CS210 Data Structures - Major Exam I - Term 212 – Weight 15%

Time allowed: 40 minutes

Student Name:	
Student ID:	

Circle your instructor's name

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Instructions:
- This exam contains three questions with multiple parts. Closed Book, Closed Notes.
- Use of Calculators and / or computing devices / smartphones etc is strictly prohibited.
- Answer the problems on the exam sheets only. No additional attachments would be accepted.
- When the "time is over" is called, it is students' responsibility to submit his exam to the invigilator. Submitting completed exam 3 minutes after the "time is over" will incur a penalty of **5 points**.

Question 1 [/9 marks]
Part a: [4 points] For each function f(n) below, give an asymptotic upper bound using "big-Oh" notation.

(a) $f(n) = 100n^3 - 7n^3 + 14n^2$ _____

(b) $f(n) = 100n^3 - 100n^3 + 7n^2$ _____

(c) $f(n) = \log(7n^2)$ _____

(d) $f(n) = 5 \log \log n + 4 \log^2(n)$ _____

(e) $f(n) = .001n + 100 \cdot 2^n$ _____

(f) $f(n) = n^3(1 + 6n + 2014n^2)$ _____

(g) $f(n) = (\log n)(n + n^2)$ _____

(h) $f(n) = n^2 \log n + 2^n$ _____

Part b: [1 point] We have two algorithms that solve a certain problem:
    Algorithm A takes $T_A(n) = n^3 + 5n^2 + 100n$
    Algorithm B takes $T_B(n) = 1000n^2 + 1000n$
When is algorithm B more efficient than algorithm A? Give the values of n_0 and constant c.

Part c: [4 points] Estimate the run time as T(n) and then state the runtime requirements in big-O for each of the following code fragments. **Draw recursion trace (tree) if applicable.**

Code Fragment	T(n)
```java void f1(int n) { for(int i=0; i < n; i++) { for(int j=0; j < 10; j++) { for(int k=0; k < n; k++) { for(int m=0; m < 10; m++) { System.out.println("!"); } } } } } ```	

| ```int f2(int n, int m){ if (n == 0) return 1; if (n % 2 == 0) { return f2(n/2, m); } else return f2((n-1)/2, m-1); }```	Do a trace for f2(15, 5)

Question 2 [3 points]: Assume a Circular Linked List C is given that stores only an integer "val" and the "next" pointer in a node. Write a remove method in java within the circular linked list class that searches for a value and removes it from the list.

```
public void problem2(int value){
```

Question 3 [3 points]: Write a method in java to merge two sorted singly linked lists A and B containing integers, as shown in the figure. Your method returns a <u>new sorted list</u> C.
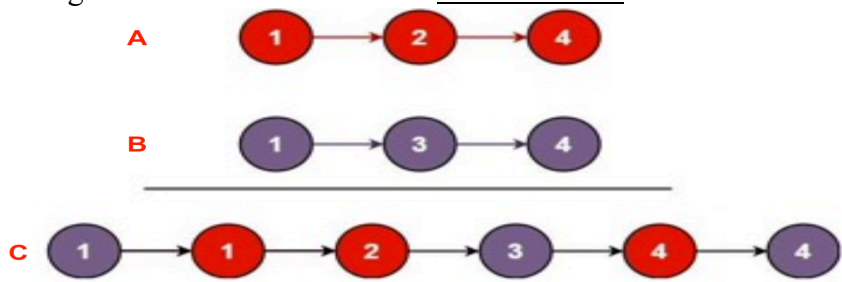

```
public SinglyLinkedList problem2(SinglyLinkedList A, SinglyLinkedList B){
```