Question 1. The series $1+1/4+1/9+1/16+1/25+1/36+... = (\pi * \pi)/6$. The code below attempts to estimate π by adding up a given number of terms of this series. Fill in the blanks.

```
#include <iostream>
using namespace std;
int main()
{
        int nterms;
        cout << "Enter a number of terms ";
        cin >> nterms;

        double term;
        double sum = _____________________________;

        int i = _____________________________________;

        while ( _____________________________________ )
        {
                term = ______________________________;
                sum  = sum + term;
                i    = i + 1;
        }
        cout << " pi is approximately " << sqrt(6*sum) << endl;
}
```

Question 2. The Game of Life is a simple simulation of a population of creatures that live in a matrix of size $N \times M$. In every cell of this table there is either a creature, denoted by a 1 stored in the matrix, or there is nothing, denoted by a 0. Each cell has between 3 and 8 neighboring cells, and the future of each cell is determined by the number of creatures in these neighboring cells. One step of the simulation consists of scanning the entire array and applying the following rules:

1. If an unoccupied cell has 3 occupied neighboring cells, then a creature is born into the cell.

2. If an occupied cell has fewer than 2 neighbors, or more than 3 neighbors, then the creature in the cell dies (of loneliness or lack of space, respectively).

3. Otherwise, the cell remains as it was (occupied or unoccupied).

Complete the following routines that apply these rules so as to take one step in the simulation.

```
int neighbors(vector<vector<int> > table, int N, int M, int ic, int jc)
{
     int ilo = max(ic-1, 0);
     int jlo = max(jc-1, 0);
     int ihi = min(ic+1, N-1);
     int jhi = min(jc+1, M-1);
     int sum = 0;
     int i   = ilo;
     while (i<=ihi)
     {
          int j=jlo;
          while (j<=jhi)
          {
               sum = sum + table[i][j];
               j=j+1;
          }
          i=i+1;
     }
     return ____________________________________________________;
}

vector<vector<int> > updateCells(vector<vector<int> > cells, int N, int M)
{
    vector<vector<int> > updated(N, M); // also initializes to zeros
    int i=0;
    while (i<N)
    {
          int j=0;
          while (j<M)
          {
               int count = neighbors(cells, N, M, i, j);

               if ____________________________________________
               {
                    updated[i][j] = ____________________________;
               }
               else if ________________________________________
               {
                    updated[i][j] = ____________________________;
               }
               j=j+1;
          }
          i=i+1;
     }
     return updated;
}
```

Question 3. Consider the following C++ code. It is an attempt to do the finite sum:

$$sum = 1 + x^2 + x^4 + x^6 + x^8 + x^{10} \tag{1}$$

The code has some errors. Fix them. You may write on the code.

```
#include<iostream>
using namespace std;

int main()
{
   double x;
   cout << "Input x ";
   cin << x;

   double p=0;
   double sum;

   int N = 10;

   while (i <= N);
   {
      p   = p * x;
      sum = sum + p;
   }

   cout << "Sum = " << sum << endl

   return 0;
}
```

Question 4. Binary and integer math.

What is decimal 22 written in base 2?

What is decimal 44 written in base 2?

What is the value of AB_{16} written in base 2?

What is $FFE3_{16} + 4FA9_{16}$ (answer in base 16)?

What is the value stored in p after this line?

```
double p = 1 + 2 + 3/4 + 5;
```

What is the value stored in k after this line?

```
int k = 10 % 3;
```

What is the value stored in j after this line?

```
int j = 13/5 + 13%5;
```

What is the value stored in n after this line?

```
int n = 1-(static_cast<int>(3*5/4.0)/2);
```

Question 5. In Michigan the legal age for buying cigarettes is 18 or older, and the legal age for buying alcohol is 21 years old or older. Please write a program that lets users enter their age and then outputs to the screen whether they are allowed to buy alcohol and/or cigarettes.

Example of program operating:

```
lazuli% prob5
Please input your age: 45

Hello, you are old enough to purchase booze and cigarettes.
Enjoy them responsibly!


lazuli% prob5
Please input your age: 20

Hello, you are old enough to purchase cigarettes, but not booze.
Lung cancer, here I come!


lazuli% prob5
Please input your age: 17

Hello, you are old enough to purchase neither booze nor cigarettes.
Your health is safe, for now.
```

Write your program on the next page.

```
#include <iostream>
using namespace std;

int main ()
{









     return 0;
}
```