*Choose exactly 2 from Questions 5, 6, and 7 – put an X through the question you don’t want graded*

- Just take a minute to skim the paper read all the questions before attempting, and first try to answer those questions/parts about which you feel most confident. The questions are roughly arranged in order of increasing difficulty. Do NOT spend too much time on one question. Pace yourself @ 100 points/75 minutes. You may consult:
  1. Lecture Slides (preferably 4/page).
  2. 1 sheet (front/back) of printed material... No restriction on font.
  3. 1 sheet of Java syntax & any amount of handwritten notes (you can’t have any code segments allowed). This can include diagrams of you classes relate to each other. You can’t have detailed code segments, just patterns.
  4. Any code that was provided in hangman or clever hangman (but not your own code). You can highlight code.

- You may not use any computers, calculators, cell phones, minions, or other lifeforms. When writing code you do not need to worry about specifying the proper import statements. If you don’t know the exact syntax, do the best you can to get partial credit. The programming logic is more important than minor syntax. Assume that all libraries and packages we’ve discussed are imported in any code you write. You may write any helper methods you would like in solving the problems. If you don’t have enough time, assume the helper method and give us the main logic. Master the art of partial credit! You need to only do 2 of Questions 5-7.

1. (5 points) I still haven’t found what I am looking for!

Consider the binary tree below.

   a. Show the path that you should follow if you search for 7 on the figure on the left.
   b. Show the result of inserting 2 and 12 in the figure on the right.

2. (12 points) Equate this!

Write the following equations as Java assignments. For example, $x = (a^{2} + 2ab + b^{2})$ can be written as $x = a * a + 2 * a * b + b * b$. Not that you can write $m_{1}$ as $m1$, etc. and assume that these are all type double and that you have Math.sqrt(number) and Math.pow(base, power) available. (2 points for each line)

   a. $E = mc^2$

   b. $W = e^{xy}$

   c. $F = G \frac{m_1 m_2}{d^2}$

   d. 2 versions of this equation $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

      with $+ \frac{(-b + Math.Sqrt(b* b - 4*a*c))}{2*a}$

      with $- \frac{(-b - Math.Sqrt(b*b - 4*a*c))}{2*a}$

   e. $T_a = \frac{T_a}{\sqrt{1 - v^2 / c^2}}$

      $T_a = T_a / Math.Sqrt(1 - (v * v) / (c * c)) / (2 * a)$
1. (6 points) Just sort() it!
   What method is called by Comparable Interface when using sort()?
   ____________________________
   What method is called by Comparator when using sort()?
   ____________________________
   List 2 reasons why would you use Comparator instead of Comparable?
   a. ____________________________
   b. ____________________________

2. (5 points) It’s all about the pivot! Partition the following array based on the first element and median of the first three elements

   Original Array: 2 5 4 3 1 7 8 6
   Partition based on first element as the pivot of the list: 2 5 4 3 1 7 8 6
   Partition based on median of 1st 3 elements as the pivot of the list: 2 5 4 3 1 7 8 6

3. (6 points) Prioritize! Consider the following priority queue. Show the result of deleting 16 and then adding 15 (including resulting sinks/swims).

4. (6 points) Binary Search: Consider the following binary search tree. Show the result of deleting 17 and then adding 13. You do not need to balance but you should follow correct deletion and insertion process.