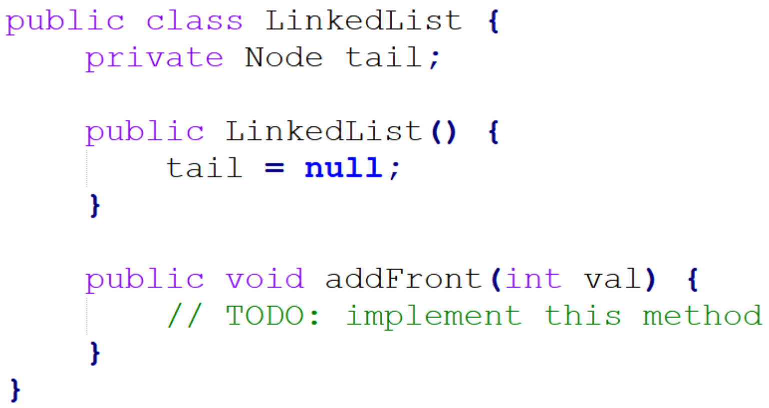
b) In the second diagram, what is the order the nodes are visited, beginning at **head** and traversing through the other nodes until the end of the sequence?

2. Implement the **addFront** method for a singly-linked list with the Node class defined below, in which Nodes ***only*** have a reference to the **PREVIOUS** Node in the list.



```
public class Node {
    public int data;
    public Node prev;

    public Node (int data) {
        this.data = data;
        this.prev = null;
    }
}
```

In the LinkedList class implementation, shown below, there is only a **tail** reference variable. **Note**: there is **NO HEAD** reference variable.



```
public class LinkedList {
    private Node tail;

    public LinkedList() {
        tail = null;
    }

    public void addFront(int val) {
        // TODO: implement this method
    }
}
```

a) Based on these restrictions, complete the implementation for the addFront method.

(more space on next page)

b) What is the growth rate of the addFront method in Big-Oh terms? Assume n represents the number of elements in the list. Circle one answer

$O(1)$

$O(\log n)$

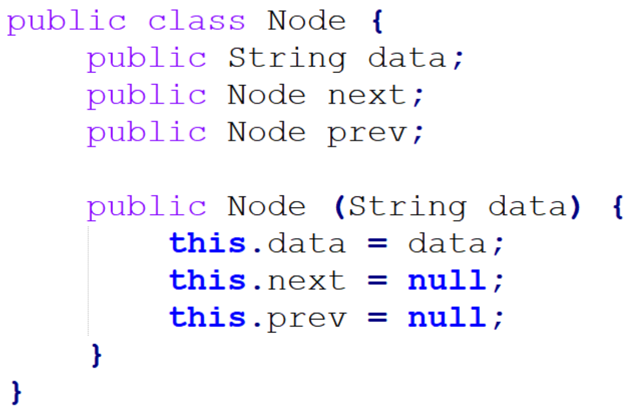
$O(n)$

$O(n^2)$

$O(n^3)$

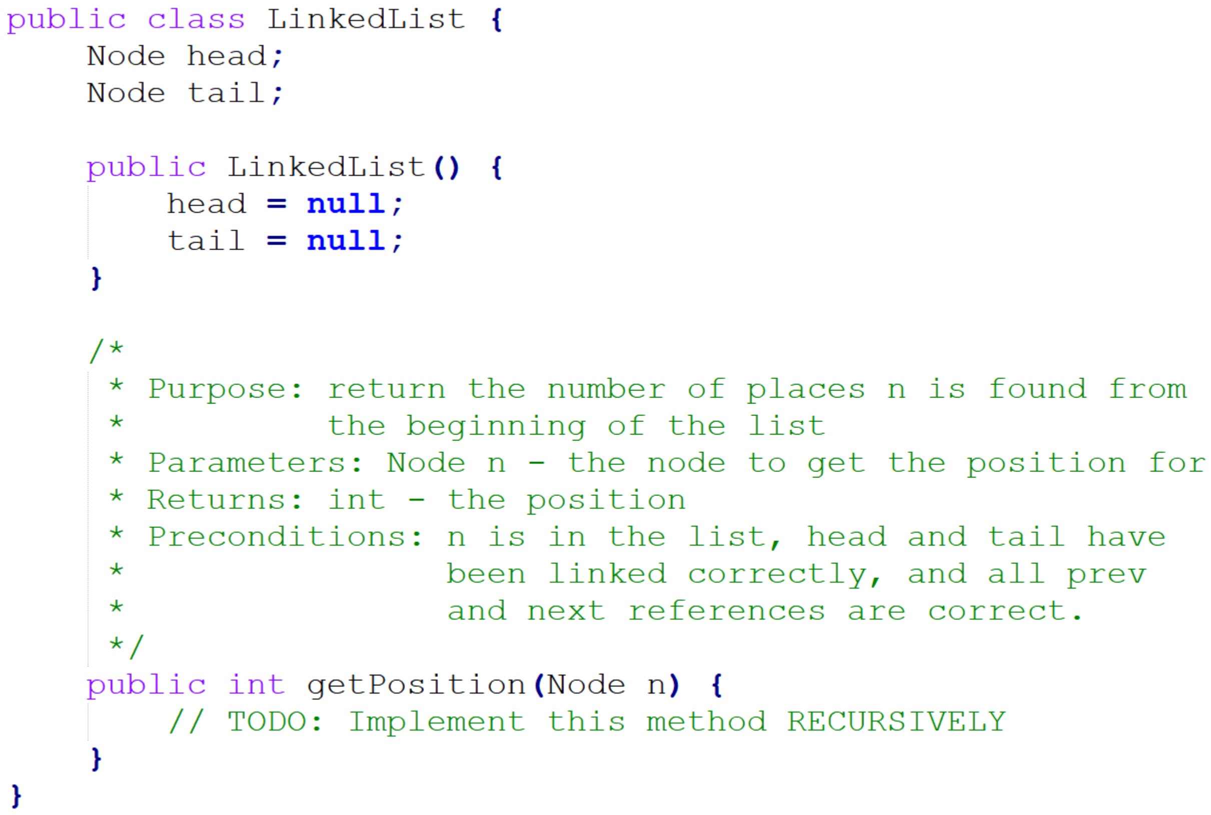
Part 2: Recursion (7 marks)

3. Complete a **RECURSIVE** implementation of the **`getPosition`** method for a doubly-linked list with the Node class defined below:



```
public class Node {
    public String data;
    public Node next;
    public Node prev;

    public Node (String data) {
        this.data = data;
        this.next = null;
        this.prev = null;
    }
}
```

For this question the LinkedList class has head and tail references.

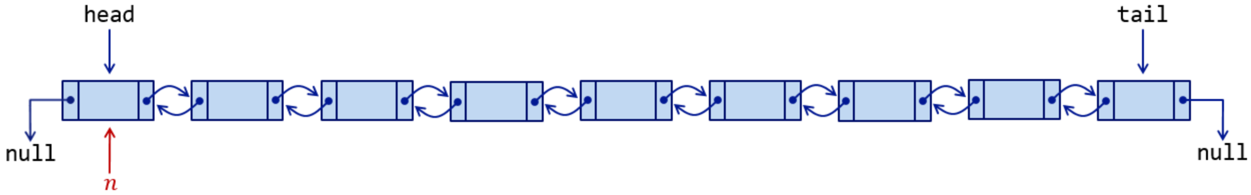


```
public class LinkedList {
    Node head;
    Node tail;

    public LinkedList() {
        head = null;
        tail = null;
    }

    /*
     * Purpose: return the number of places n is found from
     *          the beginning of the list
     * Parameters: Node n - the node to get the position for
     * Returns: int - the position
     * Preconditions: n is in the list, head and tail have
     *                been linked correctly, and all prev
     *                and next references are correct.
     */
    public int getPosition(Node n) {
        // TODO: Implement this method RECURSIVELY
    }
}
```

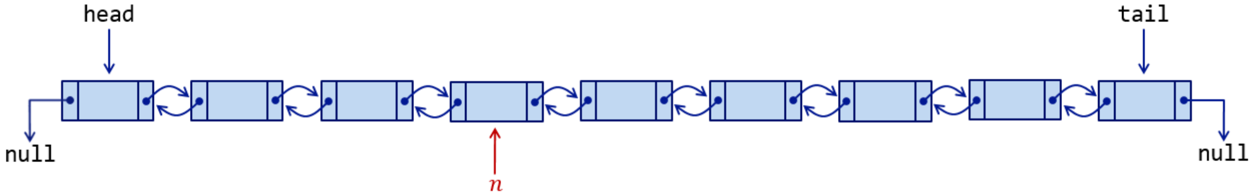
(The problem description is continued on the next page.)

The **getPosition** method is given a node from the linked list, and returns the number of places from the front of the list the node is positioned. For example:

Example 1: when Node n shown below is passed to getPosition, 0 is returned:



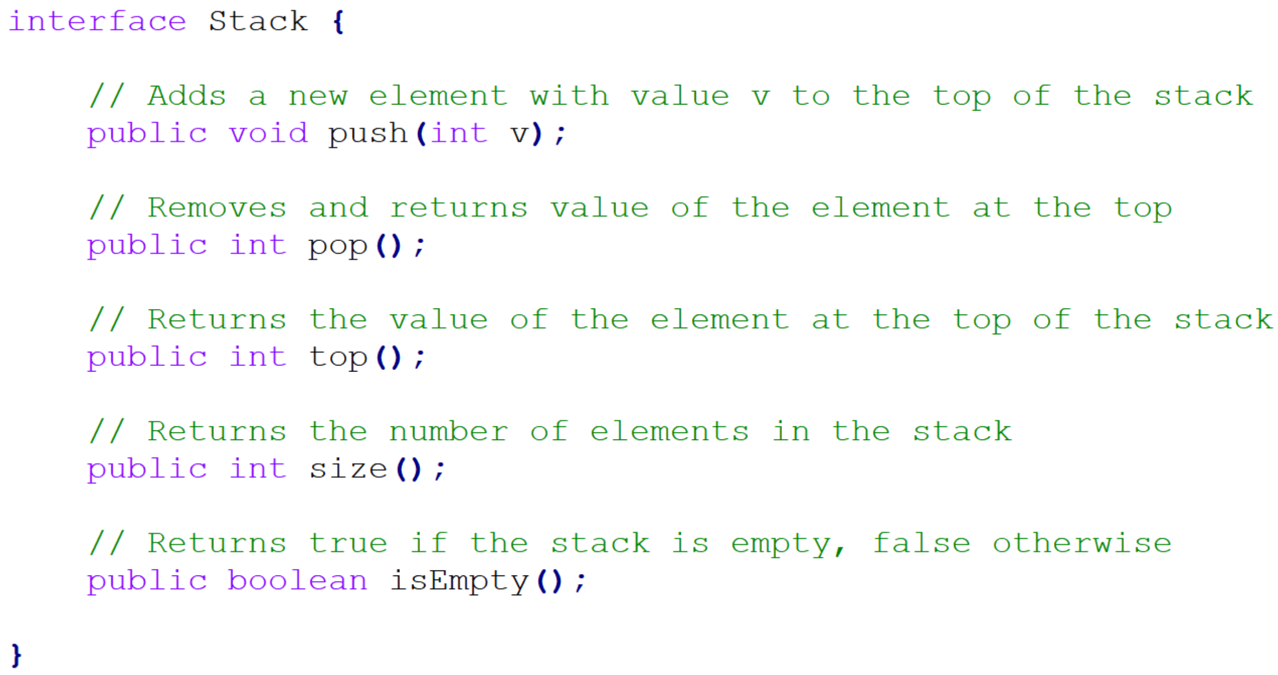
Example 2: when Node n shown below is passed to getPosition, 3 is returned:



```
public int getPosition (Node n) {









}
```

Part 3: Stacks (9 marks)

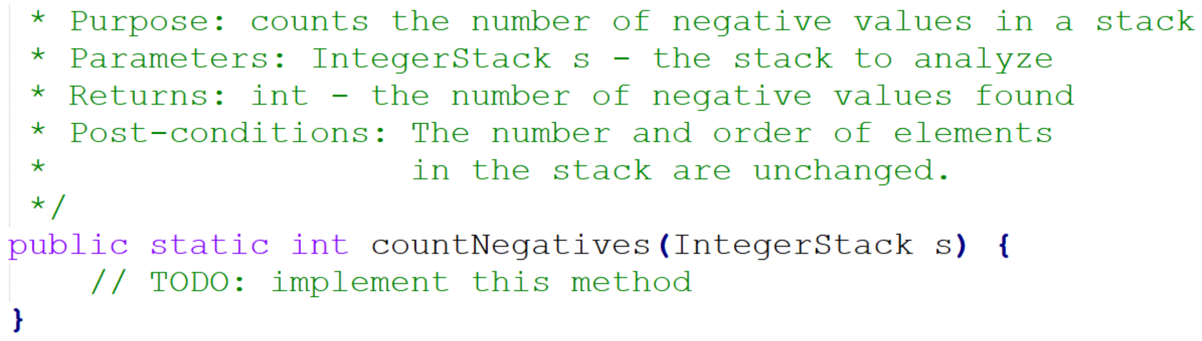
4. For this question you will work with an instance of the IntegerStack class, which is an implementation of the Stack interface shown below:



```
interface Stack {

    // Adds a new element with value v to the top of the stack
    public void push(int v);

    // Removes and returns value of the element at the top
    public int pop();

    // Returns the value of the element at the top of the stack
    public int top();

    // Returns the number of elements in the stack
    public int size();

    // Returns true if the stack is empty, false otherwise
    public boolean isEmpty();

}
```

Assume all of the methods specified in the Stack Interface have been implemented correctly in the IntegerStack class. There is no `isFull` method as the implementation allows for an unlimited number of elements to be inserted.

Complete the implementation of the countNegatives method specified below, which takes a reference to an IntegerStack as a parameter and returns a count of the number of negative numbers found in the stack.



```
 * Purpose: counts the number of negative values in a stack
 * Parameters: IntegerStack s - the stack to analyze
 * Returns: int - the number of negative values found
 * Post-conditions: The number and order of elements
 *                  in the stack are unchanged.
 */
public static int countNegatives(IntegerStack s) {
    // TODO: implement this method
}
```

Note: The countNegatives method is a static method defined in a **DIFFERENT** class than IntegerStack.java.

Similar to Assignment 4, you can use any of the Stack methods on the `IntegerStack` variable **`s`**, (ie. s.push(x) or s.pop()). You may create any other variables, including another IntegerStack, in your implementation of the `countNegatives` method.

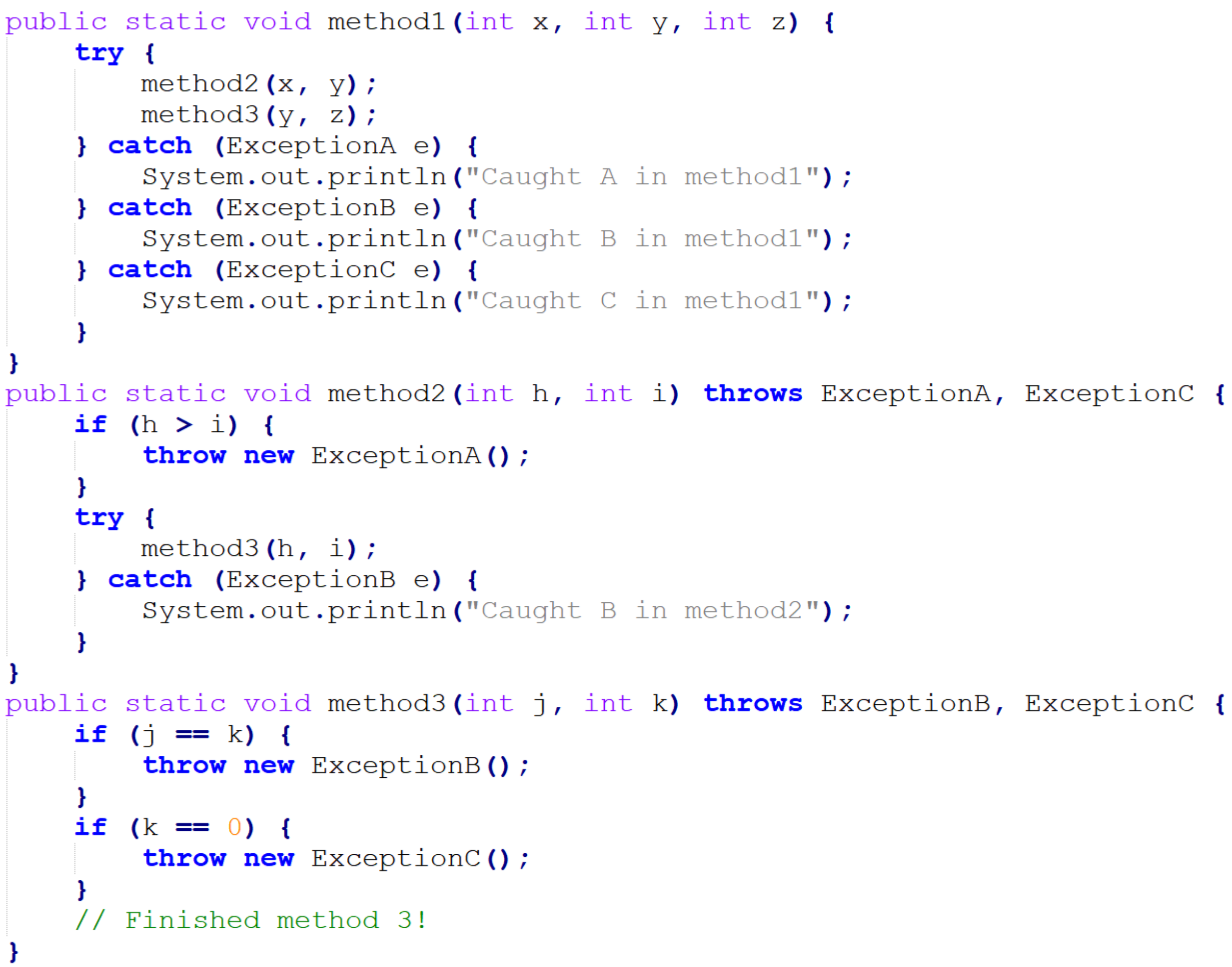
You will receive marks for the following:

- returning the correct value representing the number negative integers found in the given stack (focus on this first)
- maintaining the order and number of elements in the stack when the value is returned (when the result is returned, the stack referenced by **`s`** should contain the same number of elements, in the same order, as it did originally).

```
public static int countNegatives (IntegerStack s) {














}
```

Part 4: Exceptions (10 marks)

5. Carefully examine the following three methods, defined below:



```
public static void method1(int x, int y, int z) {
    try {
        method2(x, y);
        method3(y, z);
    } catch (ExceptionA e) {
        System.out.println("Caught A in method1");
    } catch (ExceptionB e) {
        System.out.println("Caught B in method1");
    } catch (ExceptionC e) {
        System.out.println("Caught C in method1");
    }
}
public static void method2(int h, int i) throws ExceptionA, ExceptionC {
    if (h > i) {
        throw new ExceptionA();
    }
    try {
        method3(h, i);
    } catch (ExceptionB e) {
        System.out.println("Caught B in method2");
    }
}
public static void method3(int j, int k) throws ExceptionB, ExceptionC {
    if (j == k) {
        throw new ExceptionB();
    }
    if (k == 0) {
        throw new ExceptionC();
    }
    // Finished method 3!
}
```

For this question you will be determining if different outputs are possible by calling `method1` with different input values for x, y, and z.

For example, your answer might be: **method1(1, 2, 3);**

a) Is it possible to call method1 and produce only output **"Caught A in method1"**? If so, provide an example method1 call, if not, simply write **no**.

b) Is it possible to call method1 and produce only output **"Caught B in method1"**? If so, provide an example method1 call, if not, simply write **no**.

c) Is it possible to call method1 and produce only output **"Caught C in method1"**? If so, provide an example method1 call, if not, simply write **no**.

d) Is it possible to call method1 and produce only output **"Caught B in method2"**? If so, provide an example method1 call, if not, simply write **no**.

e) Is it possible to call method1 and have it complete execution without any exceptions being thrown? If so, provide an example method1 call, if not, simply write **no**.

f) Is it possible to call method1 and have ExceptionA, ExceptionB, or ExceptionC be thrown and never caught? If so, provide an example method1 call, if not, write **no.**

g) Is it possible to call method1 and produce output: **"Caught A in method1"** followed by **"Caught B in method1".** If so, provide an example method1 call, if not, write **no**.

h) Is it possible to call method1 and produce output: **"Caught B in method2"** followed by **"Caught B in method1".** If so, provide an example method1 call, if not, write **no**.

i) Is it possible to call method1 and produce output: **"Caught B in method2"** followed by **"Caught C in method1".** If so, provide an example method1 call, if not, write **no**.

j) Is it possible to call method1 and produce output: **"Caught C in method1"** followed by **"Caught B in method1".** If so, provide an example method1 call, if not, write **no**.

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END OF EXAM

Question	**Value**	**Mark**
Part 1	14	
Part 2	7	
Part 3	9	
Part 4	10	
Total	**40**	