

The following problems have been used on previous midterm exams in CS111. The exam will have 4 problems.

**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:**

**Problem 2** 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:**

**Problem 3** 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!

```
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:**

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

**Answer:**

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

**Answer:**

(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:**

**Problem 4** 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!

```
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:**

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

**Answer:**

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

**Answer:**

(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:**

**Problem 5** 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:**

**Problem 6** 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:**

**Problem 7** 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:

```
*
oo
***
oooo
***
oo
*
```

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.

```
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:**

(b) Give a replacement for PART (b) to loop over the upper rows of the picture:

**Answer:**

(c) Give a replacement for PART (c) to loop over columns of the row:

**Answer:**

(d) Give a replacement for PART (d) to test whether to print a star

**Answer:**

(e) Give a replacement for PART (e) to finish each row

**Answer:**

(f) Give a replacement for PART (f) to loop over the lower rows of the picture:

**Answer:**

(g) Give a replacement for PART (g) to loop over columns of the row:

**Answer:**

(h) Give a replacement for PART (h) to test whether to print a star

**Answer:**

(i) Give a replacement for PART (i) to finish each row

**Answer:**

**Problem 8** 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
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.

```

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 ; 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:**

(b) Give a replacement for PART (b) to loop over the upper rows of the picture:

**Answer:**

(c) Give a replacement for PART (c) to loop over columns of the row:

**Answer:**

(d) Give a replacement for PART (d) to test whether to print a star

**Answer:**

(e) Give a replacement for PART (e) to finish each row

**Answer:**

(f) Give a replacement for PART (f) to loop over the lower rows of the picture:

**Answer:**

(g) Give a replacement for PART (g) to loop over columns of the row:

**Answer:**

(h) Give a replacement for PART (h) to test whether to print a star

**Answer:**

(i) Give a replacement for PART (i) to finish each row

**Answer:**

**Problem 9** Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.** **Skip: This is for exam 2.**



(a) Write the block for the function called at the line marked (a). It has title line:

```
double average(int x, int y, int z)
```

it returns the average of its 3 parameters.

**Answer:**

(b) Write the block for the function called at the line marked (b). It has title line:

```
int smallest(int x, int y, int z)
```

it returns the smallest of 3 parameters.

**Answer:**

(c) Write the block for the function called at the line marked (c). It has title line:

```
void multiPrint(string s, int n, int m)
```

it prints n copies of s in batches of m to a line.

**Answer:**

**Problem 11** Write a complete C++ program that asks the user to enter two items of data, a course number such as 111 and a class time such as 9am. If the user enters 111 for the course number and 9am for the class time the program should print the message: **You are in the right test.** Otherwise it prints a message **You are in the wrong test!**

Here is a sample to show how the program runs.

```
Enter the your course number: 111
```

```
Enter your course time: 8.30pm
```

```
You are in the wrong test!
```

**Answer:**

**Problem 12** Write a complete C++ program that asks the user to enter two items of data, a course number such as 111 and a class time such as 10am. If the user entered 111 for the course number the program says **You are in the right course.** If user entered 10am for the class time the program should print the message: **You are at the right time.**

Here is a sample to show how the program runs.

```
Enter the your course number: 211
```

```
Enter your course time: 10am
```

```
You are at the right time.
```

**Answer:**

**Problem 13** Consider the following C++ program. Before answering the questions about it you should read through the code to decide what random value is given to **x**.

```

int main() {
    srand(time(0));

    int x = rand() % 100;
    int y = 16, z = 7;

    cout << y << z << endl;           // line (a)
    cout << x + z % y << endl;         // line (b)
    if (x > y && y > z * z) cout << "111\n"; // line (c)
    else cout << "CS\n";

    for (int c = z; c <= y + x / 10; c++) { // line (d)
        cout << c;
    }
    cout << endl;

    while (y < x) y += 10;
    cout << y << endl;                 // line (e)

    x -= 3;
    cout << x << endl;                 // The output printed here is 41

    return 0;
}

```

Answer the following questions in the space provided by blackboard. Each answer fits on one line. Make sure to write a letter (a), (b), (c), (d) or (e) before each line in your answer.

- (a) What is the output from the instruction beginning on line (a)?
- (b) What is the output from the instruction beginning on line (b)?
- (c) What is the output from the instruction beginning on line (c)?
- (d) What is the output from the instruction beginning on line (d)?
- (e) What is the output from the instruction beginning on line (e)?

**Problem 14** Consider the following C++ program. Before answering the questions about it you should read through the code to decide what random value is given to  $x$ .

```

int main() {
    srand(time(0));

    int x = rand() % 100;
    int y = 16, z = 7;

    cout << y << z << endl;           // line (a)
    cout << x + z % y << endl;         // line (b)
    if (x > y || y < z * z) cout << "111\n"; // line (c)
    else cout << "CS\n";

    for (int c = z; c <= y + x / 10; c++) { // line (d)
        cout << c;
    }
    cout << endl;

    while (y < x) y += 10;
}

```

```

cout << y << endl; // line (e)

x *= 2;
cout << x << endl; // The output printed here is 42

return 0;
}

```

Answer the following questions in the space provided by blackboard. Each answer fits on one line. Make sure to write a letter (a), (b), (c), (d) or (e) before each line in your answer.

- (a) What is the output from the instruction beginning on line (a)?
- (b) What is the output from the instruction beginning on line (b)?
- (c) What is the output from the instruction beginning on line (c)?
- (d) What is the output from the instruction beginning on line (d)?
- (e) What is the output from the instruction beginning on line (e)?

**Problem 15** Write a complete C++ program that asks the user to enter an integer value as a size limit. It then generates 100 random numbers  $x$  in the range  $1 \leq x \leq 342$ . The program finishes by printing a count of how many of the 100 random numbers are smaller than the size limit. You must make sure that your program generates different random numbers each time it is run.

Here is a sample to show how the program runs.

```

Enter a size limit: 150
42 of the 100 random numbers were less than 150

```

**Answer:**

**Problem 16** Write a complete C++ program that asks the user to enter an integer value as a target. It then generates 1000 random numbers  $x$  in the range  $1 \leq x \leq 243$ . The program finishes by printing a count of how many of the 1000 random numbers have a difference from the target that is less than 10. For example, if the target is 100 then 91 and 109 would be counted but 90 and 110 would not. You must make sure that your program generates different random numbers each time it is run.

Here is a sample to show how the program runs.

```

Enter a target: 3
42 of the 1000 random numbers are close to the target.

```

**Answer:**

**Problem 17** This question gives a program in which some parts of the code have been hidden. Your task is to supply the missing parts of code so that the program prints the following 10 mathematical formulas for sums of cubes. (The output from your program must match this exactly.)

```

1^3 = 1 = 1^2
1^3 + 2^3 = 9 = 3^2
1^3 + 2^3 + 3^3 = 36 = 6^2
1^3 + 2^3 + 3^3 + 4^3 = 100 = 10^2
1^3 + 2^3 + 3^3 + 4^3 + 5^3 = 225 = 15^2
1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 = 441 = 21^2
1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 = 784 = 28^2
1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 = 1296 = 36^2
1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3 = 2025 = 45^2
1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3 + 10^3 = 3025 = 55^2

```

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.

```
int main() {
    for (int r = 1; r <= PART (a); r++) {
        int sum = 0;
        for (int c = 1; c<= r; c++) {
            cout PART (b);
            if (c PART (c)) {
                cout << "+ ";
            }
            else {
                cout << " = ";
            }
            sum += PART (d);
        }
        cout << sum << " = " << PART (e);
    }
    return 0;
}
```

Answer the following questions in the space provided by blackboard. Each answer fits on one line. Make sure to write a letter (a), (b), (c), (d) or (e) before each line in your answer.

- (a) Give a replacement for PART (a) to specify how many rows of output are printed.
- (b) Give a replacement for PART (b) to print the individual terms that are added in each row.
- (c) Give a replacement for PART (c) to decide whether to print a + or an = sign.
- (d) Give a replacement for PART (d) to calculate the sum in each row.
- (e) Give a replacement for PART (e) to print the right hand part of the formula.

**Problem 18** This question gives a program in which some parts of the code have been hidden. Your task is to supply the missing parts of code so that the program prints the following 10 mathematical formulas for sums of odd numbers. (The output from your program must match this exactly.)

```
1 = 1 = 1^2
1 + 3 = 4 = 2^2
1 + 3 + 5 = 9 = 3^2
1 + 3 + 5 + 7 = 16 = 4^2
1 + 3 + 5 + 7 + 9 = 25 = 5^2
1 + 3 + 5 + 7 + 9 + 11 = 36 = 6^2
1 + 3 + 5 + 7 + 9 + 11 + 13 = 49 = 7^2
1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 = 64 = 8^2
1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 = 81 = 9^2
1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 + 19 = 100 = 10^2
```

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.

```
int main() {
    for (int r = 1; r <= 10; PART (a)) {
        int sum = 0;
        for (int c = 1, odd = 1; c<= r; PART (b)) {
            cout << odd;
            if (c PART (c)) {
                cout << " + ";
            }
            else {
```

```

        cout << " = ";
    }
    sum += PART (d);
}
cout << PART (e) << sqrt(sum) << "^2" << endl;
}
return 0;
}

```

Answer the following questions in the space provided by blackboard. Each answer fits on one line. Make sure to write a letter (a), (b), (c), (d) or (e) before each line in your answer.

- (a) Give a replacement for PART (a) to specify how *r* is modified.
- (b) Give a replacement for PART (b) to specify how *c* and *odd* are modified.
- (c) Give a replacement for PART (c) to decide whether to print a + or an = sign.
- (d) Give a replacement for PART (d) to calculate the sum in each row.
- (e) Give a replacement for PART (e) to do printing after the = sign in each row.

**Problem 19** Write C++ statements to carry out the following tasks. Do not write complete programs. Each answer should be at most 3 lines of C++. Assume the following variables have been declared and initialized with positive values.

```
int x, y;
```

Answer the following questions in the space provided by blackboard. Each answer fits on a few lines. Make sure to write a letter (a), (b), (c), (d) or (e) before each part of your answer.

- (a) Print 53 copies of the word *Hello* on a single (long) line of output.
- (b) Make C++ calculate and print the remainder when variable *y* is divided by variable *x*.
- (c) Print the square root of 2020. Use a C++ function for the calculation.
- (d) Print a random number in the range 100 to 999, inclusive. Use a C++ function.
- (e) Print the digits of the variable *y* backwards. So if *y* is 19683, print 38691.

**Problem 20** Write C++ statements to carry out the following tasks. Do not write complete programs. Each answer should be at most 3 lines of C++. Assume the following variables have been declared and initialized with positive values.

```
int x, y;
```

Answer the following questions in the space provided by blackboard. Each answer fits on a few lines. Make sure to write a letter (a), (b), (c), (d) or (e) before each part of your answer.

- (a) Print *x* copies of the word *Hello* on a single (long) line of output.
- (b) Make C++ calculate and print the exact quotient when the variable *y* is divided by the variable *x*.
- (c) Print the square root of 2021. Use a C++ function for the calculation.
- (d) Print a random number in the range 2000 to 2029, inclusive. Use a C++ function.
- (e) Print the last digits of the variables *x* and *y*.

**Problem 21** Write a complete program that asks the user to enter an integer *n*. If the value of *n* is greater than or equal to 10 and less than or equal to 99 the program should print a line of *n* stars. Otherwise it should say *Hello*. Here is a sample to show how the program runs.

Enter the value of n: 17

\*\*\*\*\*

**Answer:**

**Problem 22** Write a complete program that asks the user to enter a string `name`. If the value of `name` is either *Freddy* or *Fred* the program should say *Goodbye*. Otherwise it should print a line with 101 stars.

Here is a sample to show how the program runs.

Enter a name: Freddy  
Goodbye

**Answer:**

**Problem 23** Write C++ statements to carry out the following tasks. Do not write complete programs. Each answer should be at most 2 lines of C++. Assume the following variables have been declared and initialized with positive values.

```
int x, y;
```

(a) Input a new value for `x` that is typed by the user.

**Answer:**

(b) Print the values of `x` and `y` separated by a comma.

**Answer:**

(c) Print the remainder when `x * x` is divided by `y`.

**Answer:**

(d) Repeatedly multiply `y` by 2 until it is larger than 1000.

**Answer:**

(e) Print the last digits of the first 80 squares. The output starts 14965 from the last digits of 1, 4, 9, 16, 25.

**Answer:**

**Problem 24** Write C++ statements to carry out the following tasks. Do not write complete programs. Each answer should be at most 2 lines of C++. Assume the following variables have been declared and initialized with positive values.

```
int x, y, z;
```

(a) Input new values for `y` and `z` that are typed by the user.

**Answer:**

(b) Print the values of `x`, `y` and `z` separated by spaces.

**Answer:**

(c) Print the remainder when `y` is divided by `x`.

**Answer:**

(d) Repeatedly add `x` to `y` until `y` becomes larger than 100.

**Answer:**

(e) Print the first 2 digits of `y`.

**Answer:**

**Problem 25** Consider the following C++ program.

```

int main() {
    int x = 10, y = 10, z = 11;
    string name = "freddy";

    cout << ((x/3) * 10.0) / 4 << endl;           // line (a)
    cout << (17 % 5) % 2 + 20 << endl;           // line (b)
    if (x > y && x < z)                          // line (c)
        cout << x << endl;
    else cout << "Hello" << endl;
    if (z > y || name == "Freddy")              // line (d)
        cout << "Goodbye" << endl;
    else cout << 12 << endl;
    for (x = 1; x < 4; x++)                      // line (e)
        for (y = 3; y < 5; y++)
            cout << x << y;
    cout << endl;
    return 0;
}

```

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

**Answer:**

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

**Answer:**

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

**Answer:**

(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:**

**Problem 26** Consider the following C++ program.

```

int main() {
    int x = 11, y = 10, z = 9;
    string name = "freddy";

    cout << ((x/4) * 10.0) / 8 << endl;           // line (a)
    cout << (17 % 7) % 2 + 10 << endl;           // line (b)
    if (x > y && x < z)                          // line (c)
        cout << x << endl;
    else cout << "Hello" << endl;
    if (z > y || name == "Freddy")              // line (d)
        cout << "Goodbye" << endl;
    else cout << 13 << endl;
    for (x = 3; x < 6; x++)                      // line (e)
        for (y = 1; y < 3; y++)
            cout << x << y;
    cout << endl;
}
return 0;
}

```

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

**Answer:**

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

**Answer:**

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

**Answer:**

(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:**

**Problem 27** The following program prints output with 5 square blocks arranged as in the following diagram.

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

Some pieces of code have been replaced by PART (a), PART (b), and so on. To answer the 5 parts of this question you should supply the C++ code that was replaced. Each answer must fit on a single line.

```
int main() {
    for (int row = 1; row <= 5; row++) {
        for (int block = 1; block <= PART (a); block++) {
            for (int col = 1; col <= PART (b); col++)
                cout << PART (c);
            cout << PART (d);
        }
        cout << PART (e);
    }
    return 0;
}
```

(a) Give a replacement for PART (a)

**Answer:**

(b) Give a replacement for PART (b)

**Answer:**

(c) Give a replacement for PART (c)

**Answer:**

(d) Give a replacement for PART (d)

**Answer:**

(e) Give a replacement for PART (e)

**Answer:**

**Problem 28** The following program prints output with 6 square blocks arranged as in the following diagram.

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

Some pieces of code have been replaced by PART (a), PART (b), and so on. To answer the 5 parts of this question you should supply the C++ code that was replaced. Each answer must fit on a single line.

```

int main() {
    for (int row = 6; row >= 1; row--) {
        for (int block = 1; block <= PART (a); block++) {
            for (int col = 1; col <= PART (b); col++)
                cout << PART (c);
            cout << PART (d);
        }
        cout << PART (e);
    }
    return 0;
}

```

(a) Give a replacement for PART (a)

**Answer:**

(b) Give a replacement for PART (b)

**Answer:**

(c) Give a replacement for PART (c)

**Answer:**

(d) Give a replacement for PART (d)

**Answer:**

(e) Give a replacement for PART (e)

**Answer:**

**Problem 29** Write a program that asks the user to enter the temperature in New York and then asks the user to enter the temperature in Los Angeles. If the temperature in New York is higher, it should print the message *Liar!* otherwise it should print a message *You need to take a vacation.*

Here is a sample to show how the program runs.

```

What is the temperature in New York? 30
What is the temperature in Los Angeles? 75
You need to take a vacation.

```

**Answer:**

**Problem 30** Write a program that asks the user to enter the day of the week. If the day is either *Tuesday* or *Thursday* it should print a message *You have a CS111 class today.* otherwise it prints: *No CS111 today!*

Here is a sample to show how the program runs.

```

What day is it? Thursday
You have a CS111 class today.

```

**Answer:**

**Problem 31** The following program asks the user to enter a number  $n$ . It then prints a picture showing a downward pointing triangle with  $n$  rows and  $2n - 1$  columns. For example, if  $n = 4$  it would print:

```

*****
*****
****
***
**
*

```

Some pieces of code have been replaced by PART (a), PART (b), and so on. To answer the 5 parts of this question you should supply the C++ code that was replaced. Each answer must fit on a single line.

```

int main() {
    int n;
    cout << "What is n?";
    cin >> n;
    for (int r = 1; PART (a)) {
        for (int c = 1; PART (b)) {
            if (PART (c)) cout << " ";
            PART (d)
        }
        PART (e)
    }
    return 0;
}

```

(a) Give a replacement for PART (a) to loop over rows of the picture:

**Answer:**

(b) Give a replacement for PART (b) to loop over columns of the picture:

**Answer:**

(c) Give a replacement for PART (c) to test whether to print a blank

**Answer:**

(d) Give a replacement for PART (d) to print \*s

**Answer:**

(e) Give a replacement for PART (e) to finish each row

**Answer:**

**Problem 32** 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. 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 5 parts of this question you should supply the C++ code that was replaced. Each answer must fit on a single line.

```

int main() {
    int n;
    cout << "What is n?";
    PART (a)
    for (int r = 1; PART (b)) {
        for (int c = 1; PART (c)) {
            if (PART (d)) cout << "*";
        }
        PART (e)
    }
    return 0;
}

```

(a) Give a replacement for PART (a) to read the user's value of n

**Answer:**

(b) Give a replacement for PART (b) to loop over rows of the picture:

**Answer:**

(c) Give a replacement for PART (c) to loop over columns of the picture:

**Answer:**

(d) Give a replacement for PART (d) to test whether to print a star

**Answer:**

(e) Give a replacement for PART (e) to finish each row

**Answer:**

**Problem 33** Consider the following C++ program.

```
int main() {
    int x = 3, y = 1, z = 4;
    double a = 4.0, b = 5.0;
    cout << x << x * a << endl;           // line (a)
    cout << (z % y) << "\n" << z / x << endl; // line (b)
    if ((a < z) && (b > y)) cout << "Hello" << endl; // line (c)
    for (; x <= 9; x++) cout << "x";      // line (d)
    cout << endl;
    cout << sqrt(a) / z << endl;          // line (e)
}
```

(a) What is the output at line (a)?

**Answer:**

(b) What is the output at line (b)?

**Answer:**

(c) What is the output at line (c)?

**Answer:**

(d) What is the output at line (d)?

**Answer:**

(e) What is the output at line (e)?

**Answer:**

**Problem 34** Consider the following C++ program.

```
int main() {
    int x = 6, y = 0, z = 3;
    double a = 5.0, b = 4.0;
    cout << x << x * a << endl;           // line (a)
    cout << (y % z) << "\n\n" << z / x << endl; // line (b)
    if ((a < x) && (b > y)) cout << "Hello" << endl; // line (c)
    for (; x <= 9; x++) cout << x;      // line (d)
    cout << endl;
    cout << sqrt(b) * sqrt(b) / x * z << endl; // line (e)
}
```

(a) What is the output at line (a)?

**Answer:**

(b) What is the output at line (b)?

**Answer:**

(c) What is the output at line (c)?

**Answer:**

(d) What is the output at line (d)?

**Answer:**

(e) What is the output at line (e)?

**Answer:**

**Problem 35** Write a program that prints out all integers between 1 and 1000 for which the square root has a 0 as the first digit after the decimal place. For example, the number 198 should be printed because its square root begins 14.0712 but 199 is not printed because its square root begins 14.1067.

**Answer:**

**Problem 36** Write a program that uses a C++ function to generate a number  $n$  between 1000 and 2000 and then prints all out all integers between 1 and  $n$  that square to a number ending in 61. For example, 31 would be printed because  $31^2 = 961$ . (You should make sure that different random numbers are generated each time your program is run.)

**Answer:**

**Problem 37** Write a complete C++ program that asks the user to type an integer  $n$ . It should then ask the user to enter  $n$  more numbers and print the average of these numbers.

Partial credit will be given for programs that perform some of the required steps but excessively long or complicated programs will lose credit.

Examples of two sample runs of the program:

|                                   |  |                             |
|-----------------------------------|--|-----------------------------|
| venus> ./a.out                    |  | venus> ./a.out              |
| Enter an integer: 4               |  | Enter an integer: 1         |
| Now enter 4 more numbers: 5 6 7 8 |  | Now enter 1 more numbers: 8 |
| Their average is 6.5              |  | Their average is 8          |
| venus>                            |  | venus>                      |

**Answer:**

**Problem 38** Write a complete C++ program that asks the user to type an integer  $n$ . It should then ask the user to enter  $n$  more numbers and print out how many of these numbers were odd.

Partial credit will be given for programs that perform some of the required steps but excessively long or complicated programs will lose credit.

Examples of two sample runs of the program:

|                                   |  |                                     |
|-----------------------------------|--|-------------------------------------|
| venus> ./a.out                    |  | venus> ./a.out                      |
| Enter an integer: 4               |  | Enter an integer: 5                 |
| Now enter 4 more numbers: 6 7 8 9 |  | Now enter 5 more numbers: 1 3 5 7 9 |
| 2 were odd                        |  | 5 were odd                          |
| venus>                            |  | venus>                              |

**Answer:**

**Problem 39** Write a complete C++ program that asks the user to type two positive integers. It should show a horizontal bar of X symbols whose length is given by the shorter of the two integers. (If the two integers are equal, either can be used as the shorter.)

Partial credit will be given for programs that perform some of the required steps but excessively long or complicated programs will lose credit.

Examples of two sample runs of the program:

```
venus> ./a.out
Enter 2 positive integers: 4 2
XX
venus>
```

```
venus> ./a.out
Enter 2 positive integers: 4 5
XXXX
venus>
```

**Answer:**

**Problem 40** Write a complete C++ program that asks the user to type two positive integers. It should show a horizontal bar of \$ symbols whose length is given by the longer of the two integers. (If the two integers are equal, either can be used as the longer.)

Partial credit will be given for programs that perform some of the required steps but excessively long or complicated programs will lose credit.

Examples of two sample runs of the program:

```
venus> ./a.out
Enter 2 positive integers: 4 2
$$$$
venus>
```

```
venus> ./a.out
Enter 2 positive integers: 4 5
$$$$$
venus>
```

**Answer:**

**Problem 41** Write a complete C++ program that asks the user to enter their name and age. If the user is less than 10 or more than 99, the program should terminate with a message of *Too young* or *Too old*. Otherwise, it should say hello to the user and tell them the first and last digits of their age.

Partial credit will be given for programs that perform some of the required steps but excessively long or complicated programs will lose credit.

Examples of two sample runs of the program:

```
venus> ./a.out
Name: Freddy
Age: 5
Too young.
venus>
```

```
venus> ./a.out
Name: Freddy
Age: 24
Hello Freddy.
The first digit of your age is 2
and the last digit is 4.
venus>
```

**Answer:**

### Problem 42

Write C++ statements to carry out the following tasks. Do not write complete programs, just give a single line of C++ code. No answer can use more than one line of code. Assume that variables x, y, z with type int have been declared.

(a) Prompt the user to enter values for x, y and z.

**Answer:**

(b) Read the values of x, y and z given by the user

**Answer:**

(c) If  $x < y < z$ , replace z by  $y - x$

**Answer:**

(d) Set  $x$  to be the remainder when  $y$  is divided by  $z$

**Answer:**

(e) Print  $x$  copies of the word HELLO (each on its own line of output)

**Answer:**

### Problem 43

Write C++ statements to carry out the following tasks. Do not write complete programs, just give a single line of C++ code. No answer can use more than one line of code. Assume that variables  $a$ ,  $b$ ,  $c$  with type `int` have been declared and initialized.

(a) Prompt the user to enter values for  $b$  and  $c$ .

**Answer:**

(b) Read the values of  $b$  and  $c$  given by the user

**Answer:**

(c) If  $c > b > 0$ , set  $a$  to be 5.

**Answer:**

(d) If any of  $a$ ,  $b$  and  $c$  is negative set  $c$  to be 6.

**Answer:**

(e) Print  $c$  copies of  $b$  separated by spaces but on one line of output.

**Answer:**

### Problem 44

Write C++ statements to carry out the following tasks. Do not write complete programs, just give a single line of C++ code. No answer can use more than one line of code. Assume that variables  $a$ ,  $b$ ,  $c$  with type `double` have been declared and initialized.

(a) Prompt the user to enter values for  $b$  and  $c$ .

**Answer:**

(b) Read the values of  $b$  and  $c$  given by the user

**Answer:**

(c) If  $c > b > 0 > a$ , set  $a$  to be 2.5.

**Answer:**

(d) If all of  $a$ ,  $b$  and  $c$  are negative set  $c$  to be 6.6.

**Answer:**

(e) Print 50 copies of  $a$  \* symbol all on one line of output.

**Answer:**

### Problem 45

Write C++ statements to carry out the following tasks. Do not write complete programs, just give a single line of C++ code. No answer can use more than one line of code. Assume that variables  $x$ ,  $y$ ,  $z$  with type `double` have been declared.

(a) Prompt the user to enter values for x, y and z.

**Answer:**

(b) Read the values of x, y and z given by the user

**Answer:**

(c) If  $0 < y^2 - 4xz < y^2$ , print NEGATIVE

**Answer:**

(d) Set x to be the cube of y

**Answer:**

(e) Print 80 copies of the number 5 (all on the same line of output)

**Answer:**

#### Problem 46

Write C++ statements to carry out the following tasks. Do not write complete programs, just give a single line of C++ code. No answer can use more than one line of code. Assume that integer variables x, y, z have been declared.

(a) Prompt the user to enter values for x and y.

**Answer:**

(b) Read the values of x and y given by the user

**Answer:**

(c) If  $x < y < 10$ , replace x by 10

**Answer:**

(d) Set z to be a random number between 20 and 36

**Answer:**

(e) Print z copies of the square root of x (each on its own line)

**Answer:**

**Problem 47** Consider the following C++ program.

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

int main() {
    int x = 2, y = 5, z = 65;
    string qc = "Queens College";
    string cs = "CS111";
    for (int c = x; c < y; c++) cout << cs; cout << endl; // line (a)
    cout << (z % y) / (y % x) << endl; // line (b)
    if ((x > y) && (y > z)) cout << qc << endl; // line (c)
    cout << cs << " / " << (y - x) << " = CS1\n"; // line (d)
    cout << x << "%" << y << "=" << "x % y" << "\n"; // line (e)
}
```

(a) What is the output at line (a)?

**Answer:**

(b) What is the output at line (b)?

**Answer:**

(c) What is the output at line (c)?

**Answer:**

(d) What is the output at line (d)?

**Answer:**

(e) What is the output at line (e)?

**Answer:**

**Problem 48** Consider the following C++ program.

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

int main() {
    int x = 9, y = 4, z = 25;
    string qc = "Quick";
    string cs = "C++";
    for (int c = x; c < y; c++) cout << cs; cout << endl;           // line (a)
    cout << (z % y) / (y % x) << endl;                               // line (b)
    if ((x > y) && (z > y)) cout << qc << endl;                       // line (c)
    cout << cs << " / " << (y - x) << " = Java\n";                   // line (d)
    cout << x << "%" << y << "=" << "x % y" << "\n";               // line (e)
}
```

(a) What is the output at line (a)?

**Answer:**

(b) What is the output at line (b)?

**Answer:**

(c) What is the output at line (c)?

**Answer:**

(d) What is the output at line (d)?

**Answer:**

(e) What is the output at line (e)?

**Answer:**

**Problem 49** Consider the following C++ program.

```

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

int main() {
    int x = 2, y = 5, z = 8, w = 11;
    string a = "b", b = "a", c = "a";

    cout << a << c << x << z << endl;           // line (a)

    cout << a << "a" << "x" << a << endl;       // line (b)

    if (x != y) cout << "x" << "==" << y << endl; // line (c)

    if ((x == y) || (b == c)) cout << x << "==" << "y" << endl; // line (d)

    while (x <= w) {x *= 2; cout << x;} cout << endl; // line (e)

    cout << endl;
    return 0;
}

```

(a) What is the output at line (a)?

**Answer:**

(b) What is the output at line (b)?

**Answer:**

(c) What is the output at line (c)?

**Answer:**

(d) What is the output at line (d)?

**Answer:**

(e) What is the output at line (e)?

**Answer:**

**Problem 50** Consider the following C++ program.

```

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

int main() {
    int a = 5, b = 8, c = 11, d = 2;
    string x = "z", y = "z", z = "x";

    cout << a << c << x << z << endl;           // line (a)

    cout << a << "a" << "x" << a << endl;       // line (b)

    if (x != y) cout << "x" << "==" << y << endl; // line (c)

    if ((x == y) || (b == c)) cout << x << "==" << "y" << endl; // line (d)

    while (a <= b) {b -= 1; cout << x;} cout << endl; // line (e)

    cout << endl;
    return 0;
}

```

(a) What is the output at line (a)?

**Answer:**

(b) What is the output at line (b)?

**Answer:**

(c) What is the output at line (c)?

**Answer:**

(d) What is the output at line (d)?

**Answer:**

(e) What is the output at line (e)?

**Answer:**

**Problem 51** Consider the following C++ program.

```

#include <iostream>
using namespace std;

int main() {
    int x = 5, y = 10, z = 15;
    cout << "x " << x << " x % x" << endl;       // line (a)
    cout << (z % y) << "\n" << x / y << endl;     // line (b)
    if ((x > y) || (y > x)) cout << y % z << endl; // line (c)
    for (int a = 1; a <= 5; a++) cout << "a";    // line (d)
    cout << endl;
    cout << x % y - 7 << endl;                   // line (e)
}

```

(a) What is the output at line (a)?

**Answer:**

(b) What is the output at line (b)?

**Answer:**

(c) What is the output at line (c)?

**Answer:**

(d) What is the output at line (d)?

**Answer:**

(e) What is the output at line (e)?

**Answer:**

**Problem 52** Write a complete C++ program that asks the user for a number  $n$  of triangles to print. It then prints  $n$  triangles made of X symbols, one above another. Each triangle has  $n$  rows and every second triangle is upside down. The triangles should be separated by lines of - symbols.

For example, here is the output from the program where the user specifies 4 for  $n$ .

Excessively long or poorly presented programs will lose credit. A reasonable solution should not require more than 30 lines of code. Very much shorter solutions are also possible.

Enter the number of triangles: 4

```
X
XX
XXX
XXXX
-----
XXXX
  XXX
   XX
    X
-----
X
XX
XXX
XXXX
-----
XXXX
  XXX
   XX
    X
-----
```

**Answer:**

**Problem 53** Write a complete C++ program that asks the user for a number  $n$  of triangles to print. It then prints  $n$  triangles made of 0 symbols, one above another. Each triangle has  $n$  rows and the triangles are alternately upside down from each other (in the way shown below). The triangles should be separated by lines of \* symbols.

For example, here is the output from the program where the user specifies 4 for  $n$ .

Excessively long or poorly presented programs will lose credit. A reasonable solution should not require more than 30 lines of code. Very much shorter solutions are also possible.

Enter the number of triangles: 4

```
0000
 000
   00
    0
****
0
00
000
0000
****
0000
 000
   00
    0
****
0
00
000
0000
****
```

**Answer:**

**Problem 54** Write a complete C++ program that asks the user for a number  $n$  of diagonal lines to print in a large extended type of M figure. It should make a picture using  $n$  diagonal lines (each  $n$  rows high) that slope upwards and then downwards in sequence. The lines should be made from the symbol X.

For example, here is the output from the program where the user specifies 6 for  $n$ .

Excessively long or poorly presented programs will lose credit. A reasonable solution should not require more than 30 lines of code. Very much shorter solutions are also possible.

Enter the number of diagonal lines: 6

```
      XX      XX      XX
     X  X    X  X    X  X
    X  X  X  X  X  X  X  X
   X  X  X  X  X  X  X  X
  X  X  X  X  X  X  X  X
 X  X  X  X  X  X  X  X
```

**Answer:**

**Problem 55** Write a complete C++ program that asks the user for a number  $n$  of diagonal lines to print in a large extended type of W figure. It should make a picture using  $n$  diagonal lines (each  $n$  rows high) that slope downwards and then upwards in sequence. The lines should be made from the symbol W.

For example, here is the output from the program where the user specifies 6 for  $n$ .

Excessively long or poorly presented programs will lose credit. A reasonable solution should not require more than 30 lines of code. Very much shorter solutions are also possible.

Enter the number of diagonal lines: 6

```
W      W      W
 W     W     W
  W    W    W
   W   W   W
    W  W  W
     W W W
```

**Answer:**

**Problem 56** Write a complete C++ program that asks the user for a number  $n$  and then prints a large grid of small squares. Each small square has size  $(n - 1) \times (n - 1)$  and contains \* symbols. The large grid should have  $n$  rows each of which contains  $n$  small squares, with a blank column separating these squares. The rows of small squares in the large grid should be separated by blank rows.

For example, if the user specified 3 for  $n$ , the program would print as follows:

\*\* \*\* \*\*  
\*\* \*\* \*\*

\*\* \*\* \*\*  
\*\* \*\* \*\*

\*\* \*\* \*\*  
\*\* \*\* \*\*

**Answer:**