Do not open this exam until instructed to do so. The exam consists of 5 problems. Please check that you have all the pages.

The answers to the exam problems should be written in the space provided with the question. Read each question carefully before answering. Make sure you print your answer neatly!

During the exam it is prohibited to:
1. Use any books or notes.
2. Use any electronic aid, including calculators.
3. Exchange information with any person other than the exam proctor.
4. Leave the exam room before you turn in your exam.

It is strongly suggested that you use all the time available. If you finish early, double check your work. By signing below you acknowledge that you have read and understood all of the instructions above.

Good luck!

NJIT Academic Honor Code Agreement

On my honor, I pledge that I have not violated the provisions of the NJIT Academic Honor Code.

Name: ___________________________ SID: ___________________________

Signature: ___________________________ Section: ___________________________
Problem 1.

A superb number is an integer which is less than the sum of its proper divisors, excluding itself. Thus, 12 is a superb number because 1, 2, 3, and 6 are its proper positive divisors and $1 + 2 + 3 + 4 + 6 > 12$. The next superb number is 18 < $1 + 2 + 3 + 6 + 9$. The next two superb numbers are 20 and 24. Write a function called `superb` that returns `true` if the argument passed to it is a superb number and `false` otherwise.
Problem 2.

Define a class called `Counter` whose objects count things. An object of this class records a count that is a non-negative integer. Include methods to set the counter to 0, to increase the counter by 1, and to decrease the counter by 1. Be sure that no method allows the value of the counter to become negative. Include an accessor method that returns the current count value. The only method that can set the counter is the method that sets it to zero. No other mutator methods are required.
Problem 3.

Write a method that searches an array of integers for the largest value. The method, which you should call `findmax` takes one argument, the array of integers to be searched. The method should return the index of the element with the largest value.

```java
public static int findmax(int[] array) {...}
```
Problem 4.

A square matrix is a matrix that has the same number of rows as columns. The transpose of a square matrix $M$ is the matrix $M^T$ gotten by turning rows into columns and columns into rows, i.e. $M_{ij} = M^T_{ji}$ for all indices $i$ and $j$.

public static double[][] transpose(double[][] m);

Write a function called `transpose` that takes a two-dimensional array, $M$, as an argument and returns $T$ so that it is the transpose of $M$. 
Problem 5.

Volume refers to the amount of space an object occupies. The formulae for a sphere, cone, and ellipsoid are:

\[ V = \frac{4}{3} \pi r^3 \]
\[ V = \frac{1}{3} \pi r^2 h \]
\[ V = \frac{4}{3} \pi abc \]

respectively. Where \( r \) is the radius of the sphere or base of the cone, \( h \) is height of the cone, and \( a, b, \) and \( c \) are the semi-axes of the ellipsoid. Implement a family of overloaded methods all called `volume` that calculate the volume of spheres, cones, and ellipsoids. You must use the constant `Math.PI` in all your calculations.