[**May use one side of an** $8.5 \times 11$ **inch sheet of paper**] Show all of your work clearly in the space provided or on the additional page at the end of the exam. If the additional page is used, clearly identify to which exam question it is related. Be sure to **read each problem carefully**. You should do all four problems. Note that the exam is double sided.

**1.** (15 points) Clearly describe the differences between a `do/while` loop and a `while` loop.

**2.** (15 points) What will the following program display?

```cpp
#include <iostream>

int main()
{
  int num[30];
  double x = 3.8;
  for(int i=0; i<=3; ++i) {
    num[i] = i;
    std::cout << i << std::endl;
    for(int j=5; j<=8; ++j) {
      std::cout << i << j << '\n';
    }
    std::cout << i;
    ++i;
  }
  return EXIT_SUCCESS;
}
```

**3.** (25 points) Write a C++ program that will ask the user to "Enter as many non-negative numbers as you would like. Signify that you are done entering numbers by entering -1." The program should then display the average of all of the numbers entered by the user.

**4.** The probability that an individual telephone call will last less than $t$ minutes can be approximated by the exponential probability function:

$$\text{probability that a call lasts less than } t \text{ minutes} = 1 - e^{-t/a}$$

where $a$ is the average length of a call and $e = 2.71828$ (Euler's number). For example, assuming that the average call length is 2 minutes, the probability that a call lasts less than 1 minute is calculated as $1 - e^{-1/2} = 0.3297$.

**(a)** (10 points) Write the complete header file with the function prototype for the function callProb which takes in two parameters: a call length and an average call length, and returns the probability that the call lasts less than the length passed in. The lengths should be in units of minutes but it should be possible to pass in fractional amounts (e.g., 0.5 minutes).

**(b)** (15 points) Write the complete source (.cpp) file that implements the callProb function from part **(a)**.

**(c)** (20 points) Write a C++ program that asks the user to enter the average length of a call and displays the probabilities of a call lasting less than 1 to less than 500 minutes, in 1 minute increments. (You should display a total of 500 probabilities.)