Problem 1  Write a complete C++ program that asks the user to enter their age and the number of pets that they have at home. A legal age must be between 1 and 100 (inclusive).

If the user enters an illegal age the program should print I don’t believe you!

Otherwise if the number of pets is divisible by the age (without a remainder) the program should print That is a lot of pets.

Here is a sample to show how the program runs.

Enter the your age and number of pets: 20 200
That is a lot of pets.

Answer:

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

int main() {
    int age, pets;
    cout << "Enter the your age and number of pets: ";
    cin >> age >> pets;
    if (age < 1 || age > 100)
        cout << "I don’t believe you!\n";
    else if (pets % age == 0)
        cout << "That is a lot of pets.\n";
    return 0;
}
```
Problem 2  Consider the following C++ program. The program makes use of a function \texttt{first3digits} that returns the number formed by the first 3 digits of its input argument as its result. So for example, \texttt{first3digits(12345678)} would be 123.

Make sure to use your own 8-digit CUNY ID number as the number entered as input to the program. It would be a very bad idea to give answers based on another student’s ID number!

```cpp
int main() {
    int id, n, x = 100, y = 17, z = 19;

    cout << "Enter your 8-digit CUNY id number: ";
    cin >> id; // assume that the user types YOUR OWN CUNY ID number

    cout << id << endl; // line (a)
    n = first3digits(id);

    cout << n % x << endl; // line (b)
    cout << n / x << endl; // line (c)

    if ( (y < z) && ((x % y) < y) ) cout << "Yes\n"; // line (d)
    else cout << "No\n";
    y += 3; z /= 3;
    cout << y << z << y << endl; // line (e)

    return 0;
}
```

(a) What is the output from the instruction beginning on line (a)?

Answer:

12345678

This answer is based on the ID number 12345678. Actual answers will be different.

(b) What is the output from the instruction beginning on line (b)?

Answer:

23

The answer will be made from the 2nd and 3rd digits of the answer to (a).

(c) What is the output from the instruction beginning on line (c)?

Answer:

1

The answer will be the 1st digit of the answer to (a).

(d) What is the output from the instruction beginning on line (d)?

Answer:

Yes
(e) What is the output from the instruction beginning on line (e)?

Answer:

20620
Problem 3  Write a complete C++ program that repeatedly asks the user to enter a number of rows. If rows is greater than or equal to 0, the program prints a triangular pattern of *s with that number of rows. When a user enters a negative number of rows, the program tells the user the total number of *s that have been printed and terminates.

Here is a sample to show how the program runs.

Enter the number of rows or a negative number to stop: 4
* **
****
Enter the number of rows or a negative number to stop: 2
* **
Enter the number of rows or a negative number to stop: 3
* **
***
Enter the number of rows or a negative number to stop: -1
A total of 19 *s were printed.

Answer:

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

int main() {
    int rows = 0, total = 0;
    while (rows >= 0) {
        for (int r = 1; r <= rows; r++) {
            for (int c = 1; c <= r; c++) {
                cout << "*";
                total++;
            }
            cout << endl;
        }
        cout << "Enter the number of rows or a negative number to stop: ";
        cin >> rows;
    }
    cout << "A total of " << total << " *s were printed.\n";
    return 0;
}
```
Problem 4  
The following program asks the user to enter a number $n$. It then prints a picture showing a triangle that points to the right that has $2n - 1$ rows and $n$ columns. The odd numbered rows are made of $*$s and the even ones are made of os. For example, if $n = 4$ the program would print:

```
* 
** 
*** 
**** 
```

Some pieces of code have been replaced by PART (a), PART (b), and so on. To answer the parts of this question you should supply the C++ code that was replaced. Each answer must fit on a single line.

```cpp
int main() {
    int n;
    cout << "What is n? ";
    PART (a)
    for (int r = 1; PART (b); r++) {
        for (int c = 1; PART (c); c++) {
            if (PART (d)) cout << "\*";
            else cout << "o";
        }
        PART (e)
    }
    for (int r = n - 1; PART (f); r--) {
        for (int c = 1; PART (g); c++) {
            if (PART (h)) cout << "\*";
            else cout << "o";
        }
        PART (i)
    }

    return 0;
}
```

(a) Give a replacement for PART (a) to read the user’s value of n
Answer: PART (a) is  
(b) Give a replacement for PART (b) to loop over the upper rows of the picture:
Answer: PART (b) is  
(c) Give a replacement for PART (c) to loop over columns of the row:
Answer: PART (c) is  
(d) Give a replacement for PART (d) to test whether to print a star
Answer: PART (d) is  
(e) Give a replacement for PART (e) to finish each row
Answer: PART (e) is  
(f) Give a replacement for PART (f) to loop over the lower rows of the picture:
Answer: PART (f) is  
(g) Give a replacement for PART (g) to loop over columns of the row:
Answer: PART (g) is  
(h) Give a replacement for PART (h) to test whether to print a star
Answer: PART (h) is  
(i) Give a replacement for PART (i) to finish each row
Answer: PART (i) is  
Problem 1  Write a complete C++ program that asks the user to enter their name and age.
If the user is called Freddy and has an age that is either 7 or 17 the program should print  You won the special prize!
Otherwise the program should print  Sorry, please try again.
Here is a sample to show how the program runs.

Enter the your name and age:  Freddy 17
You won the special prize!

Answer:

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

int main() {
    string name;
    int age;
    cout << "Enter the your name and age: ";
    cin >> name >> age;
    if (name == "Freddy" && (age == 7 || age == 17))
        cout << "You won the special prize!\n";
    else
        cout << "Sorry, please try again.\n";
    return 0;
}
```
Problem 2 Consider the following C++ program. The program makes use of a function `first3digits` that returns the number formed by the first 3 digits of its input argument as its result. So for example, `first3digits(12345678)` would be 123.

Make sure to use your own 8-digit CUNY ID number as the number entered as input to the program. It would be a very bad idea to give answers based on another student’s ID number!

```cpp
int main() {
    int id, n, x = 10, y = 27, z = 16;

    cout << "Enter your 8-digit CUNY id number: ";
    cin >> id; // assume that the user types YOUR OWN CUNY ID number

    cout << id << endl; // line (a)
    n = first3digits(id);

    cout << n % x << endl; // line (b)
    cout << n / x << endl; // line (c)

    if ( (y < z) && ((x % y) < y) ) cout << "Yes\n"; // line (d)
    else cout << "No\n";
    y += 3; z /= 3;
    cout << y << z << y << endl; // line (e)

    return 0;
}
```

(a) What is the output from the instruction beginning on line (a)?
Answer:
12345678

This answer is based on the ID number 12345678. Actual answers will be different.

(b) What is the output from the instruction beginning on line (b)?
Answer:
3

The answer will be the 3rd digit of the answer to (a).

(c) What is the output from the instruction beginning on line (c)?
Answer:
12

The answer will be the first two digits of the answer to (a).

(d) What is the output from the instruction beginning on line (d)?
Answer:
(e) What is the output from the instruction beginning on line (e)?

**Answer:**

30530
Problem 3  Write a complete C++ program that repeatedly asks the user to enter a size. If the size is greater than or equal to 0, the program prints a square pattern of *s with that size. When a user enters a negative size, the program tells the user the total number of *s that have been printed and terminates.

Here is a sample to show how the program runs.

Enter a size or a negative number to stop: 2
**
Enter a size or a negative number to stop: 1 *
Enter a size or a negative number to stop: 2 **
Enter a size or a negative number to stop: -1
A total of 9 *s were printed.

Answer:

#include <iostream>
using namespace std;

int main() {

    int size = 0, total = 0;
    while (size >= 0) {
        for (int r = 1; r <= size; r++) {
            for (int c = 1; c <= size; c++) {
                cout << "*";
                total++;
            }
            cout << endl;
        }
        cout << "Enter a size or a negative number to stop: ";
        cin >> size;
    }
    cout << "A total of " << total << " *s were printed.\n";
    return 0;
}
Problem 4 The following program asks the user to enter a number $n$. It then prints a picture showing a triangle that points to the right that has $2n + 1$ rows and $n + 1$ columns. The odd numbered columns are made of os and the even ones are made of *s. For example, if $n = 3$ the program would print:

```
  O
 O*O
 O*O*
 O*O
  O
```

Some pieces of code have been replaced by PART (a), PART (b), and so on. To answer the parts of this question you should supply the C++ code that was replaced. Each answer must fit on a single line.

```cpp
int main() {
  int n;
  cout << "What is n? ";
  PART (a)
  for (int r = 1; PART (b); r++) {
    for (int c = 1; PART (c); c++) {
      if (PART (d)) cout << "*";
      else cout << "o";
    }
    PART (e)
  } // end loop over upper rows

  for (int r = n ; PART (f); r--) {
    for (int c = 1; PART (g); c++) {
      if (PART (h)) cout << "*";
      else cout << "o";
    }
    PART (i)
  } // end loop over lower rows

  return 0;
}
```

(a) Give a replacement for PART (a) to read the user’s value of n
Answer: PART (a) is `cin >> n;`

(b) Give a replacement for PART (b) to loop over the upper rows of the picture:
Answer: PART (b) is `r <= n + 1`

(c) Give a replacement for PART (c) to loop over columns of the row:
Answer: PART (c) is `c <= r`

(d) Give a replacement for PART (d) to test whether to print a star
Answer: PART (d) is `c % 2 == 0`

(e) Give a replacement for PART (e) to finish each row
Answer: PART (e) is `cout << endl;`

(f) Give a replacement for PART (f) to loop over the lower rows of the picture:
Answer: PART (f) is `r >= 1`

(g) Give a replacement for PART (g) to loop over columns of the row:
Answer: PART (g) is `c <= r`

(h) Give a replacement for PART (h) to test whether to print a star
Answer: PART (h) is `c % 2 == 0`

(i) Give a replacement for PART (i) to finish each row
Answer: PART (i) is `cout << endl;`