

Problem 1 Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[2] = {1.1, 2.2};
    int d[2][2] = {{2,2},{3,4}};

    x = multiply(z, y);           // (a) sets x to product 2
    copy(x, y);                  // (b) replaces x by value of y
    bigCol(d, 2, 2);             // (c) prints biggest column: 2 4
    cout << printAll(b, 2) << endl; // (d) prints array: 1.1 2.2
    cout << add(b[1], b[1]) << endl; // (e) prints the sum 4.4
    return 0;
}
```

(a) Title line for **multiply** as called at the line marked (a).

Answer:

(b) Title line for **copy** as called at the line marked (b).

Answer:

(c) Title line for **bigCol** as called at the line marked (c).

Answer:

(d) Title line for **printAll** as called at the line marked (d).

Answer:

(e) Title line for **add** as called at the line marked (e).

Answer:

Problem 2 Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[2] = {1.1, 2.2};
    int d[2][2] = {{0,1},{3,4}};

    d[0][0] = sum(x, y);         // (a) sets d[0][0] to the sum 1
    swap(x, y);                 // (b) swaps x and y
    cout << biggest(d, 2, 2);    // (c) prints biggest entry 4
    printAll(b, 2);             // (d) prints 1.1 2.2
    cout << summit(b[0], b[0]) << endl; // (e) prints the sum 2.2
    return 0;
}
```

(a) Title line for **sum** as called at the line marked (a).

Answer:

(b) Title line for **swap** as called at the line marked (b).

Answer:

(c) Title line for **biggest** as called at the line marked (c).

Answer:

(d) Title line for **printAll** as called at the line marked (d).

Answer:

(e) Title line for **summit** as called at the line marked (e).

Answer:

Problem 3 Consider the following C++ program.

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

double down(int x[], int cap, int gap) {
    double ans = 0.0;
    for (int i = 0; i < cap; i+= gap)
        ans += x[i];
    return ans / 10;
}

int main() {
    int x[4] = {2, 1, 3, 0};
    cout << x[2] << endl;           // line (a)
    cout << x[5/3] << endl;         // line (b)
    cout << x[x[3]] << endl;        // line (c)
    cout << down(x, 4, 1) << endl;  // line (d)
    cout << down(x, 4, 3) << 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 4 Consider the following C++ program.

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

double down(int x[], int cap, int gap) {
    double ans = 0.0;
    for (int i = 0; i < cap; i+= gap)
        ans += x[i];
    return ans / 10;
}

int main() {
    int x[4] = {3, 2, 0, 1};
    cout << x[2] << endl;           // line (a)
    cout << x[5/3] << endl;         // line (b)
    cout << x[x[3]] << endl;        // line (c)
    cout << down(x, 4, 1) << endl;  // line (d)
    cout << down(x, 4, 3) << 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 5 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```
int main() {
    int i = 2;
    int x[5] = {3, 1, 4, 1, 5};
    // (a) Is i even? Here YES is printed.
    if (isEven(i)) cout << "YES" << endl;
    // (b) Return the bigger. Here 4 is printed.
    cout << bigger(i, 4) << endl;
    // (c) Are all entries in the array x positive? Here YES is printed.
    if (allPositive(x, 5)) cout << "YES" << endl;
    // (d) Print the array with spaces between entries. Here 3 1 4 1 5.
    printArray(x, 5);
    // (e) Print the number of digits. Here 3.
    cout << numDigits(729) << endl;
    return 0;
}
```

(a) bool isEven(int x)

Answer:

(b) int bigger(int x, int y)

Answer:

(c) bool allPositive(int x[], int cap)

Answer:

(d) void printArray(int x[], int cap)

Answer:

(e) int numDigits(int x)

Answer:

Problem 6 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    double i = 2.5;
    string x = "Hello";
    // (a) Is i positive? Here YES is printed.
    if (isPositive(i)) cout << "YES" << endl;
    // (b) Return the bigger. Here 4 is printed.
    cout << bigger(i, 4) << endl;
    // (c) Does the string x start with an upper case character? Here YES.
    if (startsUpper(x)) cout << "YES" << endl;
    // (d) Add on a second copy of the string. Here HelloHello is printed.
    cout << twice(x) << endl;
    // (e) Print the first digit. Here 7.
    cout << firstDigit(729) << endl;
    return 0;
}

```

(a) bool isPositive(double x)

Answer:

(b) double bigger(double x, double y)

Answer:

(c) bool startsUpper(string x)

Answer:

(d) string twice(string x)

Answer:

(e) int firstDigit(int x)

Answer:

Problem 7 Write a function called *shorten* that shortens each element of an array of strings. Every string with more than two characters is cut down to its first two characters.

For example, a program that uses the function *shorten* follows.

```

int main() {
    string x[6] = {"CSCI", "1", "11", "Queens", "College", "CUNY"};
    shorten(x, 6);
    for (int i = 0; i < 6; i++) cout << x[i] << " ";
    // Output:  CS 1 11 Qu Co CU
    cout << endl;
    return 0;
}

```

Answer:

Problem 8 Write a function called *lengthen* that lengthens each element of an array of strings. Every string with at least two characters has a *XXX* added after its first character.

For example, a program that uses the function *lengthen* follows.

```

int main() {
    string x[3] = {"csci", "1", "11"};
    lengthen(x, 3);
    for (int i = 0; i < 3; i++) cout << x[i] << " ";
    // Output:  cXXXsci 1 1XXX1
    cout << endl;
    return 0;
}

```

Answer:

Problem 9 Write a function called *allOdd* that reports whether all the digits in a positive integer parameter are odd.

For example, a program that uses the function *allOdd* follows.

```
int main() {
    if (allOdd(153)) cout << "All odd" << endl;           // prints: All odd
    if (!allOdd(153972)) cout << "Not" << endl;           // prints: Not
    if (!allOdd(222)) cout << "Not " << endl;             // prints: Not
    if (allOdd(5)) cout << "All odd" << endl;            // prints: All odd
    return 0;
}
```

Answer:

Problem 10 Write a function called *evenToNine* that returns a result obtained by turning all the even digits in a positive integer parameter to nines.

For example, a program that uses the function *evenToNine* follows.

```
int main() {
    cout << evenToNine(1234) << endl;                     // prints: 1939
    cout << evenToNine(1357) << endl;                     // prints: 1357
    cout << evenToNine(22) << endl;                       // prints: 99
    cout << evenToNine(1) << endl;                       // prints: 1
    return 0;
}
```

Answer:

Problem 11 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter 25 quiz scores each of which is an integer between 0 and 10.
2. It reads the 25 quiz scores.
3. It prints out the most common score (or scores).

For example if the scores 6 and 8 were the two most common scores, the output would be:

6 8

Answer:

Problem 12 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter quiz scores of 25 students. Each score is an integer between 0 and 10.
2. It reads the 25 quiz scores.
3. It prints out the score obtained by the middle student. (The middle student is ranked 13th in the class.)

Answer:

Problem 13 Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    int x = 0, y = 1, z = 2;
    double b[2] = {1.1, 2.2};
    int d[2][2] = {{1,2},{3,4}};

    cout << diff(x, y) << endl;           // (a) prints difference: -1
    y = addUp(x, y);                     // (b) sets y to sum 0 + 1
    cout << lastElt(b, 2);                // (c) prints last element: 2.2
    b[0] = average(d, 2, 2);             // (d) sets as average 2.5
    setZero(y, z);                       // (e) sets both to 0
    return 0;
}

```

(a) Title line for **diff** as called at the line marked (a).

Answer:

(b) Title line for **addUp** as called at the line marked (b).

Answer:

(c) Title line for **lastElt** as called at the line marked (c).

Answer:

(d) Title line for **average** as called at the line marked (d).

Answer:

(e) Title line for **setZero** as called at the line marked (e).

Answer:

Problem 14 Consider the following C++ program.

```

#include <iostream>
using namespace std;

double down(int x[], int cap, int gap) {
    double ans = 0.0;
    for (int i = 0; i < cap; i+= gap)
        ans += x[i];
    return ans / 10;
}

int main() {
    int x[4] = {1, 1, 3, 2};
    cout << x[2] << endl;           // line (a)
    cout << x[5/3] << endl;         // line (b)
    cout << x[x[3]] << endl;        // line (c)
    cout << down(x, 4, 1) << endl;  // line (d)
    cout << down(x, 4, 3) << 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 15 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```
int main() {
    int i = 2;
    string x = "Hello";
    // (a) Does the number end in a 0? Here YES is printed.
    if (endInZero(100)) cout << "YES" << endl;
    // (b) Return the smaller. Here 2 is printed.
    cout << smaller(i, 4) << endl;
    // (c) Return the first character of the string. Here H is printed.
    cout << firstCharacter(x) << endl;
    // (d) Print first two characters in reverse order. Here eH is printed.
    swapFirstTwo(x); cout << endl;
    // (e) Print the sum of the digits. Here 18.
    cout << sumDigits(729) << endl;
    return 0;
}
```

(a) bool endInZero(int x)

Answer:

(b) int smaller(int x, int y)

Answer:

(c) char firstCharacter(string x)

Answer:

(d) void swapFirstTwo(string x)

Answer:

(e) int sumDigits(int x)

Answer:

Problem 16 Write a function called *setRandom* that assigns a random value between 21 and 40 to each element of a 2-dimensional array of integers (with 3 columns). (You must use a standard C++ function to generate random numbers.)

For example, a program that uses the function *setRandom* follows.

```
int main() {
    int x[2][3];
    setRandom(x, 2, 3);
    for (int c = 0; c < 3; c++) cout << x[1][c] << " ";
    // The output would be something like: 30 21 29
    cout << endl;
    return 0;
}
```

Answer:

Problem 17 Write a function called *startsWith* that returns a result of *even* or *odd* that describes the first digit of a positive integer parameter.

For example, a program that uses the function *startsWith* follows.

```
int main() {
    cout << startsWith(1234) << endl; // prints: odd
    cout << startsWith(2345) << endl; // prints: even
    cout << startsWith(22) << endl; // prints: even
    cout << startsWith(1) << endl; // prints: odd
    return 0;
}
```

Answer:

Problem 18 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter quiz scores of 24 students. Each score is an integer between 0 and 10.
2. It reads the 24 quiz scores.
3. It prints out the lowest score obtained by a student in the first quartile. (This is the score of the student ranked 6th in the class.)

Answer:

Problem 19 Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[3] = {1.9, 2.3, 3.0};
    int d[2][2] = {{1,2},{3,4}};

    x = sum(z, y); // (a) sets x to the sum: 3
    reset(d[1][1], z); // (b) replaces d[1][1] by the value of z
    diagonal(d, 2, 2); // (c) prints diagonal: 1 4
    cout << printAll(d, 2, 2) << endl; // (d) prints array: 1 2 3 4
    cout << add(b[2], d[0][0]) << endl; // (e) prints the sum: 4
    return 0;
}
```

- (a) Title line for **sum** as called at the line marked (a).

Answer:

- (b) Title line for **reset** as called at the line marked (b).

Answer:

(c) Title line for **diagonal** as called at the line marked (c).

Answer:

(d) Title line for **printAll** as called at the line marked (d).

Answer:

(e) Title line for **add** as called at the line marked (e).

Answer:

Problem 20 Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    double d = 2;
    string x[5] = {"3", "1", "4", "1", "5"};
    d = average(x, 5); // (a) sets d to 2.8
    d = max(d, x[4], 3); cout << d << endl; // (b) prints 5.0
    cout << inWords(x[1]) << endl; // (c) prints one
    cout << f(f(x[0],d), 1.0) << endl; // (d) mystery function prints 1.0
    percentage(8.0, x[2]); // (e) prints 200%
    return 0;
}
```

(a) Title line for **average** as called at the line marked (a).

Answer:

(b) Title line for **max** as called at the line marked (b).

Answer:

(c) Title line for **inWords** as called at the line marked (c).

Answer:

(d) Title line for **f** as called at the line marked (d).

Answer:

(e) Title line for **percentage** as called at the line marked (e).

Answer:

Problem 21 Consider the following C++ program.

```

#include <iostream>
using namespace std;
int recursive (int x) {
    if (x < 5) return 3;
    return recursive (x / 3) + x % 6;
}

char swap (int x, int y) {
    x = y;
    y = x;
    cout << x << y;
    return 's';
}

void set (int arr []) {
    arr[0] = 1; arr[1] = 9; arr[2] = 6; arr[3] = 8; arr[4] = 3;
}

int main() {
    int x[5];
    set(x);
    swap(1, 2); cout << endl; //line (a)
    set(x);
    cout << x[0 + 2] << x[0] + 2 << endl; //line (b)
    cout << swap(1, 2) << endl; //line (c)
    for (int i = 1; i < 4; i++) cout << x[i]; cout << endl; //line (d)
    int e = 21;
    cout << recursive(e) << endl; //line (e)
    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:

```

#include <iostream>
using namespace std;
int recursive (int x) {
    if (x < 5) return 4;
    return recursive (x / 4) + x % 6;
}

char swap (int x, int y) {
    y = x;
    x = y;
    cout << x << y;
    return '0';
}

void set (int arr []) {
    arr[0] = 5; arr[1] = 9; arr[2] = 0; arr[3] = 4; arr[4] = 9;
}

int main() {
    int x[5];
    set(x);
    swap(1, 2); cout << endl; //line (a)
    set(x);
    cout << x[0 + 2] << x[0] + 2 << endl; //line (b)
    cout << swap(1, 2) << endl; //line (c)
    for (int i = 1; i < 4; i++) cout << x[i]; cout << endl; //line (d)
    int e = 21;
    cout << recursive(e) << endl; //line (e)
    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 23 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    int i = 2;
    int x[5] = {3, 1, 4, 1, 5};
    // (a) Return the sum. Here 4 is printed.
    cout << add(i, 2) << endl;
    // (b) Return number of odd entries. Here 4 is printed.
    cout << numOdd(x, 5) << endl;
    // (c) Multiply i by 2. Here 4 is printed.
    doubleIt(i); cout << i << endl;
    // (d) Find the index of the largest entry. Here 4 is printed.
    cout << findIndexMax(x, 5) << endl;
    // (e) Is it a lower case character? Here 4 is printed.
    if (isLowerCase('h')) cout << "4" << endl;
    return 0;
}

```

(a) int add(int x, int y)

Answer:

(b) int numOdd(int array[], int cap)

Answer:

(c) void doubleIt(int &x)

Answer:

(d) int findIndexMax(int array[], int cap)

Answer:

(e) bool isLowerCase(char x)

Answer:

Problem 24 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    int i = 2;
    int x[5] = {3, 1, 4, 1, 5};
    // (a) Return the absoluteValue. Here 2 is printed.
    cout << absoluteValue(i) << endl;
    // (b) Return number of even entries, here 1 is printed.
    cout << numEven(x, 5) << endl;
    // (c) Cube i. Here 8 is printed.
    cubeIt(i); cout << i << endl;
    // (d) Find the (first) index of the smallest entry. Here 1 is printed.
    cout << findIndexMin(x, 5) << endl;
    // (e) Is it a digit? Here print nothing.
    if (isDigit('h')) cout << "Digit" << endl;
    return 0;
}

```

(a) `int absoluteValue(int x)`

Answer:

(b) `int numEven(int array[], int cap)`

Answer:

(c) `void cubeIt(int &x)`

Answer:

(d) `int findIndexMin(int array[], int cap)`

Answer:

(e) `bool isDigit(char x)`

Answer:

Problem 25 Write a function called *noEl* that returns the number of elements that do not contain the letter *l* in a 2-dimensional array of strings (that has 3 columns).

For example, a program that uses the function *noEl* follows.

```
int main() {
    string x[2][3] = {"CSCI", "One", "eleven"}, {"Queens", "College", "CUNY"};
    cout << noEl(x, 2, 3) << endl;    // prints: 4
    return 0;
}
```

Answer:

Problem 26 Write a function called *cString* that returns a comma separated list of all elements that start with the letter *C* in an array of strings.

For example, a program that uses the function *cString* follows.

```
int main() {
    string x[6] = {"Computer", "Science", "111", "Queens", "College", "CUNY"};
    cout << cString(x, 6) << endl;    // prints: Computer,College,CUNY
    return 0;
}
```

Answer:

Problem 27 Write a function called *removeDuplicates* that replaces any sequence of copies of a digit in a positive integer parameter by a single copy of that digit.

For example, a program that uses the function *removeDuplicates* follows.

```
int main() {
    cout << removeDuplicates(55511) << endl;    // prints 51
    cout << removeDuplicates(51155) << endl;    // prints 515
    cout << removeDuplicates(551155) << endl;    // prints 515
    cout << removeDuplicates(515) << endl;    // prints 515
    return 0;
}
```

Answer:

Problem 28 Write a function called *makeDecreasing* that makes a result with decreasing digits from a positive integer parameter. It selects the leftmost digit of the parameter and then later digits that are smaller than all that have already been selected.

For example, a program that uses the function *makeDecreasing* follows.

```
int main() {
    cout << makeDecreasing(89321) << endl;           // prints 8321
    cout << makeDecreasing(892321) << endl;          // prints 821
    cout << makeDecreasing(1995) << endl;            // prints 1
    cout << makeDecreasing(7) << endl;               // prints 7
    return 0;
}
```

Answer:

Problem 29 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter 25 integers and it reads the numbers that the user gives.
2. It calculates the average of the entered numbers.
3. It reports all entered numbers that are greater than the average, by printing them to a file called output6.txt.

Answer:

Problem 30 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter 25 integers and it reads the numbers that the user gives.
2. It calculates the smallest of the entered numbers.
3. It reports all entered numbers that are greater than the square of the smallest one. This output is to be printed to a file called output6.txt (and not to the user's screen).

Answer:

Problem 31 Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int a[3] = {1, 1, 1}, i = 7, j = 8, k = 9;
    int b[5] = {1, 9, 6, 8, 3};
    int x[2][2] = {{2, 0}, {4, 8}};
    cout << max(i, j, k) << endl; // (a) prints: 9
    printMax(b, 5); // (b) prints: 9
    cout << max2d(x, 2, 2) << endl; // (c) prints: 8
    swap(i, j); // (d) swaps i and j
    swapArrays(a, b, 2); // (e) swaps first 2 elements of arrays a and b
    return 0;
}
```

(a) Title line for **max** as called at the line marked (a).

Answer:

(b) Title line for **printMax** as called at the line marked (b).

Answer:

(c) Title line for **max2d** as called at the line marked (c).

Answer:

(d) Title line for **swap** as called at the line marked (d).

Answer:

(e) Title line for **swapArrays** as called at the line marked (e).

Answer:

Problem 32 Write the best **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    double a[3] = {1.0, 1.0, 1.0}, i = 7.0, j = 8.0, k = 9.9;
    double b[5] = {1.9, 9.9, 6.9, 8.9, 3.9};
    double x[2][2] = {{2.9, 0.9}, {4.9, 8.9}};
    cout << max(i, j, k) << endl; // (a) prints: 9.9
    printMax(b, 5); // (b) prints: 9.9
    cout << max2d(x, 2, 2) << endl; // (c) prints: 8.9
    swap(i, j); // (d) swaps i and j
    swapArrays(a, b, 2); // (e) swaps first 2 elements of arrays a and b
    return 0;
}
```

(a) Title line for **max** as called at the line marked (a).

Answer:

(b) Title line for **printMax** as called at the line marked (b).

Answer:

(c) Title line for **max2d** as called at the line marked (c).

Answer:

(d) Title line for **swap** as called at the line marked (d).

Answer:

(e) Title line for **swapArrays** as called at the line marked (e).

Answer:

Problem 33 Consider the following C++ program.

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

void yesNo(bool ans) {
    if (ans) cout << "Y\n";
    else cout << "N\n";
    cout << endl;
}

int main() {
    int x = 3, y = 4, z = 5, a[4] = {0, 1, 2, 3};
    if (x == y) cout << "Y\n"; else cout << "N\n"; // line (a)
    if (x == a[x]) cout << "Y\n"; else cout << "N\n"; // line (b)
    if (!(x != y)) cout << "Y\n"; else cout << "N\n"; // line (c)
    yesNo((y < z) && (z < x)); // line (d)
    yesNo((x < y) || (z < y)); // 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.

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

void yesNo(bool ans) {
    if (ans) cout << "Y";
    else cout << "N";
    cout << endl;
}

int main() {
    int x = 3, y = 5, z = 4, a[4] = {3, 2, 1, 0};
    if (x == y) cout << "Y\n"; // line (a)
    if (x == a[0]) cout << "Y\n"; // line (b)
    if (!(y < x)) cout << "Y\n"; else cout << "N\n"; // line (c)
    yesNo((x < z) && (y < z)); // line (d)
    yesNo((x < z) || (y < z)); // 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 blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.


```

int main() {
    double a[4] = {1.0, 2.0, -3.0, -4.0};
    double b[4] = {0.5, 1.5, 2.5, 3.5};
    // (a) Return the absolute value (ignoring sign). Here 7 is printed.
    cout << absoluteValue(-7) << endl;
    // (b) Return x/2 if x is even, otherwise 3*x+1: Here 22 is printed.
    cout << collatz(7) << endl;
    // (c) Return the least factor. (Assume input at least 2.) Here 5 is printed.
    cout << leastFactor(35) << endl;
    // (d) Test whether all array entries are positive. Here: Not all positive
    if (!allPositive(a, 4)) cout << "Not all positive\n";
    // (e) Swap entries of the two arrays.
    swapArrays(a, b, 4);
    return 0;
}

```

(a) int absoluteValue(int x)

Answer:

(b) int collatz(int x)

Answer:

(c) int leastFactor(int x)

Answer:

(d) bool allPositive(double x[], int capacity)

Answer:

(e) void swapArrays(double x[], double y[], int capacity)

Answer:

Problem 36 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    int x = 5;
    double e = 2.718;
    double a[4] = {1.0, 2.0, -3.0, -4.0};
    double b[2] = {5.5, 4.5};
    // (a) Changes the sign. Here to -5
    changeSign(x);
    // (b) Return first digit after decimal point. Here 7 is printed.
    cout << firstDecimal(e) << endl;
    // (c) Return the number of negative entries. Here 2 is printed.
    cout << numberNeg(a, 4) << endl;
    // (d) Test whether the first argument is a factor of the second. Here: Yes
    if (isFactor(7, 14)) cout << "Yes\n";
    // (e) print average of all entries both arrays: Here 1.0 is printed.
    averageArrays(a, 4, b, 2);
    return 0;
}

```

(a) void changeSign(int &x)

Answer:

(b) int firstDecimal(double x)

Answer:

(c) int numberNeg(double x[], int capacity)

Answer:

(d) bool isFactor(int x, int y)

Answer:

(e) void averageArrays(double x[], int capacityX, double y[], int capacityY)

Answer:

Problem 37 Write a function called *longestString* that returns the longest element in a 2-dimensional array of strings (that is known to have 2 columns).

For example, a program that uses the function *longestString* follows.

```
int main() {
    string x[3][2] = {"This", "is"}, {"an", "easy"}, {"question", ""} ;
    cout << longestString(x, 3, 2) << endl; // prints: question
    return 0;
}
```

Answer:

Problem 38 Write a function called *print3* that prints the elements of an array of integers, separated by commas and with 3 elements on each output line.

For example, a program that uses the function *print3* follows.

```
int main() {
    int x[8] = {1,2,3,4,5,6,7,8};
    print3(x, 8);
    return 0;
}
```

The output should be exactly:

```
1,2,3
4,5,6
7,8
```

Answer:

Problem 39 Write a function called *become5* that has two inputs – the first input is a positive integer and the second input is a single-digit integer. (You may assume that the two inputs have these forms.) The function has an integer output. The output is identical to the first input, except that every digit that matches the second input is replaced with a 5.

For example, a program that uses the function *become5* follows.

```
int main() {
    cout << become5(232, 2) << endl; // prints 535
    cout << become5(232, 3) << endl; // prints 252
    cout << become5(232, 4) << endl; // prints 232
    return 0;
}
```

Answer:

Problem 40 Write a function called *change5* that has two inputs – the first input is a positive integer and the second input is a single-digit integer. (You may assume that the two inputs have these forms.) The function has an integer output. The output is identical to the first input, except that every digit equal to 5 is replaced by the digit given by the second parameter.

For example, a program that uses the function *change5* follows.

```
int main() {
    cout << change5(535, 2) << endl;      // prints 232
    cout << change5(252, 3) << endl;      // prints 232
    cout << change5(232, 4) << endl;      // prints 232
    return 0;
}
```

Answer:

Problem 41 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It opens an input file called *input14a.txt* that contains only integers, including at least one negative integer. (You may assume that the file has exactly this content.)
2. It reads integers from the file until a negative integer is found.
3. It reports how many integers were read (upto and including the first negative value).

For example if the file *input14a.txt* has the following content:

```
12 16 29
17 10001
2 -34
-1 35 -3
11
```

The first negative entry in the file is its 7th number -34 and the program would output: 7

Answer:

Problem 42 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It opens an input file called *input14b.txt* that contains only strings, including at least one that starts with the letter X. (You may assume that the file has exactly this content.)
2. It reads strings from the file until one beginning with X is found.
3. It reports how many strings were read (upto and including the first that begins with X).

For example if the file *input14b.txt* has the following content:

```
A BBB Cat
```

```
Dog
XYZ E   XXX
```

The first X-word in the file is its 5th string XYZ and the program would output: 5

Answer:

Problem 43 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    int i = 2;
    int x[5] = {3, 1, 4, 1, 5};
    cout << max(2.1, i, i) << endl;           // (a) prints 2.1
    cout << min(x[2], x[3]) << endl;         // (b) prints 1
    doubleIt(i); cout << i << endl;         // (c) prints 4
    printIt(x, 3);                           // (d) prints 314
    cout << sum(sum(2,6), sum(x[0],x[1])) << endl; // (e) prints 12
    return 0;
}

```

(a) Title line for **max** as called at the line marked (a).

Answer:

(b) Title line for **min** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **printIt** as called at the line marked (d).

Answer:

(e) Title line for **sum** as called at the line marked (e).

Answer:

Problem 44 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    int i = 3;
    int x[5] = {2, 7, 1, 8, 2};
    cout << min(i, 2.1, i) << endl;           // (a) prints 2.1
    cout << max(x[2], 3) << endl;             // (b) prints 3
    cout << doubleIt(i) << endl;             // (c) prints the following: 2 x 3
    cout << sum(sum(2,6,i), i, i) << endl;     // (d) prints 17
    sortIt(x, 3);                            // (e) sorts array x by selection sort
    return 0;
}

```

(a) Title line for **min** as called at the line marked (a).

Answer:

(b) Title line for **max** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **sum** as called at the line marked (d).

Answer:

(e) Title line for **sortIt** as called at the line marked (e).

Answer:

Problem 45 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    int i = 2;
    double x[5] = {3, 1, 4, 1, 5};
    cout << max(4.1, x[i], i) << endl;           // (a) prints 4.1
    cout << min(x[2], x[3]) << endl;           // (b) prints 1
    doubleIt(i); cout << i << endl;           // (c) prints 4
    printIt(x, 3);                             // (d) prints 314
    cout << sum(sum(2.1,6), sum(x[0],x[1])) << endl; // (e) prints 12.1
    return 0;
}

```

(a) Title line for **max** as called at the line marked (a).

Answer:

(b) Title line for **min** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **printIt** as called at the line marked (d).

Answer:

(e) Title line for **sum** as called at the line marked (e).

Answer:

Problem 46 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    double i = 3;
    double x[5] = {2, 7, 1, 8, 2};
    cout << min(i, 2.1, i) << endl;           // (a) prints 2.1
    cout << max(x[2], 3.1) << endl;           // (b) prints 3.1
    cout << doubleIt(i) << endl;           // (c) prints the following: 2 x 3
    cout << sum(sum(2.1,6,i), i, i) << endl; // (d) prints 17.1
    sortIt(x, 3);                             // (e) sorts array x by selection sort
    return 0;
}

```

(a) Title line for **min** as called at the line marked (a).

Answer:

(b) Title line for **max** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **sum** as called at the line marked (d).

Answer:

(e) Title line for **sortIt** as called at the line marked (e).

Answer:

Problem 47 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    int i = 2;
    int x[5] = {3, 1, 4, 1, 5};
    cout << add(i, i) << endl;           // (a) prints 4
    cout << numOdd(x, 5) << endl;       // (b) prints 4
    doubleIt(x[1]); cout << x[1] << endl; // (c) prints 2
    cout << diff(diff(3,1), 1) << endl;  // (d) prints 1
    cout << percentage(i, x[2]) << endl; // (e) prints 50%
    return 0;
}

```

(a) Title line for **add** as called at the line marked (a).

Answer:

(b) Title line for **numOdd** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **diff** as called at the line marked (d).

Answer:

(e) Title line for **percentage** as called at the line marked (e).

Answer:

Problem 48 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    int i = 2;
    int x[5] = {3, 1, 4, 1, 5};
    cout << average(x, 5) << endl;       // (a) prints 2.8
    cout << max(i, i, 3) << endl;       // (b) prints 3
    cout << doubleIt(x[1]) << endl;     // (c) prints 2
    cout << total(total(3,1,1), 1, 1) << endl; // (d) prints 7
    percentage(i, x[2]);                // (e) prints 50%
    return 0;
}

```

(a) Title line for **average** as called at the line marked (a).

Answer:

(b) Title line for **max** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **total** as called at the line marked (d).

Answer:

(e) Title line for **percentage** as called at the line marked (e).

Answer:

Problem 49 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    double i = 2.5;
    int x[5] = {3, 1, 4, 1, 5};
    cout << add(i, i) << endl;           // (a) prints 5.0
    if (oddSum(x, 5)) cout << "true" << endl; // (b) prints true
    doubleIt(i); cout << i << endl;       // (c) prints 5.0
    cout << diff(diff(3.0,i), i) << endl;   // (d) prints -2.0
    cout << percentage(x[1], x[2]) << endl; // (e) prints 25%
    return 0;
}

```

(a) Title line for **add** as called at the line marked (a).

Answer:

(b) Title line for **oddSum** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **diff** as called at the line marked (d).

Answer:

(e) Title line for **percentage** as called at the line marked (e).

Answer:

Problem 50 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    double i = 2; int n = 2;
    double x[5] = {3, 1, 4, 1, 5};
    cout << average(x, 5) << endl;           // (a) prints 2.8
    cout << max(i, i, 3.0) << endl;         // (b) prints 3.0
    cout << doubleIt(x[1]) << endl;       // (c) prints 2.0
    cout << ratio(ratio(3,1), n) << endl;   // (d) prints 1.5
    percentage(i, x[2]);                   // (e) prints 50.0%
    return 0;
}

```

(a) Title line for **average** as called at the line marked (a).

Answer:

(b) Title line for **max** as called at the line marked (b).

Answer:

(c) Title line for **doubleIt** as called at the line marked (c).

Answer:

(d) Title line for **ratio** as called at the line marked (d).

Answer:

(e) Title line for **percentage** as called at the line marked (e).

Answer:

Problem 51 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out abc 123**.

```

#include <iostream>
using namespace std;

int main(int argc, char *argv[]) {
    string words[4] = {"An ", "easy ", "question ", ""};
    for (int i = 0; i <= 2; i++) cout << words[i]; cout << endl; // line (a)
    for (int i = 0; i <= 2; i++) cout << words[i][i]; cout << endl; // line (b)
    words[3] = argv[1];
    cout << words[3] << endl; // line (c)
    cout << ++words[0][0] << endl; // line (d)
    cout << argc << endl; // line (e)
    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 52 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out 123**.

```

#include <iostream>
using namespace std;

int main(int argc, char *argv[]) {
    string words[4] = {"An ", "easy ", "question ", ""};
    for (int i = 2; i >= 0; i--) cout << words[i]; cout << endl; // line (a)
    for (int i = 2; i >= 0; i--) cout << words[i][i+1]; cout << endl; // line (b)
    words[3] = argv[1];
    cout << words[3] << endl; // line (c)
    cout << words[0][0]++ << endl; // line (d)
    cout << argc << endl; // line (e)
    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 53 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out xyz 987**.

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

int main(int argc, char *argv[]) {
    string words[4] = {"Not ", "very ", "difficult ", ""};
    for (int i = 0; i <= 2; i++) cout << words[i]; cout << endl; // line (a)
    for (int i = 0; i <= 2; i++) cout << words[i][i]; cout << endl; // line (b)
    words[3] = argv[1];
    cout << words[3] << endl; // line (c)
    cout << ++words[0][0] << endl; // line (d)
    cout << argc << endl; // line (e)
    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 54 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out 007**.

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

int main(int argc, char *argv[]) {
    string words[4] = {"Not ", "very ", "difficult ", ""};
    for (int i = 2; i >= 0; i--) cout << words[i]; cout << endl; // line (a)
    for (int i = 2; i >= 0; i--) cout << words[i][i+1]; cout << endl; // line (b)
    words[3] = argv[1];
    cout << words[3] << endl; // line (c)
    cout << words[0][0]++ << endl; // line (d)
    cout << argc << endl; // line (e)
    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 55 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out a 1**.

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

int main(int argc, char *argv[]) {
    string words[4] = {"CS111 ", "Queens ", "College ", ""};
    for (int i = 1; i <= 3; i++) cout << words[i]; cout << endl; // line (a)
    for (int i = 0; i <= 2; i++) cout << words[i][i]; cout << endl; // line (b)
    words[3] = argv[2];
    cout << words[3] << endl; // line (c)
    cout << ++words[0][0] << endl; // line (d)
    cout << argc << endl; // line (e)
    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 56 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out CS111**.

```

#include <iostream>
using namespace std;

int main(int argc, char *argv[]) {
    string words[4] = {"Queens ", "College ", "CUNY ", "NY"};
    for (int i = 3; i >= 0; i--) cout << words[i]; cout << endl; // line (a)
    for (int i = 2; i >= 0; i--) cout << words[i][i+1]; cout << endl; // line (b)
    words[3] = argv[1];
    cout << words[3] << endl; // line (c)
    cout << words[0][0]++ << endl; // line (d)
    cout << ++argc << endl; // line (e)
    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 57 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out out out**.

```

#include <iostream>
using namespace std;

int main(int argc, char *argv[]) {
    string words[4] = {"CS ", "QC ", "CUNY ", "EDU "};
    for (int i = 0; i <= 2; i++) cout << words[i]; cout << endl; // line (a)
    for (int i = 0; i <= 2; i++) cout << words[i][i]; cout << endl; // line (b)
    words[3] = argv[1];
    cout << words[3] << endl; // line (c)
    cout << ++words[0][0] << endl; // line (d)
    cout << argc++ << endl; // line (e)
    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 58 Consider the following C++ program. It is compiled to **a.out** and executed with the command **./a.out 007**.

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

int main(int argc, char *argv[]) {
    string words[4] = {"Queens ", "College ", "Flushing ", "New York"};
    for (int i = 3; i >= 0; i--) cout << words[i]; cout << endl; // line (a)
    for (int i = 3; i >= 0; i--) cout << words[i][i+1]; cout << endl; // line (b)
    words[3] = argv[1];
    cout << words[3] << endl; // line (c)
    cout << words[0][0]++ << endl; // line (d)
    cout << --argc << endl; // line (e)
    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 59 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```
int main() {
    int a = 2, b = 3, c = 4;
    ifstream f;
    string s = "HELLO"; char t[] = "HELLO";
    f.open("testFile.txt");
    // (a) Tests whether a number is even, here Even!
    if (isEven(c)) cout << "Even!" << endl;
    // (b) Removes first and last chars from a string, here ELL
    cout << removeEnds(s) << endl;
    // (c) Prints first word in the input file
    cout << firstWord(f) << endl;
    // (d) Print last character of a C-string, here O
    cout << lastChar(t) << endl;
    // (e) Rotate a,b,c so as to print 3,4,2
    rotate(a, b, c);
    cout << a << b << c << endl;
    return 0;
}
```

(a) `bool isEven(int x)`

Answer:

(b) `string removeEnds(string x)`

Answer:

(c) `string firstWord(istream &file)`

Answer:

(d) `char lastChar(char x[])`

Answer:

(e) `void rotate(int &x, int &y, int &z)`

Answer:

Problem 60 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```
int main() {
    int a = 23, b = 3, c = 4;
    ifstream f;
    string s = "HELLO"; char t[] = "HELLO";
    f.open("testFile.txt");
    // (a) Tests whether a number has 2 digits, here Yes!
    if (is2digit(a)) cout << "Yes!" << endl;
    // (b) Doubles a string, here HELLOHELLO
    cout << doubleIt(s) << endl;
    // (c) The number of words read from the input file before eof() is true
    cout << countWords(f) << endl;
    // (d) Print middle character of a C-string that has a middle, here L
    cout << midChar(t) << endl;
    // (e) Rotate a,b,c so as to print 4,23,3
    rotate(a, b, c);
    cout << a << ", " << b << ", " << c << endl;
    return 0;
}
```

(a) `bool is2digit(int x)`

Answer:

(b) `string doubleIt(string x)`

Answer:

(c) `int countWords(istream &file)`

Answer:

(d) `char midChar(char x[])`

Answer:

(e) `void rotate(int &x, int &y, int &z)`

Answer:

Problem 61 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    int a = 2, b = 3, c = 4;
    ifstream f;
    string s = "HELLO"; char t[] = "HELLO";
    f.open("testFile.txt");
    // (a) Tests whether a number is seven, here No!
    if (!isSeven(c)) cout << "No!" << endl;
    // (b) Removes the last char from a string, here HELL
    cout << removeLast(s) << endl;
    // (c) Prints second word in the input file
    cout << secondWord(f) << endl;
    // (d) Print first character of a C-string, here H
    cout << firstChar(t) << endl;
    // (e) swap a with the biggest of a,b,c. Here prints 4,3,2
    swapBig(a, b, c);
    cout << a << b << c << endl;
    return 0;
}

```

(a) bool isSeven(int x)

Answer:

(b) string removeLast(string x)

Answer:

(c) string secondWord(ifstream &file)

Answer:

(d) char firstChar(char x[])

Answer:

(e) void swapBig(int &x, int &y, int &z)

Answer:

Problem 62 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    int a = 123, b = 3, c = 4;
    ifstream f;
    string s = "HELLO"; char t[] = "HELLO";
    f.open("testFile.txt");
    // (a) Tests whether a number has 3 digits, here Yes!
    if (is3digit(a)) cout << "Yes!" << endl;
    // (b) Returns the part of a string before its midpoint, here HE
    cout << halfIt(s) << endl;
    // (c) The number of characters read from the input file before eof() is true
    cout << countChar(f) << endl;
    // (d) Print third character of a C-string that has a middle, here L
    cout << thirdChar(t) << endl;
    // (e) Replace a, b and c by their sum to print 130, 130, 130
    replace(a, b, c);
    cout << a << ", " << b << ", " << c << endl;
    return 0;
}

```

(a) `bool is3digit(int x)`

Answer:

(b) `string halfIt(string x)`

Answer:

(c) `int countChar(istream &file)`

Answer:

(d) `char thirdChar(char x[])`

Answer:

(e) `void replace(int &x, int &y, int &z)`

Answer:

Problem 63 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```
int main() {
    string s = "HELLO", t = "GOODBYE";
    // (a) Tests whether a string has 5 or more letters
    if (isLong(s)) cout << "Long!" << endl;
    // (b) Tests whether a string contains the letter E
    cout << hasE(s) << endl;
    // (c) Returns a string with just the first 4 characters
    cout << first4(t) << endl;
    // (d) Prints the last character at or before the middle of the string
    cout << middle(t) << endl;
    // (e) swaps them
    swap(s, t);
    cout << s << " " << t << endl;
    return 0;
}
```

(a) `bool isLong(string x)`

Answer:

(b) `bool hasE(string x)`

Answer:

(c) `string first4(string x)`

Answer:

(d) `char middle(string x)`

Answer:

(e) `void swap(string &x, string &y)`

Answer:

Problem 64 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    string s = "HELLO", t = "GOODBYE";
    // (a) return number of characters
    cout << stringLength(s) << endl;
    // (b) Tests whether a string contains a target
    cout << contains(s, "HELL") << endl;
    // (c) Returns a string with just the last 4 characters
    cout << last4(t) << endl;
    // (d) Prints the first character
    cout << first(t) << endl;
    // (e) adds on the second string
    addOn(s, t);
    cout << s << endl;
    return 0;
}

```

(a) int stringLength(string x)

Answer:

(b) bool contains(string x, string target)

Answer:

(c) string last4(string x)

Answer:

(d) char first(string x)

Answer:

(e) void addOn(string &x, string y)

Answer:

Problem 65 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```

int main() {
    string s = "HELLO", t = "GOODBYE";
    // (a) Tests whether a string starts in upper case
    if (isUpper(s)) cout << "Upper Case!" << endl;
    // (b) Tests whether a string omits the letter E
    cout << hasNoE(s) << endl;
    // (c) Returns a string that drops the first character
    cout << dropFirst(t) << endl;
    // (d) Prints the last character
    cout << last(t) << endl;
    // (e) If t is shorter than s, swap the strings, otherwise do nothing
    sort(s, t);
    cout << s << " " << t << endl;
    return 0;
}

```


(a) `bool isUpper(string x)`

Answer:

(b) `bool hasNoE(string x)`

Answer:

(c) `string dropFirst(string x)`

Answer:

(d) `char last(string x)`

Answer:

(e) `void sort(string &x, string &y)`

Answer:

Problem 66 Write blocks of code to perform the functions used in the following main program. Your blocks must match the given title lines. Each block should be a short function of only a few lines.

```
int main() {
    string s = "HELLO", t = "GOODBYE";
    // (a) Do two strings have the same number of characters?
    cout << sameLength(s, t) << endl;
    // (b) Tests whether a string contains a target
    cout << contains("HELL", s) << endl;
    // (c) Returns a string that drops the last character
    cout << dropLast(t) << endl;
    // (d) Prints the third character
    cout << third(t) << endl;
    // (e) Turns an upper case character to lower case
    lower(s[0]);
    cout << s << endl;
    return 0;
}
```

(a) `bool sameLength(string x, string y)`

Answer:

(b) `bool contains(string target, string x)`

Answer:

(c) `string dropLast(string x)`

Answer:

(d) `char third(string x)`

Answer:

(e) `void lower(char &x)`

Answer:

Problem 67 Write a function called *subtractAverage* that calculates the average of the entries in a 2-dimensional array (that is known to have 2 columns) and subtracts this average from every entry of the array.

For example, a program that uses the function *subtractAverage* follows.

```
int main() {
    double x[3][2] = {{1,3}, {1,3}, {1,3}} ; // average is 2 here
    subtractAverage(x, 3, 2);
    cout << x[0][0] << " " << x[0][1] << endl; // prints: -1 1
    return 0;
}
```

Answer:

Problem 68 Write a function called *addMin* that calculates the minimum of the entries in a 2-dimensional array (that is known to have 2 columns) and adds this minimum to every entry of the array.

For example, a program that uses the function *addMin* follows.

```
int main() {
    int x[3][2] = {{1,3}, {1,3}, {1,3}} ; // min is 1 here
    addMin(x, 3, 2);
    cout << x[0][0] << " " << x[0][1] << endl; // prints: 2 4
    return 0;
}
```

Answer:

Problem 69 Write a function called *subtractAverage* that calculates the average of the entries in an array and subtracts this average from every positive entry of the array.

For example, a program that uses the function *subtractAverage* follows.

```
int main() {
    double x[5] = {3, 1, 4, 1, 6} ; // average is 3 here
    subtractAverage(x, 5);
    cout << x[0] << " " << x[1] << " " << x[2] << endl; // prints: 0 -2 1
    return 0;
}
```

Answer:

Problem 70 Write a function called *addMin* that calculates the minimum of the entries in an array and adds this minimum to every odd entry of the array.

For example, a program that uses the function *addMin* follows.

```
int main() {
    int x[5] = {3, 1, 4, 1, 5} ; // min is 1 here
    addMin(x, 5);
    cout << x[0] << " " << x[1] << " " << x[2] << endl; // prints: 4 2 4
    return 0;
}
```

Answer:

Problem 71 Write a function called *minGap* that calculates the smallest gap between adjacent entries of an array. (A gap between two numbers is the absolute value of their difference.)

For example, a program that uses the function *minGap* follows.

```
int main() {
    int x[5] = {3, 1, 4, 1, 5};
    cout << minGap(x, 5) << endl; // prints 2 corresponding to the gap from 3 to 1.
    return 0;
}
```

Answer:

Problem 72 Write a function called *gapSum* that calculates the sum of the gaps between adjacent entries of an array. (A gap between two numbers is the absolute value of their difference.)

For example, a program that uses the function *gapSum* follows.

```
int main() {
    int x[5] = {3, 1, 4, 1, 5};
    cout << gapSum(x, 5) << endl;    // prints 12
    // The gaps are 2, 3, 3, 4 and these add to 12
    return 0;
}
```

Answer:

Problem 73 Write a function called *maxGap* that calculates the biggest gap between adjacent entries of an array. (A gap between two numbers is the absolute value of their difference.)

For example, a program that uses the function *maxGap* follows.

```
int main() {
    int x[5] = {3, 1, 4, 1, 5};
    cout << maxGap(x, 5) << endl;    // prints 4 corresponding to the gap from 1 to 5.
    return 0;
}
```

Answer:

Problem 74 Write a function called *gapProd* that calculates the product of the gaps between adjacent entries of an array. (A gap between two numbers is the absolute value of their difference.)

For example, a program that uses the function *gapProd* follows.

```
int main() {
    int x[5] = {3, 1, 4, 1, 5};
    cout << gapProd(x, 5) << endl;    // prints 72
    // The gaps are 2, 3, 3, 4 and these multiply to 72
    return 0;
}
```

Answer:

Problem 75 Write a function called *roundOff* that returns the result of turning all digits (except the first) in a positive integer parameter to 0.

For example, a program that uses the function *roundOff* follows.

```
int main() {
    cout << roundOff(19683) << endl;    // prints 10000
    cout << roundOff(2) << endl;        // prints 2
    return 0;
}
```

Answer:

Problem 76 Write a function called *allFirst* that returns the result of turning all digits in a positive integer parameter to match the first digit.

For example, a program that uses the function *allFirst* follows.

```
int main() {
    cout << allFirst(19683) << endl; // prints 1111
    cout << allFirst(2048) << endl; // prints 2222
    return 0;
}
```

Answer:

Problem 77 Write a function called *firstDown* that returns the result of decreasing the first digit in a positive integer by 1.

For example, a program that uses the function *firstDown* follows.

```
int main() {
    cout << firstDown(2048) << endl; // prints 1048
    cout << firstDown(19683) << endl; // prints 9683
    return 0;
}
```

Answer:

Problem 78 Write a function called *firstUp* that returns the result of increasing the first digit of the parameter by 1, unless this first digit is 9 in which case it is not changed.

For example, a program that uses the function *firstUp* follows.

```
int main() {
    cout << firstUp(19683) << endl; // prints 29683
    cout << firstUp(95) << endl; // prints 95
    return 0;
}
```

Answer:

Problem 79 Write a function called *oddOne* that returns the result of turning all odd digits in a positive integer parameter to 1.

For example, a program that uses the function *oddOne* follows.

```
int main() {
    cout << oddOne(19683) << endl; // prints 11681
    cout << oddOne(2) << endl; // prints 2
    return 0;
}
```

Answer:

Problem 80 Write a function called *oddOneOut* that returns the result of removing the rightmost odd digit in a positive integer parameter.

For example, a program that uses the function *oddOneOut* follows.

```
int main() {
    cout << oddOneOut(19682) << endl; // prints 1682
    cout << oddOneOut(2) << endl; // prints 2
    return 0;
}
```

Answer:

Problem 81 Write a function called *eveNine* that returns the result of turning all even digits in a positive integer parameter to 9.

For example, a program that uses the function *eveNine* follows.

```
int main() {
    cout << eveNine(19683) << endl; // prints 19993
    cout << eveNine(3) << endl;     // prints 3
    return 0;
}
```

Answer:

Problem 82 Write a function called *evenOut* that returns the result of removing the rightmost even digit in a positive integer parameter.

For example, a program that uses the function *evenOut* follows.

```
int main() {
    cout << evenOut(19683) << endl; // prints 1963
    cout << evenOut(2) << endl;     // prints 0
    return 0;
}
```

Answer:

Problem 83 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads the entries in a 2-dimensional array with 4 rows and 4 columns from the user.
2. It prints (all) rows that have the greatest sum.

Here is an example of how the program should work:

Give me the entries of a 4 x 4 array:

```
0 0 0 -1
1 2 3 4
1 1 1 1
2 3 3 2
```

Largest rows:

```
1 2 3 4
2 3 3 2
```

Answer:

Problem 84 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads the entries in a 2-dimensional array with 5 rows and 3 columns from the user.
2. It prints the last row that has an even sum.

Here is an example of how the program should work:

Give me the entries of a 5 x 3 array:

```
0 0 0
1 2 3
1 1 1
3 3 3
1 1 1
```

Last row with even sum:

```
1 2 3
```

Answer:

Problem 85 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads the entries in a 2-dimensional array with 4 rows and 4 columns from the user.
2. It prints (all) columns that have the greatest sum.

Here is an example of how the program should work:

Give me the entries of a 4 x 4 array:

```
0 0 0 -1
1 2 3 4
1 1 1 1
2 3 3 2
```

Largest columns:

```
0 3 1 3
```

Answer:

Problem 86 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads the entries in a 2-dimensional array with 5 rows and 3 columns from the user.
2. It prints the last column that has an even sum.

Here is an example of how the program should work:

Give me the entries of a 5 x 3 array:

```
0 0 0
1 2 3
1 1 1
3 3 3
1 2 0
```

Last column with even sum:

```
0 2 1 3 2
```

Answer:

Problem 87 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads (from the user) the entries in a 2-dimensional array with 5 rows and 5 columns.
2. It prints (all) rows that have the property that entries increase as we move along their columns.

Here is an example of how the program should work:

Give me the entries of a 5 x 5 array:

```
0 0 0 0 0
1 2 3 4 5
1 5 6 7 99
2 -1 3 4 5
5 4 3 2 1
```

Increasing rows:

```
1 2 3 4 5
1 5 6 7 99
```

Answer:

Problem 88 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads (from the user) the entries in a 2-dimensional array with 5 rows and 5 columns.
2. It prints (all) columns that have the property that entries increase as we move down their rows.

Here is an example of how the program should work:

Give me the entries of a 5 x 5 array:

```
0 1 5 10 10
0 2 4 11 20
0 3 3 9 21
0 4 2 12 41
0 5 1 13 99
```

Increasing columns:

```
1 2 3 4 5
10 20 21 41 99
```

Answer:

Problem 89 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads (from the user) the entries in a 2-dimensional array with 5 rows and 5 columns.
2. It prints (all) rows that have the property that entries decrease as we move along their columns.

Here is an example of how the program should work:

Give me the entries of a 5 x 5 array:

```
0 0 0 0 0
1 2 3 4 5
501 5 306 107 99
2 -1 -3 -4 -5
5 4 3 2 1
```

Decreasing rows:

```
2 -1 -3 -4 -5
5 4 3 2 1
```

Answer:

Problem 90 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It reads (from the user) the entries in a 2-dimensional array with 5 rows and 5 columns.
2. It prints (all) columns that have the property that entries decrease as we move down their rows.

Here is an example of how the program should work:

Give me the entries of a 5 x 5 array:

```
0 1 5 10 99
0 2 4 11 41
0 3 3 9 21
0 4 2 12 20
0 5 1 13 10
```

Decreasing columns:

```
5 4 3 2 1
99 41 21 20 10
```

Answer:

Problem 91 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 21.
2. It terminates if the user supplies an illegal value for n .
3. It prints out a triangular picture with n rows like the one shown in the example (below). The triangle has a vertical left edge and a horizontal bottom edge. Odd numbered rows of the triangle are made from the letter A and even numbered rows with the letter B, as in the example.

Here is an example of how the program should work:

```
Give me an integer between 1 and 21: 9
A
BB
AAA
BBBB
AAAAA
BBBBBB
AAAAAAA
BBBBBBBB
AAAAAAAAA
```

Answer:

Problem 92 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 23.
2. It terminates if the user supplies an illegal value for n .
3. It prints out a triangular picture with n rows like the one shown in the example (below). The triangle has a vertical right edge and a horizontal top edge. Odd numbered rows of the triangle are made from the letter x and even numbered rows with the letter y, as in the example.

Here is an example of how the program should work:

```
Give me an integer between 1 and 23: 5
xxxxx
  yyyy
   xxx
    yy
     x
```

Answer:

Problem 93 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 16.
2. It terminates if the user supplies an illegal value for n .
3. It prints out a triangular picture with n rows like the one shown in the example (below). The triangle has a vertical left edge and a horizontal bottom edge. Odd numbered columns of the triangle are made from the letter A and even numbered columns with the letter B, as in the example.

Here is an example of how the program should work:

```
Give me an integer between 1 and 16: 6
A
AB
ABA
ABAB
ABABA
ABABAB
```

Answer:

Problem 94 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 18.
2. It terminates if the user supplies an illegal value for n .
3. It prints out a triangular picture with n rows like the one shown in the example (below). The triangle has a vertical right edge and a horizontal top edge. Odd numbered columns of the triangle are made from the letter x and even numbered columns with the letter y, as in the example.

Here is an example of how the program should work:

```
Give me an integer between 1 and 18: 5
xyxyx
 yxyx
  xyx
   yx
    x
```

Answer:

Problem 95 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 1, y = 10, z = 19;
    double b[5] = {1.9, 2.3, 3.0};
    int d[2][2] = {{1,2},{3,4}};

    b[1] = divide(z, y);           // (a) sets b[1] to quotient 2
    reset(d[1][1], x);           // (b) replaces d[1][1] by value of x
    cout << bigRow(d, 2, 2);      // (c) prints biggest row: 3 4
    printAll(b, 3);              // (d) prints array: 1.9 2.3 3.0
    cout << add(d[0][0], b[2]) << endl; // (e) prints the sum 4
    return 0;
}
```

(a) Title line for **divide** as called at the line marked (a).

Answer:

(b) Title line for **reset** as called at the line marked (b).

Answer:

(c) Title line for **bigRow** as called at the line marked (c).

Answer:

(d) Title line for **printAll** as called at the line marked (d).

Answer:

(e) Title line for **add** as called at the line marked (e).

Answer:

Problem 96 Consider the following C++ program.

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

string fun(int x) {
    string ans = "9876543210";
    if (x <= 10) return "0";
    if ((x <= 30) || (x > 10000)) return ans.substr(x % 10);
    if ((x >= 0) && (x < 100)) return "x+1";
    return ans.substr(x%4, x%4);
}

int nuf(int &x) {
    cout << x << endl;
    x = x * x - 3;
    return x;
}

int main() {
    int x = 2;
    cout << fun(23) << endl;    // line (a)
    cout << fun(233) << endl;   // line (b)
    cout << fun(2333) << endl;  // line (c)
    nuf(x);                    // line (d)
    cout << nuf(x) << 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 97 Write a function called *smallRow* that calculates and returns the smallest possible sum of entries of any row in a 2-dimensional array.

For example, a program that uses the function *smallRow* follows.

```
int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << smallRow (x, 2, 3) << endl;
    // from the 2-d array x that has size 2 x 3, find the smallest row sum
    // output will be 8 since row #0 contains 3, 1 and 4 is smallest.
    return 0;
}
```

Answer:

Problem 98 Write a function called *bond* that changes any sequence of digits 006 to 007 in a positive integer parameter.

For example, a program that uses the function *bond* follows.

```
int main() {
    cout << bond(4006) << endl;           // prints 4007
    cout << bond(4006006) << endl;        // prints 4007007
    cout << bond(106) << endl;           // prints 106
    cout << bond(1006) + 1 << endl;       // prints 1008
    return 0;
}
```

Answer:

Problem 99 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer *n* that is between 1 and 24.
2. It terminates if the user supplies an illegal value for *n*.
3. It prints out a triangular picture with *n* rows like the one shown in the example (below). The triangle has a vertical right edge and a horizontal top edge. The right edge is formed from the letter A, next to it is a vertical line formed from the letter B, then one formed from the letter C and so on. The top edge is also formed from the letter A, just below it is a line formed from the letter B and so on as in the example.

Here is an example of how the program should work:

```
Give me an integer between 1 and 24: 8
AAAAAAAA
BBBBBBA
CCCCBA
DDCBA
DCBA
CBA
BA
A
```

Answer:

Problem 100 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[3] = {1.9, 2.3, 3.0};
    int d[2][2] = {{1,2},{3,4}};
```

```

    x = diffTwo(y, b[0]);           // (a) sets x to approx difference 1
    swap(d[1][1], x);             // (b) swaps x with value of d[1][1]
    cout << biggest(d, 2, 2);     // (c) prints biggest row: 3 4
    printThree(b);                // (d) prints three entries: 1.9 2.3 3.0
    summit(b[2], d[0][0]);        // (e) prints the sum 4
    return 0;
}

```

(a) Title line for **diffTwo** as called at the line marked (a).

Answer:

(b) Title line for **swap** as called at the line marked (b).

Answer:

(c) Title line for **biggest** as called at the line marked (c).

Answer:

(d) Title line for **printThree** as called at the line marked (d).

Answer:

(e) Title line for **summit** as called at the line marked (e).

Answer:

Problem 101 Consider the following C++ program.

```

#include <iostream>
using namespace std;

string fun(int x) {
    string ans = "0123456789";
    if (x <= 0) return "0";
    if ((x <= 10) || (x > 10000)) return ans.substr(x % 10);
    if ((x >= 0) && (x < 100)) return "x+1";
    return ans.substr(x%4, x%4);
}

int nuf(int &x) {
    cout << x << endl;
    x = x * x;
    return x - 6;
}

int main() {
    int x = 4;
    cout << fun(3) << endl;    // line (a)
    cout << fun(32) << endl;   // line (b)
    cout << fun(323) << endl;  // line (c)
    nuf(x);                    // line (d)
    cout << nuf(x) << 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 102 Write a function called *smallCol* that calculates and returns the smallest possible sum of entries of any column in a 2-dimensional array.

For example, a program that uses the function *smallCol* follows.

```
int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << smallCol(x, 2, 3) << endl;
    // from the 2-d array x that has size 2 x 3, find the smallest col sum
    // output will be 4 since col #0 contains 3 and 1 is smallest.
    return 0;
}
```

Answer:

Problem 103 Write a function called *bond* that inserts a digit 0 before any digit pair 07 in a positive integer parameter.

For example, a program that uses the function *bond* follows.

```
int main() {
    cout << bond(407) << endl; // prints 4007
    cout << bond(401) << endl; // prints 401
    cout << bond(40707) << endl; // prints 4007007
    cout << bond(107) + 1 << endl; // prints 1008
    return 0;
}
```

Answer:

Problem 104 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 23.
2. It terminates if the user supplies an illegal value for n .
3. It prints out a triangular picture with n rows like the one shown in the example (below). The triangle has a vertical right edge and a horizontal bottom edge. The right edge is formed from the letter A, next to it is a vertical line formed from the letter B, then one formed from the letter C and so on. The bottom edge is also formed from the letter A, just above it is a line formed from the letter B and so on as in the example.

Here is an example of how the program should work:

Give me an integer between 1 and 23: 9

A
BA
CBA
DCBA
EDCBA
DDDCBA
CCCCCBA
BBBBBBBA
AAAAAAAAA

Answer:

Problem 105 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[3] = {1.9, 2.3, 3.0};
    int d[2][2] = {{1,2},{3,4}};

    cout << twoD(y, b[0]) << endl;           // (a) prints difference: 0.9
    y = addUp(d[1][1], y);                  // (b) sets y to sum 4 + 1
    cout << firstElt(d, 2, 2);              // (c) prints last element: 1
    b[2] = av(b, 3);                        // (d) sets as average
    setOne(b[2], d[0][0]);                  // (e) sets both to 1
    return 0;
}
```

(a) Title line for **twoD** as called at the line marked (a).

Answer:

(b) Title line for **addUp** as called at the line marked (b).

Answer:

(c) Title line for **firstElt** as called at the line marked (c).

Answer:

(d) Title line for **av** as called at the line marked (d).

Answer:

(e) Title line for **setOne** as called at the line marked (e).

Answer:

Problem 106 Consider the following C++ program.

```

#include <iostream>
using namespace std;

string fun(int x) {
    string ans = "0123456789";
    if (x <= 10) return "0";
    if ((x <= 30) || (x > 10000)) return ans.substr(x % 10);
    if ((x >= 0) && (x < 100)) return "x+1";
    return ans.substr(x%4, x%4);
}

int nuf(int &x) {
    cout << x << endl;
    x = x * x;
    return x;
}

int main() {
    int x = 2;
    cout << fun(2) << endl;    // line (a)
    cout << fun(22) << endl;   // line (b)
    cout << fun(222) << endl;  // line (c)
    nuf(x);                   // line (d)
    cout << nuf(x) << 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 107 Write a function called *bigRow* that calculates and returns the biggest possible sum of entries of any row in a 2-dimensional array.

For example, a program that uses the function *bigRow* follows.

```

int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << bigRow (x, 2, 3) << endl;
    // from the 2-d array x that has size 2 x 3, find the biggest row sum
    // output will be 15 since row #1 contains 1, 5 and 9 is biggest.
    return 0;
}

```

Answer:

Problem 108 Write a function called *bond* that inserts the digit 7 after any pair of zero digits in a positive integer parameter.

For example, a program that uses the function *bond* follows.

```

int main() {
    cout << bond(400) << endl;      // prints 4007
    cout << bond(401) << endl;      // prints 401
    cout << bond(4007) << endl;     // prints 40077
    cout << bond(400) + 1 << endl;   // prints 4008
    return 0;
}

```

Answer:

Problem 109 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 22.
2. It terminates if the user supplies an illegal value for n .
3. It prints out a triangular picture with n rows like the one shown in the example (below). The triangle has a vertical left edge and a horizontal top edge. The left edge is formed from the letter A, next to it is a vertical line formed from the letter B, then one formed from the letter C and so on. The top edge is also formed from the letter A, just below it is a line formed from the letter B and so on as in the example.

Here is an example of how the program should work:

```

Give me an integer between 1 and 22: 8
AAAAAAAA
BBBBBBB
ABCCCC
ABCDD
ABCD
ABC
AB
A

```

Answer:

Problem 110 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    double x = 0, y = 1, z = 2;
    int b[3] = {1, 2, 3};
    double d[2][2] = {{1.9,2},{3.9,4}};

    cout << add3(b[0], y, d[0][0]) << endl; // (a) prints sum: 3.9
    y = addUp(d[1][1], x) + 1;             // (b) sets y to sum 4.0 + 0 + 1
    cout << col(d, 2, 2, 0);                 // (c) prints column 0 as: 1.9,3.9
    b[0] = min(b, 3);                       // (d) sets as min element
    decrease(b[2], d[0][0]);                 // (e) decreases both by 1
    return 0;
}

```

(a) Title line for **add3** as called at the line marked (a).

Answer:

(b) Title line for **addUp** as called at the line marked (b).

Answer:

(c) Title line for **col** as called at the line marked (c).

Answer:

(d) Title line for **min** as called at the line marked (d).

Answer:

(e) Title line for **decrease** as called at the line marked (e).

Answer:

Problem 111 Consider the following C++ program.

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

string fun(int x) {
    string ans = "0123456789";
    if (x <= 10) return "0";
    if ((x <= 30) || (x > 10000)) return ans.substr(x % 10);
    if ((x >= 0) && (x < 100)) return "x+1";
    return ans.substr(x%4, x%4);
}

int nuf(int &x) {
    cout << x << endl;
    x = x * x;
    return x;
}

int main() {
    int x = 4;
    cout << fun(3) << endl;    // line (a)
    cout << fun(33) << endl;   // line (b)
    cout << fun(333) << endl;  // line (c)
    nuf(x);                   // line (d)
    cout << nuf(x) << 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 112 Write a function called *bigCol* that calculates and returns the biggest possible sum of entries of any column in a 2-dimensional array.

For example, a program that uses the function *bigCol* follows.

```
int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << bigCol (x, 2, 3) << endl;
    // from the 2-d array x that has size 2 x 3, find the biggest col sum
    // output will be 13 since col #2 contains 4 and 9 is biggest.
    return 0;
}
```

Answer:

Problem 113 Write a function called *bond* that inserts the digits 07 after each digit 0 in a positive integer parameter.

For example, a program that uses the function *bond* follows.

```
int main() {
    cout << bond(40) << endl;           // prints 4007
    cout << bond(41) << endl;           // prints 41
    cout << bond(400) << endl;         // prints 4007007
    cout << bond(10) + 1 << endl;      // prints 1008
    return 0;
}
```

Answer:

Problem 114 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 21.
2. It terminates if the user supplies an illegal value for n .
3. It prints out a triangular picture with n rows like the one shown in the example (below). The triangle has a vertical left edge and a horizontal bottom edge. The left edge is formed from the letter A, next to it is a vertical line formed from the letter B, then one formed from the letter C and so on. The bottom edge is also formed from the letter A, just above it is a line formed from the letter B and so on as in the example.

Here is an example of how the program should work:

```
Give me an integer between 1 and 21: 9
A
AB
ABC
ABCD
ABCDE
ABCDDD
ABCCCC
ABBBBBBB
AAAAAAAAA
```

Answer:

Problem 115 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    int b[3] = {1, 2, 3};
    double d[2][2] = {{1.9,2},{3.9,4}};
```

```

    cout << sum3(b[0], y, d[0][0]) << endl; // (a) prints sum: 3.9
    y = addUp(x, d[1][1]) + 1;           // (b) sets y to sum 0 + 4.0 + 1
    cout << col0(d, 2, 2);                // (c) prints column as: 1.9,3.9
    b[0] = max(b, 3);                    // (d) sets as max element
    increase(b[2], d[0][0]);             // (e) increases both by 1
    return 0;
}

```

(a) Title line for **sum3** as called at the line marked (a).

Answer:

(b) Title line for **addUp** as called at the line marked (b).

Answer:

(c) Title line for **col0** as called at the line marked (c).

Answer:

(d) Title line for **max** as called at the line marked (d).

Answer:

(e) Title line for **increase** as called at the line marked (e).

Answer:

Problem 116 Consider the following C++ program.

```

#include <iostream>
using namespace std;

string fun(int x) {
    string ans = "012345";
    if (x <= 0) return "";
    if ((x >= 30) && (x < 1000)) return ans.substr(x % 5);
    if ((x >= 0) || (x < 100)) return "xyz";
    return ans;
}

int up(int &x) {
    x += 3;
    cout << x << endl;
    return x - 1;
}

int main() {
    int x = 7;
    cout << fun(0) << endl;    // line (a)
    cout << fun(33) << endl;   // line (b)
    cout << fun(3003) << endl; // line (c)
    up(x);                    // line (d)
    cout << up(x) << 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 117 Write a function called *rowProd* that calculates and returns the product of the entries of a specified row of a 2-dimensional array.

For example, a program that uses the function *rowProd* follows.

```
int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << rowProd(x, 2, 3, 1) << endl;
    // from the 2-d array x that has size 2 x 3, find the product of row 1
    // output will be 45 since row #1 contains 1, 5 and 9.
    return 0;
}
```

Answer:

Problem 118 Write a function called *numOdd* that the returns the number of digits in a positive integer parameter that are odd.

For example, a program that uses the function *numOdd* follows.

```
int main() {
    cout << numOdd(777) << endl;           // prints 3
    cout << numOdd(747) << endl;           // prints 2
    cout << numOdd(42) << endl;            // prints 0
    return 0;
}
```

Answer:

Problem 119 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an odd integer n that is between 1 and 19.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a triangular picture (as shown in the diagram, but with n characters in the first row). Reading from the right, along each row the characters to be used is the sequence of uppercase letters A, B, C, \dots , and so on.

Here is an example of how the program should work:

```
Give me an odd integer between 1 and 19: 7
GFEDCBA
 EDCBA
  CBA
   A
```

Answer:

Problem 120 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[3] = {1.9, 2.3, 3.0};
    int d[2][2] = {{1,2},{3,4}};

    cout << twoD(b[0], y) << endl;           // (a) prints difference: 0.9
    y = addUp(x, d[1][1]);                   // (b) sets y to sum 0 + 4
    cout << lastElt(d, 2, 2);                // (c) prints last element: 4
    b[0] = average(b, 3);                    // (d) sets as average
    setZero(b[2], d[0][0]);                  // (e) sets both to 0
    return 0;
}
```

(a) Title line for **twoD** as called at the line marked (a).

Answer:

(b) Title line for **addUp** as called at the line marked (b).

Answer:

(c) Title line for **lastElt** as called at the line marked (c).

Answer:

(d) Title line for **average** as called at the line marked (d).

Answer:

(e) Title line for **setZero** as called at the line marked (e).

Answer:

Problem 121 Consider the following C++ program.

```

#include <iostream>
using namespace std;

string fun(int x) {
    string ans = "9876543210";
    if (x <= 0) return "5";
    if ((x >= 30) && (x < 1000)) return ans.substr(x % 10);
    if ((x >= 0) || (x < 100)) return "1+x";
    return ans + ans;
}

int up(int &x) {
    x++;
    cout << x << endl;
    return x - 2;
}

int main() {
    int x = 2;
    cout << fun(0) << endl;    // line (a)
    cout << fun(33) << endl;   // line (b)
    cout << fun(3003) << endl; // line (c)
    up(x);                    // line (d)
    cout << up(x) << 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 122 Write a function called *colProd* that calculates and returns the product of the entries of a specified column in a 2-dimensional array.

For example, a program that uses the function *colProd* follows.

```

int main() {
    int x[2][3] = {{3, 2, 4}, {1, 5, 9}};
    cout << colProd (x, 2, 3, 1) << endl;
    // from the 2-d array x that has size 2 x 3, find the product of column 1
    // output will be 10 since col #1 contains 2 and 5.
    return 0;
}

```

Answer:

Problem 123 Write a function called *numBig* that returns the number of digits in a positive integer parameter that are greater than or equal to 7.

For example, a program that uses the function *numBig* follows.

```
int main() {
    cout << numBig(777) << endl;      // prints 3
    cout << numBig(747) << endl;      // prints 2
    cout << numBig(41) << endl;       // prints 0
    return 0;
}
```

Answer:

Problem 124 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an odd integer n that is between 1 and 23.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a triangular picture (as shown in the diagram, but with n characters in the last row). Reading from the right, along each row the characters to be used is the sequence of uppercase letters A, B, C, \dots , and so on.

Here is an example of how the program should work:

```
Give me an odd integer between 1 and 23: 7
  A
 CBA
EDCBA
GFEDCBA
```

Answer:

Problem 125 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[3] = {1.9, 2.3, 3.0};
    int d[2][2] = {{1,2},{3,4}};

    x = diffTwo(b[0], y);           // (a) sets x to approx difference 1
    swap(x, d[1][1]);               // (b) swaps x with value of d[1][1]
    cout << biggest(d, 2, 2);        // (c) prints biggest row: 3 4
    printTwo(b);                    // (d) prints two entries: 1.9 2.3
    cout << summit(b[2], d[0][0]) << endl; // (e) prints the sum 4
    return 0;
}
```

(a) Title line for **diffTwo** as called at the line marked (a).

Answer:

(b) Title line for **swap** as called at the line marked (b).

Answer:

(c) Title line for **biggest** as called at the line marked (c).

Answer:

(d) Title line for **printTwo** as called at the line marked (d).

Answer:

(e) Title line for **summit** as called at the line marked (e).

Answer:

Problem 126 Consider the following C++ program.

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

string fun(int x) {
    string ans = "0123456789";
    if (x <= 0) return "4";
    if ((x >= 30) && (x < 1000)) return ans.substr(x % 7);
    if ((x >= 0) || (x < 100)) return "x11";
    return ans;
}

int up(int &x) {
    x--;
    cout << x << endl;
    return x - 1;
}

int main() {
    int x = 5;
    cout << fun(0) << endl;    // line (a)
    cout << fun(33) << endl;   // line (b)
    cout << fun(3003) << endl; // line (c)
    up(x);                    // line (d)
    cout << up(x) << 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 127 The following C++ program has errors at the lines marked a,b,c,d, and e. For each answer write a single line of C++ that fixes the errors in the corresponding line.


```

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

void main(double x, string s[]) { // line a

    ofstream f;
    f.open("outputFile");
    if (f == 0) return f; // line b

    while (1 = 1) { // line c

        x -- 1; // line d

        if (x < 0) return 0;
        cout << s[x] endl; // line e

    }

    return 0;
}

```

(a) Correct line (a):

Answer:

(b) Correct line (b):

Answer:

(c) Correct line (c):

Answer:

(d) Correct line (d):

Answer:

(e) Correct line (e):

Answer:

Problem 128 Write a function called *rowSum* that calculates and returns the sum of the entries of a specified row of a 2-dimensional array.

For example, a program that uses the function *rowSum* follows.

```

int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << rowSum (x, 2, 3, 1) << endl;
    // from the 2-d array x that has size 2 x 3, find the sum of row 1
    // output will be 15 since row #1 contains 1, 5 and 9.
    return 0;
}

```

Answer:

Problem 129 Write a function called *numEven* that returns the number of digits in a positive integer parameter that are even.

For example, a program that uses the function *numEven* follows.

```
int main() {
    cout << numEven(444) << endl;      // prints 3
    cout << numEven(414) << endl;      // prints 2
    cout << numEven(91) << endl;       // prints 0
    return 0;
}
```

Answer:

Problem 130 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an odd integer n that is between 1 and 25.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a triangular picture (as shown in the diagram, but with n characters in the first row). Along each row the characters to be used is the sequence of uppercase letters A, B, C, \dots , and so on.

Here is an example of how the program should work:

```
Give me an odd integer between 1 and 25: 7
ABCDEFG
 ABCDE
  ABC
   A
```

Answer:

Problem 131 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int x = 0, y = 1, z = 2;
    double b[5] = {1.9, 2.3, 3.0};
    int d[2][2] = {{1,2},{3,4}};

    x = subtract(z, y);           // (a) sets x to difference 1
    reset(x, d[1][1]);           // (b) replaces x by value of d[1][1]
    bigRow(d, 2, 2);             // (c) prints biggest row: 3 4
    cout << printAll(b, 3) << endl; // (d) prints array: 1.9 2.3 3.0
    cout << add(b[2], d[0][0]) << endl; // (e) prints the sum 4
    return 0;
}
```

(a) Title line for **subtract** as called at the line marked (a).

Answer:

(b) Title line for **reset** as called at the line marked (b).

Answer:

(c) Title line for **bigRow** as called at the line marked (c).

Answer:

(d) Title line for **printAll** as called at the line marked (d).

Answer:

(e) Title line for **add** as called at the line marked (e).

Answer:

Problem 132 Consider the following C++ program.

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

string fun(int x) {
    string ans = "0123456789";
    if (x <= 0) return "0";
    if ((x >= 30) && (x < 1000)) return ans.substr(x % 10);
    if ((x >= 0) || (x < 100)) return "x+1";
    return ans + ans;
}

int up(int &x) {
    x++;
    cout << x << endl;
    return x;
}

int main() {
    int x = 4;
    cout << fun(0) << endl;    // line (a)
    cout << fun(33) << endl;   // line (b)
    cout << fun(3003) << endl; // line (c)
    up(x);                    // line (d)
    cout << up(x) << 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 133 The following C++ program has errors at the lines marked a,b,c,d, and e. For each answer write a single line of C++ that fixes the errors in the corresponding line.

```

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

int main(int x, string y[]) {           // line a

    while (0 < x < 5) {                 // line b

        cout >> y[x - 1] >> endl;     // line c

        x --= 1;                       // line d

    }
    ifstream f;
    f.open("inputFile");
    if (f = 0) return -1;              // line e

    return 0;
}

```

(a) Correct line (a):

Answer:

(b) Correct line (b):

Answer:

(c) Correct line (c):

Answer:

(d) Correct line (d):

Answer:

(e) Correct line (e):

Answer:

Problem 134 Write a function called *colSum* that calculates and returns the sum of the entries of a specified column in a 2-dimensional array.

For example, a program that uses the function *colSum* follows.

```

int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << colSum (x, 2, 3, 1) << endl;
    // from the 2-d array x that has size 2 x 3, find the sum of column 1
    // output will be 6 since col #1 contains 1 and 5.
    return 0;
}

```

Answer:

Problem 135 Write a function called *num4* that returns the number of digits in a positive integer parameter that are equal to 4.

For example, a program that uses the function *num4* follows.

```
int main() {
    cout << num4(444) << endl;      // prints 3
    cout << num4(414) << endl;      // prints 2
    cout << num4(81) << endl;       // prints 0
    return 0;
}
```

Answer:

Problem 136 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an odd integer n that is between 1 and 21.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a triangular picture (as shown in the diagram, but with n characters in the last row). Along each row the characters to be used is the sequence of uppercase letters A, B, C, \dots , and so on.

Here is an example of how the program should work:

```
Give me an odd integer between 1 and 21: 7
  A
 ABC
ABCDE
ABCDEF
```

Answer:

Problem 137 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    double b[5] = {1.9, 2.3, 3.0, 4.4, 5.7};
    double d = 3.1415926;
    int x = 2;
    cout << decimalPart(b[1]) << endl; // (a) prints 0.3
    medianPosition(b, 5);             // (b) prints 2, the index of the median
    swap1(d, b[1]);                   // (c) swaps b[1] with d
    swap2(b, 3, x);                   // (d) swaps entry b[3] with b[x]
    cout << sqrt(d) << endl;           // (e) prints the square root of d
    return 0;
}
```

- (a) Title line for **decimalPart** as called at the line marked (a).

Answer:

- (b) Title line for **medianPosition** as called at the line marked (b).

Answer:

- (c) Title line for **swap1** as called at the line marked (c).

Answer:

- (d) Title line for **swap2** as called at the line marked (d).

Answer:

- (e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 138 Consider the following C++ program.

```

#include <iostream>
using namespace std;

string fun(int x) {
    if (x <= 0) return "";
    if (x >= 9 && x % 2 == 1) return "x+1";
    if (x >= 9 || x % 3 == 0) return "x+2";
    return "5";
}

int rec(int x) {
    if (x < 100) return x/5;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun(-3) << endl;    // line (a)
    cout << fun(33) << endl;    // line (b)
    cout << rec(36) << endl;    // line (c)
    cout << rec(-555) << endl; // line (d)
    cout << rec(987) << 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 139 Write a function called *dropEvens* that forms a new number from a positive integer parameter by dropping all even digits. In case all digits are even or a negative parameter is given an answer of 0 is to be returned.

For example, a program that uses the function *dropEvens* follows.

```

int main() {
    cout << dropEvens(1245); // prints 15
    cout << dropEvens(19683); // prints 193
    cout << dropEvens(0); // prints 0
    cout << dropEvens(-10); // prints 0
    return 0;
}

```

Answer:

Problem 140 Write a function called *randChange* that selects one entry at random in an array of integers and changes it to a random negative integer that lies between -99 and -1 inclusive. (You must use an appropriate standard C++ function to generate all random numbers.)

For example, a program that uses the function *randChange* follows.

```

int main() {
    int x[6] = {3, 1, 4, 1, 5, 9};
    randChange(x, 6);
    for (int i = 0; i <= 5; i++)
        cout << x[i] << " ";    // might print 3 1 -17 1 5 9
    cout << endl;
    return 0;
}

```

Answer:

Problem 141 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```

venus> g++ prog.cpp
venus> a.out file1 file2 file3

```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```

char a = 'b';
cout << a << endl;

```

Answer:

(ii)

```

char a = 'b';
while (a <= 'f') {
    cout << a - 'a';
    a = a + 1;
}

```

Answer:

(iii)

```

int main(int argc, char *argv[]) {
    cout << argv[1];
}

```

Answer:

(iv)

```

string x = "Easy Question";
cout << x.substr(1,2);

```

Answer:

(v)

```

string x = "Easy Question";
cout << x.rfind("E");

```

Answer:

Problem 142 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 20.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a square picture (as shown in the diagram, but with n rows) that uses the uppercase letters A , B , C , ... in sequence, to form an outer perimeter of A s that contains a perimeter of B s, that contains a perimeter of C s, and so on.

Here is an example of how the program should work:

```
Give me an integer between 1 and 20: 7
AAAAAAA
ABBBBBBA
ABCCCBBA
ABCDCBBA
ABCCCBBA
ABBBBBBA
AAAAAAA
```

Answer:

Problem 143 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    bool b[5] = {true, true, false, true, true};
    int x = 2;
    cout << isTrue(b[1 + 2]) << endl;    // (a) prints true
    allTrue(b, 5);                       // (b) prints False
    swap1(b, 3, x);                      // (d) swaps entry b[3] with b[x]
    swap2(b[x], b[x+1]);                 // (d) swaps entries
    cout << sqrt(x) << endl;             // (e) prints the square root of x
    return 0;
}
```

(a) Title line for **isTrue** as called at the line marked (a).

Answer:

(b) Title line for **allTrue** as called at the line marked (b).

Answer:

(c) Title line for **swap1** as called at the line marked (c).

Answer:

(d) Title line for **swap2** as called at the line marked (d).

Answer:

(e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 144 Consider the following C++ program.


```

#include <iostream>
using namespace std;

double fun(int x) {
    if (x <= 0) return sqrt((double) (-x));
    if (x >= 9 && x % 2 == 1) return x+1.0;
    if (x >= 9 || x % 3 == 0) return x+2.0;
    return 3.0;
}

int rec(int x) {
    if (x < 100) return x/3;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun(-3) << endl;    // line (a)
    cout << fun(33) << endl;    // line (b)
    cout << rec(36) << endl;    // line (c)
    cout << rec(-555) << endl; // line (d)
    cout << rec(987) << 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 145 Write a function called *onlyEvens* that forms a new number from a positive integer parameter by dropping all odd digits. In case all digits are odd or a negative parameter is given an answer of 0 is to be returned.

For example, a program that uses the function *onlyEvens* follows.

```

int main() {
    cout << onlyEvens(1245); // prints 24
    cout << onlyEvens(19683); // prints 68
    cout << onlyEvens(0);    // prints 0
    cout << onlyEvens(-10); // prints 0
    return 0;
}

```

Answer:

Problem 146 Write a function called *randChange* that selects one entry at random in a 2-dimensional array of integers and changes it to -17. (You must use an appropriate standard C++ function to generate all random numbers.)

For example, a program that uses the function *randChange* follows.

```

int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    randChange(x, 2, 3);
    for (int i = 0; i <= 1; i++)
        for (int j = 0; j <= 2; j++)
            cout << x[i][j] << " ";    // might print 3 1 -17 1 5 9
    cout << endl;
    return 0;
}

```

Answer:

Problem 147 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```

venus> g++ prog.cpp
venus> a.out file1 file2 file3

```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```

char a = 'a';
cout << a << endl;

```

Answer:

(ii)

```

char a = 'a';
while (a <= 'f') {
    cout << 'a' - a;
    a = a + 1;
}

```

Answer:

(iii)

```

int main(int argc, char *argv[]) {
    cout << argc;
}

```

Answer:

(iv)

```

string x = "Easy Question";
cout << x.substr(6, 0);

```

Answer:

(v)

```

string x = "Easy Question";
cout << x.rfind("s");

```

Answer:

Problem 148 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 20.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a square picture (as shown in the diagram, but with n rows) that uses the uppercase letters O and X in sequence, to form an outer perimeter of O s that contains a perimeter of X s, that contains a perimeter of O s, and so on.

Here is an example of how the program should work:

```
Give me an integer between 1 and 20: 7
0000000
OXXXXXO
OXOOOXO
OXOXOXO
OXOOOXO
OXXXXXO
0000000
```

Answer:

Problem 149 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    string b[5] = {"1.9", "2.3", "3.0", "4.4", "5.7"};
    double d = 3.1415926;
    int x = 2;
    cout << decimalPart(b[1]) << endl;    // (a) prints 0.3
    medianPosition(b, 5);                // (b) prints 2, the index of the median
    swap1(d, b[1]);                       // (c) changes b[1] and d
    swap2(b, 3, x);                       // (d) swaps entry b[3] with b[x]
    cout << sqrt(d) << endl;              // (e) prints the square root of d
    return 0;
}
```

(a) Title line for **decimalPart** as called at the line marked (a).

Answer:

(b) Title line for **medianPosition** as called at the line marked (b).

Answer:

(c) Title line for **swap1** as called at the line marked (c).

Answer:

(d) Title line for **swap2** as called at the line marked (d).

Answer:

(e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 150 Consider the following C++ program.

```

#include <iostream>
using namespace std;

string fun(char x) {
    if (x <= 'k') return "";
    if (x >= 'l' && x <= 't') return "x++";
    if (x >= 'p') return "x-1";
    return "20";
}

int rec(int x) {
    if (x < 1000) return x/5;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun('m') << endl;    // line (a)
    cout << fun('p') << endl;    // line (b)
    cout << rec(666) << endl;    // line (c)
    cout << rec(-555) << endl; // line (d)
    cout << rec(2013) << 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 151 Write a function called *upEvens* that forms a new number from a non-negative integer parameter by increasing all even digits. In case a negative parameter is given an answer of 0 is to be returned.

For example, a program that uses the function *upEvens* follows.

```

int main() {
    cout << upEvens(1245); // prints 1355
    cout << upEvens(19683); // prints 19793
    cout << upEvens(0); // prints 1
    cout << upEvens(-10); // prints 0
    return 0;
}

```

Answer:

Problem 152 Write a function called *randSelect* that selects one row at random in a 2-dimensional array of integers and returns the sum of the entries in that row. (You must use an appropriate standard C++ function to generate all random numbers.)

For example, a program that uses the function *randSelect* follows.

```

int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << randSelect(x, 2, 3); // might print 8 if the first row is selected
    cout << endl;
    return 0;
}

```

Answer:

Problem 153 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```

venus> g++ prog.cpp
venus> a.out file1 file2 file3

```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```

char a = 'a';
cout << (char) (a + 2) << endl;

```

Answer:

(ii)

```

char a = 'b';
while ((a - 'a') <= 5) {
    cout << a;
    a = a + 1;
}

```

Answer:

(iii)

```

int main(int argc, char *argv[]) {
    cout << argv[2];
}

```

Answer:

(iv)

```

string x = "Easy Question";
cout << x.substr(3,2);

```

Answer:

(v)

```

string x = "Easy Question";
cout << x.rfind("e");

```

Answer:

Problem 154 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 20.
2. It exits if the user enters an illegal value for n .
3. It prints out a triangular picture (as shown in the diagram, but with n rows) that uses the uppercase letters A, B, C, \dots in sequence, to form the diagonal sides of the triangle. The vertical straight side should be at the right.

Here is an example of how the program should work:

Give me an integer between 1 and 20: 7

```
A
AB
ABC
ABCD
ABCDE
ABCDEF
ABCDEFG
```

Answer:

Problem 155 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    char b[5] = {'t', 't', 'f', 't', 't'};
    int x = 2;
    cout << isT(b[1 + 2]) << endl;      // (a) prints true
    allTrue(b, 5);                      // (b) prints false
    swap1(b, 3, x);                     // (d) swaps entry b[3] with b[x]
    swap2(b[x], b[x+1]);                // (d) swaps entries
    cout << sqrt(x) << endl;           // (e) prints the square root of x
    return 0;
}
```

(a) Title line for **isT** as called at the line marked (a).

Answer:

(b) Title line for **allTrue** as called at the line marked (b).

Answer:

(c) Title line for **swap1** as called at the line marked (c).

Answer:

(d) Title line for **swap2** as called at the line marked (d).

Answer:

(e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 156 Consider the following C++ program.

```

#include <iostream>
using namespace std;

double fun(double x) {
    if (x <= 0.0) return sqrt(-x);
    if (x >= 9.0 && x <= 100.0) return x+1.0;
    if (x >= 90.0 || x >= 5.0) return x+2.0;
    return 3.0;
}

int rec(int x) {
    if (x < 100) return x/6;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun(-4.0) << endl;    // line (a)
    cout << fun(99.0) << endl;    // line (b)
    cout << fun(2.0) << endl;    // line (c)
    cout << rec(-666) << endl;    // line (d)
    cout << rec(987) << 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 157 Write a function called *downOdds* that forms a new number from a non-negative integer parameter by decreasing all odd digits. In case a negative parameter is given an answer of 0 is to be returned.

For example, a program that uses the function *downOdds* follows.

```

int main() {
    cout << downOdds(3245); // prints 2244
    cout << downOdds(19683); // prints 8682
    cout << downOdds(1); // prints 0
    cout << downOdds(-10); // prints 0
    return 0;
}

```

Answer:

Problem 158 Write a function called *randSelect* that selects one column at random in a 2-dimensional array of integers and returns the product of the entries in that row. (You must use an appropriate standard C++ function to generate all random numbers.)

For example, a program that uses the function *randSelect* follows.

```

int main() {
    int x[2][3] = {{3, 1, 4}, {1, 5, 9}};
    cout << randSelect(x, 2, 3); // might print 36 if the last col is selected
    cout << endl;
    return 0;
}

```

Answer:

Problem 159 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```

venus> g++ prog.cpp
venus> a.out file1 file2 file3

```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```

char c = 'a';
cout << (char) (c + 3) << endl;

```

Answer:

(ii)

```

char a = 'a';
while (('a' - a) <= 3) {
    cout << 'a';
    a = a - 1;
}

```

Answer:

(iii)

```

int main(int argc, char *argv[]) {
    cout << argv[argc - 1];
}

```

Answer:

(iv)

```

string x = "Easy Question";
cout << x.length();

```

Answer:

(v)

```

string x = "Easy Question";
cout << x.find("e");

```

Answer:

Problem 160 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 25.
2. It exits if the user enters an illegal value for n .
3. It prints out a downward pointing triangular picture (as shown in the diagram, but with n rows) that uses the lowercase letters a, b, c, \dots in sequence, to form the diagonal sides of the triangle.

Here is an example of how the program should work:

```
Give me an integer between 1 and 25: 7
abcdefg
 abcdef
  abcde
   abcd
    abc
     ab
      a
```

Answer:

Problem 161 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int b[5] = {9, 3, 0, 4, 7};
    int x = 17;
    cout << decimalPart(3.14159) << endl; // (a) prints 0.14159
    median(b, 5); // (b) prints 4, the median entry
    swap1(x, b[1]); // (c) swaps b[1] with x
    swap2(b, 3, 4); // (d) swaps entry b[3] with b[4]
    cout << sqrt(5, 10, 12) << endl; // (e) prints "Hello" for any input values
    return 0;
}
```

(a) Title line for **decimalPart** as called at the line marked (a).

Answer:

(b) Title line for **median** as called at the line marked (b).

Answer:

(c) Title line for **swap1** as called at the line marked (c).

Answer:

(d) Title line for **swap2** as called at the line marked (d).

Answer:

(e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 162 Consider the following C++ program.

```

#include <iostream>
using namespace std;

int fun(int x) {
    if (x <= 0) return 10;
    if (x >= 9 && x % 2 == 1) return x + 1;
    if (x >= 9 || x % 3 == 0) return x + 2;
    return 5;
}

int rec(int x) {
    if (x < 100) return x/10;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun(-3) << endl;    // line (a)
    cout << fun(33) << endl;    // line (b)
    cout << rec(36) << endl;    // line (c)
    cout << rec(-666) << endl; // line (d)
    cout << rec(987) << 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 163 Write a function called *multiDigit* that prints a new number formed from a positive integer parameter by printing each odd digit once and each even digit twice. If a negative parameter is given, it should print the word *Idiot* and if 0 is entered it should do nothing.

For example, a program that uses the function *multiDigit* follows.

```

int main() {
    multiDigit(1245); // prints 122445
    multiDigit(19683); // prints 1966883
    multiDigit(0); // prints
    multiDigit(-10); // prints Idiot
    return 0;
}

```

Answer:

Problem 164 Write a function called *randFill* that fills the entries of an array with random negative integers that lie between -99 and -1 inclusive. (Use an appropriate C++ function to generate the random numbers.)

For example, a program that uses the function follows.

```
int main() {
    int x[4];
    randFill(x, 4);
    for (int i = 0; i <= 3; i++)
        cout << x[i] << endl;    // prints 4 random negative numbers
    return 0;
}
```

Answer:

Problem 165 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```
venus> g++ prog.cpp
venus> a.out input1.txt input2 out.txt
```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
int x = 4, y = 10;
cout << (x/y + 1.0) << endl;
```

Answer:

(ii)

```
char x = 'a';
while (x <= 'f') {
    cout << (char) (x + 1);
    x = x + 1;
}
```

Answer:

(iii)

```
cout << 'a' - 'd';
```

Answer:

(iv)

```
string x = "Easy Question";
cout << x.substr(1,2);
```

Answer:

(v)

```
int main(int argc, char *argv[]) {
    cout << argc;
```

Answer:

Problem 166 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 20.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a triangular picture (as shown in the diagram, but with n rows) that uses the uppercase letters A, B, C, \dots in sequence, and if necessary returns to the letter A after any Z .

Here is an example of how the program should work:

Give me an integer between 1 and 20: 6

```
A
BC
DEF
GHIJ
KLMNO
PQRSTU
```

Answer:

Problem 167 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int a[5] = {9, 3, 0, 4, 7};
    int x = 17;
    cout << reducedFraction(2, 6) << endl; // (a) prints 1/3
    swap1(a[1], a[2]); // (b) swaps a[1] with a[2]
    swap2(x, a, 3); // (c) swaps entry a[3] with x
    median(5, 4, 6); // (d) prints 5, the median entry
    cout << sqrt(5, 10, 12, 14) << endl; // (e) prints 25 for any input values
    return 0;
}
```

(a) Title line for **reducedFraction** as called at the line marked (a).

Answer:

(b) Title line for **swap1** as called at the line marked (b).

Answer:

(c) Title line for **swap2** as called at the line marked (c).

Answer:

(d) Title line for **median** as called at the line marked (d).

Answer:

(e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 168 Consider the following C++ program.

```

#include <iostream>
using namespace std;

int fun(int x) {
    if (x <= 0) return 10;
    if (x >= 9 && x % 2 == 1) return x + 1;
    if (x >= 9 || x % 3 == 0) return x + 2;
    return 5;
}

int rec(int x) {
    if (x < 100) return x/10;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun(-6) << endl;    // line (a)
    cout << fun(63) << endl;    // line (b)
    cout << rec(66) << endl;    // line (c)
    cout << rec(-747) << endl; // line (d)
    cout << rec(876) << 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 169 Write a function called *multiDigit* that prints a new number formed from a positive integer parameter by printing each odd digit twice and each even digit once. If a negative parameter is given, it should print the word *Negative* and if 0 is entered it should do nothing.

For example, a program that uses the function *multiDigit* follows.

```

int main() {
    multiDigit(1245); cout << endl; // prints 112455
    multiDigit(19683); cout << endl; // prints 11996833
    multiDigit(0); cout << endl; // prints
    multiDigit(-10); cout << endl; // prints Negative
    return 0;
}

```

Answer:

Problem 170 Write a function called *randFill* that fills the entries of an array with random integers between 1 and a specified maximum value. (Use an appropriate C++ function to generate the random numbers.)

For example, a program that uses the function follows.

```

int main() {
    int x[4];
    int max = 999;
    randFill(x, 4, max);
    for (int i = 0; i <= 3; i++)
        cout << x[i] << endl;    // prints 4 random numbers between 1 and 999
    return 0;
}

```

Answer:

Problem 171 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```

venus> g++ prog.cpp
venus> a.out input1.txt input2 out.txt

```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```

int x = 8, y = 10;
cout << ((x + 1.0)/y) << endl;

```

Answer:

(ii)

```

char x = 'f';
while (x <= 'a') {
    cout << (char) (x + 1);
    x = x + 1;
}

```

Answer:

(iii)

```

cout << 'e' - 'd';

```

Answer:

(iv)

```

string x = "Easy Question";
cout << x.substr(2,1);

```

Answer:

(v)

```

int main(int argc, char *argv[]) {
    cout << argv[2];
}

```

Answer:

Problem 172 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 9.
2. It repeatedly reads n from the user until the supplied value of n is legal.
3. It prints out a triangular picture (as shown in the diagram, but with n rows) that uses the lowercase letters a, b, c, \dots in sequence, and if necessary continues with uppercase letter starting at A after any z .

Here is an example of how the program should work:

```
Give me an integer between 1 and 9:    7
a
bc
def
ghij
klmno
pqrstu
vwxyzAB
```

Answer:

Problem 173 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int b[5] = {9, 3, 0, 4, 7};
    int x = 17;
    cout << integerPart(3.14159) << endl;    // (a) prints 3
    swap1(x, b[1]);                          // (b) swaps b[1] with x
    swap2(b, 1, x);                          // (c) swaps b[1] with x
    median(x +1, x, x+2);                    // (d) prints 18 the median value
    cout << sqrt(5, 10, 12) << endl;    // (e) prints "Error" for any input values
    return 0;
}
```

(a) Title line for **integerPart** as called at the line marked (a).

Answer:

(b) Title line for **swap1** as called at the line marked (b).

Answer:

(c) Title line for **swap2** as called at the line marked (c).

Answer:

(d) Title line for **median** as called at the line marked (d).

Answer:

(e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 174 Consider the following C++ program.

```

#include <iostream>
using namespace std;

int fun(int x) {
    if (x <= 0) return 100;
    if (x >= 9 && x % 2 == 1) return x + 1;
    if (x >= 9 || x % 3 == 0) return x + 2;
    return 5;
}

int rec(int x) {
    if (x < 100) return x/10;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun(-144) << endl;    // line (a)
    cout << fun(92) << endl;      // line (b)
    cout << rec(92) << endl;      // line (c)
    cout << rec(-144) << endl;    // line (d)
    cout << rec(678) << 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 175 Write a function called *multiDigit* that prints a new number formed from a positive integer parameter by printing each odd digit twice and omitting all even digits. If a negative parameter is given, it should print the word *Done* and if 0 is entered it should do nothing.

For example, a program that uses the function *multiDigit* follows.

```

int main() {
    multiDigit(1245); cout << endl;    // prints 1155
    multiDigit(19683); cout << endl;  // prints 119933
    multiDigit(220); cout << endl;    // prints
    multiDigit(-10); cout << endl;    // prints Done
    return 0;
}

```

Answer:

Problem 176 Write a function called *randFill* that fills the entries of an array with random two digit integers. (Use an appropriate C++ function to generate the random numbers.)

For example, a program that uses the function follows.


```
int main() {
    int x[4];
    randFill(x, 4);
    for (int i = 0; i <= 3; i++)
        cout << x[i] << endl;    // prints 4 random two digit numbers
    return 0;
}
```

Answer:

Problem 177 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```
venus> g++ prog.cpp
venus> a.out input1.txt input2 out.txt
```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
int x = 8, y = 10;
cout << (x + 1.0/y) << endl;
```

Answer:

(ii)

```
char x = 'f';
while (x <= 'i') {
    cout << (char) (x - 1);
    x = x + 1;
}
```

Answer:

(iii)

```
cout << 'f' - 'c';
```

Answer:

(iv)

```
string x = "Easy Question";
cout << x.substr(4,1);
```

Answer:

(v)

```
int main(int argc, char *argv[]) {
    cout << argv[0];
}
```

Answer:

Problem 178 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 25.
2. It immediately stops if the supplied value of n is not legal.
3. Otherwise it prints out a triangular picture (as shown in the diagram, but with n rows) that uses the lowercase letters a, b, c, \dots in sequence, and if necessary returns to the letter a after any z .

Here is an example of how the program should work:

```
Give me an integer between 1 and 25: 6
abcdef
 ghijk
  lmno
   pqr
    st
     u
```

Answer:

Problem 179 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int a[5] = {9, 3, 0, 4, 7};
    int x = 17;
    cout << asFraction(2, 6) << endl;    // (a) prints 2/6
    swap1(x, a[2]);                    // (b) swaps x with a[2]
    swap2(a[1], a[3]);                // (c) swaps entry a[1] with a[3]
    median(1, 5, 4, 6, 7);            // (d) prints 5, the median entry
    cout << sqrt(5, 10, 12, 14) << endl; // (e) prints 0.5 for any input values
    return 0;
}
```

(a) Title line for **asFraction** as called at the line marked (a).

Answer:

(b) Title line for **swap1** as called at the line marked (b).

Answer:

(c) Title line for **swap2** as called at the line marked (c).

Answer:

(d) Title line for **median** as called at the line marked (d).

Answer:

(e) Title line for **sqrt** as called at the line marked (e).

Answer:

Problem 180 Consider the following C++ program.

```

#include <iostream>
using namespace std;

int fun(int x) {
    if (x <= 0) return 100;
    if (x >= 9 && x % 2 == 1) return x + 1;
    if (x >= 9 || x % 3 == 0) return x + 2;
    return 5;
}

int rec(int x) {
    if (x < 100) return x/10;
    return rec(x / 10) + rec(x % 100);
}

int main() {
    cout << fun(-144) << endl;    // line (a)
    cout << fun(71) << endl;      // line (b)
    cout << rec(71) << endl;      // line (c)
    cout << rec(-256) << endl;    // line (d)
    cout << rec(729) << 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 181 Write a function called *multiDigit* that prints a new number formed from an integer parameter by printing each odd digit and omitting all even digits. If a negative parameter is given, it should ignore the – sign and treat the parameter as if it was positive.

For example, a program that uses the function *multiDigit* follows.

```

int main() {
    multiDigit(1245); cout << endl;    // prints 15
    multiDigit(19683); cout << endl;  // prints 193
    multiDigit(220); cout << endl;    // prints
    multiDigit(-132); cout << endl;   // prints 13
    return 0;
}

```

Answer:

Problem 182 Write a function called *randFill* that fills the entries of an array with random integers between a specified pair of limits. (Use an appropriate C++ function to generate the random numbers.)

For example, a program that uses the function follows.

```
int main() {
    int x[4];
    int min = 20, max = 29;
    randFill(x, 4, min, max);
    for (int i = 0; i <= 3; i++)
        cout << x[i] << endl;    // prints 4 random numbers between 20 and 29
    return 0;
}
```

Answer:

Problem 183 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```
venus> g++ prog.cpp
venus> a.out input1.txt input2 out.txt
```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
int x = 7, y = 10;
cout << (x/y + 2.0/y) << endl;
```

Answer:

(ii)

```
char x = 'f';
while (x >= 'a') {
    cout << x;
    x = x - 1;
}
```

Answer:

(iii)

```
cout << 'Z' - 'A';
```

Answer:

(iv)

```
string x = "Easy Question";
cout << x.substr(4,2);
```

Answer:

(v)

```
int main(int argc, char *argv[]) {
    cout << argv[2];
}
```

Answer:

Problem 184 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter an integer n that is between 1 and 9.
2. It immediately stops if the supplied value of n is not legal.
3. Otherwise it prints out a triangular picture (as shown in the diagram, but with n rows) that uses the lowercase letters a, b, c, \dots in sequence, and if necessary continues with uppercase letter starting at A after any z .

Here is an example of how the program should work:

```
Give me an integer between 1 and 9:    7
abcdefg
hijklm
nopqr
stuv
wxy
zA
B
```

Answer:

Problem 185 Write **title lines** for the functions most of which are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    cout << numSixes("19683") << endl;           // (a) prints 1
    printNumSixes(19683);                       // (b) prints 1
    cout << longest(961, 1961, 5) << endl;       // (c) prints 1961
    average(2.5, 3.4, 4.0);                     // (d) prints 3.3
    return 0;
}
```

(a) Title line for **numSixes**

Answer:

(b) Title line for **printNumSixes**

Answer:

(c) Title line for **longest**

Answer:

(d) Title line for **average**

Answer:

(e) The required title line for a main program that uses arguments.

Answer:

Problem 186 Consider the following C++ program.

```

#include <iostream>
#include <fstream>
using namespace std;
int main() {
    ifstream infile("file.txt");
    for (int line = 1; line <= 5; line++) {
        cout << "Line " << line << " ";
        int x;
        if (infile.eof()) cout << "Done";
        infile >> x;
        if (x > 10) cout << ++x;
        if (x > 5) cout << 2 * x;
        if (x > 0) cout << x;
        if (x < 0) {
            infile >> x;
            cout << x;
        }
        cout << endl;
    }
    return 0;
}

```

The file called *file.txt* exists in the directory in which the above program is run. The file consists of the following data:

```
0  2  22  -2  2  -2 -22 22 222 2222
```

(a) What is the output line that begins: Line 1?

Answer:

(b) What is the output line that begins: Line 2?

Answer:

(c) What is the output line that begins: Line 3?

Answer:

(d) What is the output line that begins: Line 4?

Answer:

(e) What is the output line that begins: Line 5?

Answer:

Problem 187 Write a function called *sum3* that determines the sum of the first 3 digits in a parameter. If the parameter has fewer than 3 digits, the sum of whatever digits are present is reported. (Assume that the parameter always has a positive value.)

For example, a program that uses the function *sum3* follows.

```

int main() {
    cout << sum3(3456) << endl; // prints 12 as the sum 3 + 4 + 5
    cout << sum3(11113) << endl; // prints 3 as the sum 1 + 1 + 1
    cout << sum3(9) << endl; // prints 9
    return 0;
}

```

Answer:

Problem 188 Write a function called *numPositive* that finds the number of rows with positive sum in a 2-dimensional array of decimals that has 4 columns. The array and the capacities are parameters. (Note that 0 is not positive.)

For example, a program that uses the function follows.

```
int main() {
    double d[2][4] = {{2, 4, -6, -8}, {-1, -3, 5, 1.5}};
    cout << numPositive(d, 2, 4) << endl;
    // prints    1    because only one row, the 2nd has a positive sum
    return 0;
}
```

Answer:

Problem 189 Write a function called *numX* that reports the number of elements in a array of strings that contain an uppercase letter *X*.

For example, a program that uses the function follows.

```
int main() {
    string data[4] = {"abcdXYZ", "Hello", "1234", "XXX"};
    cout << numX(data, 4); // prints: 2 because 2 strings include an X
    return 0;
}
```

Answer:

Problem 190 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer *n*.
2. It repeatedly reads *n* from the user until the supplied value of *n* is positive.
3. It prints out a large letter *N* that has height *n* and width *n*. The locations of the printed characters should lie in the $n \times n$ square region that the letter occupies.

Here is an example of how the program should work:

```
Give me a positive integer: 5
N N
NN N
N N N
N NN
N N
```

Answer:

Problem 191 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    cout << numDigits(19683) << endl; // (a) prints 5
    printNumDigits("19683"); // (b) prints 5
    cout << longer("Hello", "Goodbye") << endl; // (c) prints "Goodbye"
    biggest(3.14, 2.718, 1.5); // (d) prints 3.14
    cout << sqrt(5, 10, 12) << endl; // (e) prints the sum as 27
    return 0;
}
```

(a) Title line for `numDigits`

Answer:

(b) Title line for `printNumDigits`

Answer:

(c) Title line for `longer`

Answer:

(d) Title line for `biggest`

Answer:

(e) Title line for `sqrt` as called at the line marked (e).

Answer:

Problem 192 Consider the following C++ program.

```
#include <iostream>
#include <fstream>
using namespace std;
int main() {
    ifstream infile("file.txt");
    for (int line = 1; line <= 5; line++) {
        cout << "Line " << line << " ";
        int x;
        if (infile.eof()) cout << "Done";
        infile >> x;
        if (x > 10) cout << ++x;
        if (x > 5) cout << 2 * x;
        if (x > 0) cout << x;
        if (x < 0) {
            infile >> x;
            cout << x;
        }
        cout << endl;
    }
    return 0;
}
```

The file called *file.txt* exists in the directory in which the above program is run. The file consists of the following data:

0 4 6 14 -1 3 -2 -5 1 2 3

(a) What is the output line that begins: Line 1?

Answer:

(b) What is the output line that begins: Line 2?

Answer:

(c) What is the output line that begins: Line 3?

Answer:

(d) What is the output line that begins: Line 4?

Answer:

(e) What is the output line that begins: Line 5?

Answer:

Problem 193 Write a function called *sumSq* that determines the sum of the squares of the digits in a parameter. For example, a program that uses the function *sumSq* follows.

```
int main() {
    cout << sumSq(34) << endl;    // prints 25 because this is 9 + 16
    cout << sumSq(11113) << endl; // prints 13 found as 1+1+1+1+9
    cout << sumSq(9) << endl;     // prints 81
    return 0;
}
```

Answer:

Problem 194 Write a function called *smallestPositive* that finds the smallest positive entry in a 2-dimensional array of decimals that has 4 columns. The array and the capacities are parameters. If no entry in the array is positive, the function should return an answer of 0.0. (Note that 0 is not positive.)

For example, a program that uses the function follows.

```
int main() {
    double d[2][4] = {{2, 4, -6, 8}, {-1, -3, 5, 1.5}};
    cout << smallestPositive(d, 2, 4) << endl;
    // prints    1.5
    return 0;
}
```

Answer:

Problem 195 Write a function called *insertX* that inserts an *X* at the middle of each element of an array of strings. (If a string has even length, the *X* should be added exactly at its middle, otherwise the *X* should be added immediately before the middle.)

For example, a program that uses the function follows.

```
int main() {
    string data[4] = {"abcd", "Hello", "1234", ""};
    insertX(data, 4);
    for (int i = 0; i < 4; i++)
        cout << data[i] << " ";    // output: abXcd HeXllo 12X34 X
    return 0;
}
```

Answer:

Problem 196 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer *n*.
2. It repeatedly reads *n* from the user until the supplied value of *n* is positive.
3. It prints out a large letter *Z* that has height *n* and width *n*. The locations of the printed characters should lie in the $n \times n$ square region that the letter occupies.

Here is an example of how the program should work:

```
Give me a positive integer: 5
ZZZZZ
  Z
 Z
Z
ZZZZZ
```

Answer:

Problem 197 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int a[10] = {3,1,4,1,5,9,2,6,5,3};
    int x[3][2] = {{0,1},{2,3},{4,5}};
    int n = 7, m = 2;
    int i = sum(n, m);           // sets i as the sum
    swap(n, m);                 // swaps n and m
    printArray(a, 10);         // prints content of a
    print2dArray(x, 3, 2);     // prints content of x
    cout << minElement(a, 10); // minimum element of array
    cout << firstDigit(n*n + m*m); // first digit
    return 0;
}
```

(a) Title line for **sum**

Answer:

(b) Title line for **swap**

Answer:

(c) Title line for **printArray**

Answer:

(d) Title line for **print2dArray**

Answer:

(e) Title line for **minElement**

Answer:

(f) Title line for **firstDigit**

Answer:

Problem 198 Write a function called *array2F* that returns the largest entry in a 2-dimensional array (of integer values). The parameters are the array, its number of rows and its number of columns. For example, a program that uses the function *array2F* follows.

```
int main() {
    int a[3][4] = {{0, -2, 2, 4}, {10, -5, 1, 3}, {1, 4, 1, 0}};
    cout << array2F(a, 3, 4) << endl; // output is 10
    return 0;
}
```

Answer:

Problem 199 Consider the following C++ program.

```

#include <iostream>
using namespace std;

char recursive(char array[], int n) {
    char x = array[n];
    if ('a' <= x && x <= 'z') return x;
    cout << x;
    return recursive(array, n - 1);
}

int main() {
    char array[8] = {'a','b','c','d','0','1','2','3'};
    cout << array[1] << endl;           // line a
    cout << (char) (array[1] + 1) << endl; // line b
    cout << recursive(array, 0) << endl; // line c
    cout << recursive(array, 4) << endl; // line d
    cout << recursive(array, 7) << endl; // line e
    cout << array[6] - array[7] << endl; // line f
    return 0;
}

```

What is the output from the program at each of the following lines:

- (a) line a:
- (b) line b:
- (c) line c:
- (d) line d:
- (e) line e:
- (f) line f:

Problem 200 Write a function called *useRecursion* that returns the sum of the first two digits in a positive number. If there is only one digit, that digit is returned. For example, a program that uses the function *useRecursion* follows.

```

int main() {
    cout << useRecursion(567982) << endl; // prints 11
    cout << useRecursion(107982) << endl; // prints 1
    cout << useRecursion(7) << endl; // prints 7
    return 0;
}

```

Answer:

Problem 201 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Declare and initialize any variables that you use in each part.

- (i) Print the number 7 to an output file whose system name is *out.txt*
- (ii) Read the first line of text in an input file whose system name is *in.txt*. Store the line in an appropriate variable called *line*.
- (iii) Write the title line for a main function that uses arguments.
- (iv) Print the 5th character of a string variable called *line* to the output screen.
- (v) Print the character after the first character equal to K in a string variable called *line* to the output screen. If there is no character K, print the first character of the string.
- (vi) Print a random 2 digit integer to the output screen.

Problem 202 Write a complete C++ program that does the following.

1. It asks the user to enter a positive integer n that is at most 20. It continues asking until the user enters a correct input.
 2. The program generates two random upper case letters (using the standard C++ random number generation function).
 3. The program prints an $n \times n$ square that uses the two characters to make a checkerboard pattern.
- For example, if the user enters 5 and the random letters are K and W the following square picture is printed.

```
KWKWK  
WKWKW  
KWKWK  
WKWKW  
KWKWK
```

Answer:

Problem 203 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {  
    int a[10] = {3,1,4,1,5,9,2,6,5,3};  
    int x[3][2] = {{0,1},{2,3},{4,5}};  
    int n = 7, m = 2;  
    int i = sum(n, m, n);           // sets i as the sum  
    swap(n, m);                    // swaps n and m  
    addToArray(a, 10, 5);          // adds 5 to every entry  
    printArray(x, 3, 2);           // prints content of x  
    cout << maxElement(a, 10);     // maximum element of array  
    cout << firstDigit(n);         // first digit  
    return 0;  
}
```

(a) Title line for **sum**

Answer:

(b) Title line for **swap**

Answer:

(c) Title line for **addToArray**

Answer:

(d) Title line for **printArray**

Answer:

(e) Title line for **maxElement**

Answer:

(f) Title line for **firstDigit**

Answer:

Problem 204 Write a function called *array2F* that returns the product of the negative entries in a 2-dimensional array (of integer values). The parameters are the array, its number of rows and its number of columns. For example, a program that uses the function *array2F* follows.

```
int main() {
    int a[3][4] = {{0, -2, 2, 4}, {10, -5, 1, 3}, {1, 4, 1, 0}};
    cout << array2F(a, 3, 4) << endl;    // output is 10
    return 0;
}
```

Answer:

Problem 205 Consider the following C++ program.

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

char recursive(char array[], int n) {
    char x = array[n];
    if ('a' == x || x == 'b') return x;
    cout << x;
    return recursive(array, n - 1);
}

int main() {
    char array[8] = {'a','b','c','d','0','1','2','3'};
    cout << array[0] << endl;           // line a
    cout << (char) (array[0] + 3) << endl; // line b
    cout << recursive(array, 0) << endl;  // line c
    cout << recursive(array, 2) << endl;  // line d
    cout << recursive(array, 7) << endl;  // line e
    cout << array[7] - array[5] << endl;  // line f
    return 0;
}
```

What is the output from the program at each of the following lines:

- (a) line a:
- (b) line b:
- (c) line c:
- (d) line d:
- (e) line e:
- (f) line f:

Problem 206 Write a function called *useRecursion* that returns the larger of the first two digits in a positive number. If there is only one digit, that digit is returned. For example, a program that uses the function *useRecursion* follows.

```
int main() {
    cout << useRecursion(567982) << endl;    // prints 6
    cout << useRecursion(107982) << endl;    // prints 1
    cout << useRecursion(7) << endl;        // prints 7
    return 0;
}
```

Answer:

Problem 207 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Declare and initialize any variables that you use in each part.

(i) Read the first line of text in an input file whose system name is *input.txt*. Store the line in an appropriate variable called *line*.

(ii) Print the number 2 to an output file whose system name is *output.txt*

(iii) Print the length of a string variable called *line* to the output screen.

(iv) Write the title line for a main function that uses arguments.

(v) Print the character before the first character equal K in a string variable called *line* to the output screen. If there is no character K, or no character before it print the first character of the string.

(vi) Print a random 3 digit integer to the output screen.

Problem 208 Write a complete C++ program that does the following.

1. It asks the user to enter a positive integer n that is at most 20. It continues asking until the user enters a correct input.

2. The program generates n^2 random upper case letters (using the standard C++ random number generation function).

3. The program prints an $n \times n$ square that is filled with its chosen random letters.

For example, if the user enters 5 the following square picture might be printed.

```
KWXDG
YKWQT
AGDKE
IEXVL
UGBLQ
```

Answer:

Problem 209 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    int a[10] = {3,1,4,1,5,9,2,6,5,3};
    int x[3][2] = {{0,1},{2,3},{4,5}};
    int n = 7, m = 2;
    int i = diff(n, m);           // sets i as the difference
    swap(n, m);                 // swaps values of inputs
    printArray(a, 10);          // prints content of a
    addToArray(x, 3, 2, 5);     // adds 5 to every entry in array
    cout << average(a, 10);     // average of array
    cout << first2Digits(n + m); // first two digits
    return 0;
}
```

(a) Title line for **diff**

Answer:

(b) Title line for **swap**

Answer:

(c) Title line for **printArray**

Answer:

(d) Title line for **addToArray**

Answer:

(e) Title line for **average**

Answer:

(f) Title line for **first2Digits**

Answer:

Problem 210 Write a function called *array2F* that returns the number of non-zero entries in a 2-dimensional array (of integer values). The parameters are the array, its number of rows and its number of columns. For example, a program that uses the function *array2F* follows.

```
int main() {
    int a[3][4] = {{0, -2, 2, 4}, {10, -5, 1, 3}, {1, 4, 1, 0}};
    cout << array2F(a, 3, 4) << endl;    // output is 10
    return 0;
}
```

Answer:

Problem 211 Consider the following C++ program.

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

char recursive(char array[], int n) {
    char x = array[n];
    if ('0' <= x && x <= '9') return x;
    cout << x;
    return recursive(array, n - 1);
}

int main() {
    char array[8] = {'0', '1', '2', '3', 'a', 'b', 'c', 'd'};
    cout << array[1] << endl;           // line a
    cout << (char) (array[1] + 1) << endl; // line b
    cout << recursive(array, 0) << endl;  // line c
    cout << recursive(array, 4) << endl;  // line d
    cout << recursive(array, 7) << endl;  // line e
    cout << array[6] - array[7] << endl;  // line f
    return 0;
}
```

What is the output from the program at each of the following lines:

- (a) line a:
- (b) line b:
- (c) line c:
- (d) line d:
- (e) line e:
- (f) line f:

Problem 212 Write a function called *useRecursion* that returns the second digit in a positive number. If there is only one digit, that digit is returned. For example, a program that uses the function *useRecursion* follows.

```
int main() {
    cout << useRecursion(567982) << endl;    // prints 6
    cout << useRecursion(107982) << endl;    // prints 0
    cout << useRecursion(7) << endl;        // prints 7
    return 0;
}
```

Answer:

Problem 213 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Declare and initialize any variables that you use in each part.

- (i) Write the title line for a main function that uses arguments.
- (ii) Print the number 13 to an output file whose system name is *out.txt*
- (iii) Read the first string in an input file whose system name is *in.txt*. Store the string in an appropriate variable called *data*.
- (iv) Print the 8th character of a string variable called *line* to the output screen.
- (v) Print the position of the first character equal to K in a string variable called *line* to the output screen. If there is no character K, print -1.
- (vi) Print a random 5 digit integer to the output screen.

Problem 214 Write a complete C++ program that does the following.

1. It asks the user to enter a positive integer *n* that is at most 20. If an incorrect response is entered it exits.
2. The program generates a random upper case letter and a random lower case letter (using the standard C++ random number generation function).
3. The program prints an $n \times n$ square that uses the two characters to make a checkerboard pattern.

For example, if the user enters 5 and the random letters are K and w the following square picture is printed.

```
KwKwK
wKwKw
KwKwK
wKwKw
KwKwK
```

Answer:

Problem 215 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**


```

int main() {
    int a[4] = {3,1,4,1}, i = 3, j = 5, k = 4;
    int x[2][2] = {{0,1},{3,2}};
    printArray(a, 3);           // outputs: 3,1,4
    printVals(i + j, a[0]);    // outputs: 8 3
    reverse(a, 0, 3);         // changes a to 1,4,1,3
    cout << sumElements(x, 2 , 2); // outputs: 6
    sort(i, j, k);
    cout << i << j << k << endl; // prints 345
    return 0;
}

```

(a) Title line for **printArray**

Answer:

(b) Title line for **printVals**

Answer:

(c) Title line for **reverse**

Answer:

(d) Title line for **sumElements**

Answer:

(e) Title line for **sort**

Answer:

Problem 216 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer that is between 1 and 26.
2. The program reads a value n entered by the user. If the value is not legal, the program exits.
3. The program prints an $n \times n$ pattern of characters, in which the bottom right character is an 'A'. The bottom right 2×2 block is completed by three 'B' characters. The bottom right 3×3 block is completed by five 'C' characters, and so on.

For example, if the user enters 5 for n the program should print the following picture.

```

EEEEEE
EDDDD
EDCCC
EDCBB
EDCBA

```

Answer:

Problem 217 Write a function called *emergency* that detects whether a number contains the sequence of digits 911. For example, a program that uses the function *emergency* follows.

```

int main() {
    if (emergency(56791182)) cout << "Warning" << endl; // prints warning
    if (emergency(56791212)) cout << "Warning" << endl; // no print here
    if (emergency(91191191)) cout << "Warning" << endl; // prints warning
    return 0;
}

```

Answer:

Problem 218 Consider the following C++ program.

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

string recursive(string x) {
    if (x.length() == 0) return ":";
    return x.substr(0,1) + "#" + recursive(x.substr(1));
}

int main(int argc, char *argv[]) {
    int i = 1, j = 2, k = 3;
    string array[2] = {"", "hello"};
    cout << ++k << endl;           // line a
    k = ++i - j++;
    cout << i << j << k << endl;   // line b
    cout << recursive(array[0]) << endl; // line c
    cout << recursive(array[1]) << endl; // line d
    cout << argv[1] << endl;       // line e
    return 0;
}
```

The program is compiled to produce a binary called a.out. The binary is run with the command:

```
venus> ./a.out CS111 Final Exam
```

What is the output from the program at each of the following lines:

- (a) line a:
- (b) line b:
- (c) line c:
- (d) line d:
- (e) line e:

Problem 219 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part. All other necessary variables should be declared and initialized.

```
int x, y, table[100][100];
string name;
```

- (i) Print the quotient when x is divided into y .
- (ii) Print `table[2][2]` to the file `out.txt`. (In this part you need to declare a variable to access the file.)
- (iii) Print HELLO if you can find the substring *Freddy* within *name*. Otherwise print HI.
- (iv) Print the sum of all the numbers in column number 17 of the 2-dimensional array called *table*. (The array *table* has 100 rows and 100 columns. As usual the array begins with row number 0.)
- (v) Print a random integer value between 13 and 19 (inclusive) to the screen. (The random integer should be determined by using an appropriate C++ function.)

Problem 220 Write a complete C++ program that does the following.

1. It asks the user to enter positive integers a and b that are each at most 100.
2. The program reads in a table of integers with a rows and b columns as entered by the user.
3. The program determines and prints the maximum entry in each column of the table.
4. The program then prints the smallest value among these maximum entries.

For example, the following represents one run of the program.

```
Enter integers for r and c (at most 100):    2 2
Enter 2 rows of 2 integers:
  1  4
  2  0
The maximum entries in the columns are:  2 4
The smallest of the printed maximum entries is :  2
```

Answer:

Problem 221 Write title lines (header lines or prototypes) for the following functions. Do not supply the blocks for the functions.

- (a) A function called **middleDigit** which returns the middle digit of an integer.

Answer:

- (b) A function called **sqrt** that returns the square root of a double precision parameter.

Answer:

- (c) A function called **duplicateString** which returns a new copy of string.

Answer:

- (d) A function called **randomFile** which is to return a randomly created name to use for an output file.

Answer:

- (e) A function called **selectionSort** which is to sort an array of strings into alphabetical order.

Answer:

Problem 222 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
3. The program prints an $n \times (2n - 1)$ pattern of * symbols in the shape of a large solid triangle.

For example, if the user enters 4 for n the program should print the following picture.

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

Answer:

Problem 223 Write a function called *removeFirst* that removes the first digit from a number. The answer should be returned as an integer. (Drop any leading 0 digits in the answer. So that as in the example below, removing the first from 1024 leaves 24.)

A program that uses the function *removeFirst* follows.

```

int main() {
    int n = 19683;
    int m = removeFirst(n);
    cout << m << endl;           // output 9683
    cout << removeFirst(1024);   // output 24
    return 0;
}

```

Answer:

Problem 224 Consider the following C++ program.

```

#include <iostream>
using namespace std;

string recursive(string x) {
    if (x.length() <= 1) return x;
    return x.substr(0,2) + recursive(x.substr(1));
}

int main(int argc, char *argv[]) {
    int i = 1, j = 2, k = 3;
    string array[2] = {"A", "hello"};
    cout << ++argc << endl;           // line a
    k = ++i * j++;
    cout << i << j << k << endl;       // line b
    cout << recursive(array[0]) << endl; // line c
    cout << recursive(array[1]) << endl; // line d
    cout << recursive(argv[3]) << endl; // line e
    return 0;
}

```

The program is compiled to produce a binary called a.out. The binary is run with the command:

```
venus> ./a.out CS111 Final Exam
```

What is the output from the program at each of the following lines:

- (a) line a:
- (b) line b:
- (c) line c:
- (d) line d:
- (e) line e:

Problem 225 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Include declarations for any variable that you use.

- (i) Print the word *HELLO* to the file *out.txt*.
- (ii) Print a random upper case letter to the screen. (The random letter should be determined by using an appropriate C++ function.)
- (iii) Read a line of text from the user and print the word *NO* if it contains the string *Fred*.
- (iv) Print the first 4 characters of the string *s*. Assume that the string has length at least 4.
- (v) Swap the values of integer variables called *p* and *q*.

Problem 226 Write a complete C++ program that does the following.

1. It asks the user to enter positive integers a and b that are each at most 20.
2. The program generates random integer values between 1 and 6 as the entries in a table with a rows and b columns.
3. The program then prints the table.
4. The program then prints the diagonal entries from the table.

For example, the following represents one run of the program.

```
Enter integers for r and c (at most 20):    2 2
The table has been generated as:
6 3
1 2
The diagonal is: 6 2
```

Answer:

Problem 227 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    string name = "Freddy", secondName = "Fred";
    cout << thirdChar(name);           // print the 3rd character
    if ( !isLegal(name) )              // reject illegal names
        readName(name);                // and reads a name entered by the user
    exchangeNames(name, secondName);    // Swap the two names
    cout << bothNames(name, secondName); // print full name
    return 0;
}
```

(a) Title line for **thirdChar**

Answer:

(b) Title line for **isLegal**

Answer:

(c) Title line for **readName**

Answer:

(d) Title line for **exchangeNames**

Answer:

(e) Title line for **bothNames**

Answer:

Problem 228 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part. All other necessary variables should be declared and initialized.

```
int x, y, table[100][100];
string name;
```

- (i) Print the remainder when x is divided into y .
- (ii) Print *name* to the file *out.txt*. (In this part you need to declare a variable to access the file.)
- (iii) Read a line of text from the file *out.txt* into the variable *name*.
- (iv) Print the average of all the numbers in row number 17 of the 2-dimensional array called *table*. (The array *table* has 100 rows and 100 columns. As usual the array begins with row number 0.)
- (v) Print a sequence of 20 random integer values each between 1 and 20 (inclusive) to the screen. (The random integers should be determined by using an appropriate C++ function.)

Problem 229 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
3. The program prints an $n \times n$ pattern of * symbols in the shape of an empty right triangle (with the point down). For example, if the user enters 7 for n the program should print the following picture.

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

Answer:

Problem 230 Write a function called *evenUp* that uses an integer parameter and returns a result that is found by increasing each even digit in the parameter by 1. For example, if the parameter has value 19683 the returned result would be 19793.

A program that uses the function *evenUp* follows.

```
int main() {
    cout << evenUp(10) << endl;    // prints 11
    cout << evenUp(2662) << endl;  // prints 3773
    cout << evenUp(19683) << endl; // prints 19793
    return 0;
}
```

Answer:

Problem 231 For each of the following short segments of a program write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
double x = 4, y = 8;
bool z = (x <= y || y <= x);
if (z) cout << y / x;
else cout << x / y;
cout << endl;
```

Answer:

(ii)

```
char Int = 'C';
Int = Int + 1;
cout << Int << endl;
```

Answer:

(iii)

```
int i = 1;
while (i++ < 10) {
    cout << ++i << endl;
}
```

Answer:

(iv)

```
int x[3][3] = {{1,2,3}, {4,7,10}, {11,15,19}};
for (int i = 0; i <= 2; i++)
    cout << x[i][i];
cout << endl;
```

Answer:

(v)

```
string x[3] = {"Hello", "CS111", "Exam"};
for (int j = 1; j <= 3; j++) for (int i = 2; i >= 0; i--)
    cout << x[i][j];
cout << endl;
```

Answer:

Problem 232 Write a complete C++ program that does the following.

1. It asks the user to enter a positive integer n that is at most 20.
2. The program then reads n words from the user. (You should assume that each word contains between 1 and 10 characters.)
3. The program then prints a summary giving the number of words with each length.

For example, the following represents one run of the program.

```
Enter an integer n (at most 20):    3
Enter 3 words:                      Hello CS111 Exam
Length 4:  count 1
Length 5:  count 2
```

In the exam the words *Hello* and *CS111* have length 5, and give the count of 2 words with length 5. No counts are printed for word lengths other than 4 and 5 because no other word lengths are encountered in this example.

Answer:

Problem 233 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    string name = "Freddy", secondName = "Fred";
    fixThirdChar(name);           // change the 3rd character to X
    if ( !isLegal(secondName) )  // reject illegal names
        secondName = readName(); // and reads a name entered by the user
    exchangeNames(name, secondName); // Swap the two names
    printBothNames(name, secondName); // print full name
    return 0;
}

```

(a) Title line for **fixThirdChar**

Answer:

(b) Title line for **isLegal**

Answer:

(c) Title line for **readName**

Answer:

(d) Title line for **exchangeNames**

Answer:

(e) Title line for **printBothNames**

Answer:

Problem 234 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part. All other necessary variables should be declared and initialized.

```

int x, y, table[100][100];
string name;

```

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

(ii) Print `table[0][0]` to the file `output.txt`. (In this part you need to declare a variable to access the file.)

(iii) Read a line of text from the file `output.txt` into the variable `name`.

(iv) Print the average of all the numbers in column number 37 of the 2-dimensional array called `table`. (The array `table` has 100 rows and 100 columns. As usual the array begins with column number 0.)

(v) Print a sequence of 10 random integer values each between 1 and 100 (inclusive) to the screen. (The random integers should be determined by using an appropriate C++ function.)

Problem 235 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.

2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.

3. The program prints an $n \times n$ pattern of * symbols in the shape of an empty right triangle (with the point up).

For example, if the user enters 7 for n the program should print the following picture.

```

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

```


Answer:

Problem 236 Write a function called *bigDown* that uses an integer parameter. It returns a result that is found from the parameter by subtracting 1 from any digit that is 5 or larger. For example, if the parameter has value 19683 the returned result would be 18573.

A program that uses the function *bigDown* follows.

```
int main() {
    cout << bigDown(10) << endl;        // prints 10
    cout << bigDown(2654) << endl;     // prints 2544
    cout << bigDown(19683) << endl;    // prints 18573
    return 0;
}
```

Answer:

Problem 237 For each of the following short segments of a program write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
double x = 4, y = 8;
bool z = (x <= y && y <= x);
if (z) cout << y / x;
else cout << x / y;
cout << endl;
```

Answer:

(ii)

```
char Int = 'D';
Int = Int - 1;
cout << Int << endl;
```

Answer:

(iii)

```
int i = 1;
while (++i < 10) {
    cout << i++ << endl;
}
```

Answer:

(iv)

```
int x[3][3] = {{4,7,10}, {11,15,19}, {1,2,3}};
for (int i = 0; i <= 2; i++)
    cout << x[i][i];
cout << endl;
```

Answer:

(v)

```
string x[3] = {"CS111", "Exam", "Hello"};
for (int j = 1; j <= 3; j++) for (int i = 2; i >= 0; i--)
    cout << x[i][j];
cout << endl;
```

Answer:

Problem 238 Write a complete C++ program that does the following.

1. It asks the user to enter a positive integer n that is at most 25.
2. The program then reads n words from the user. (You should assume that each word contains between 3 and 12 characters.)
3. The program then prints a summary giving the number of words with each length.

For example, the following represents one run of the program.

```
Enter an integer n (at most 20):    3
Enter 3 words:                      Hello CS111 Exam
Length 4:  count 1
Length 5:  count 2
```

In the exam the words *Hello* and *CS111* have length 5, and give the count of 2 words with length 5. No counts are printed for word lengths other than 4 and 5 because no other word lengths are encountered in this example.

Answer:

Problem 239 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part. All other necessary variables should be declared and initialized.

```
int x, y, table[100][100];
string name;
```

- (i) Print the remainder when x is divided by y .
- (ii) Print `table[1][1]` to the file `outfile.txt`. (In this part you need to declare a variable to access the file.)
- (iii) Read a line of text from the file `infile.txt` into the variable `name`.
- (iv) Print the average of all the numbers in row number 27 of the 2-dimensional array called `table`. (The array `table` has 100 rows and 100 columns. As usual the array begins with row number 0.)
- (v) Print two random integer values each between 100 and 200 (inclusive) to the screen. (The random integers should be determined by using an appropriate C++ function.)

Problem 240 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
3. The program prints an $n \times n$ pattern of * symbols in the shape of an empty right triangle (with the point up).

For example, if the user enters 7 for n the program should print the following picture.

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

Answer:

Problem 241 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part. All other necessary variables should be declared and initialized.

```
int x, y, table[100][100];
string name;
```

- (i) Print the remainder when y is divided into x .
- (ii) Print x and y to the file *out.txt*. (In this part you need to declare a variable to access the file.)
- (iii) Read a word of text from the file *infile.txt* into the variable *name*.
- (iv) Print the average of all the numbers in column number 27 of the 2-dimensional array called *table*. (The array *table* has 100 rows and 100 columns. As usual the array begins with column number 0.)
- (v) Print two random integer values each between 10 and 99 (inclusive) to the screen. (The random integers should be determined by using an appropriate C++ function.)

Problem 242 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
3. The program prints an $n \times n$ pattern of * symbols in the shape of an empty right triangle (with the point down). For example, if the user enters 7 for n the program should print the following picture.

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

Answer:

Problem 243 For each of the following short segments of a program write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
double x = 4, y = 8;
bool z = (x > y || y > x);
if (z) cout << y / x;
else cout << x / y;
cout << endl;
```

Answer:

(ii)

```
char Int = 'd';
Int = Int + 1;
cout << Int << endl;
```

Answer:

(iii)

```

int i = 1;
while (i++ < 10) {
    cout << i++ << endl;
}

```

Answer:

(iv)

```

int x[3][3] = {{1,2,3}, {4,7,10}, {11,15,19}};
for (int i = 0; i <= 2; i++)
    cout << x[i][2 - i];
cout << endl;

```

Answer:

(v)

```

string x[3] = {"Hello", "CS111", "Exam"};
for (int j = 1; j <= 3; j++) for (int i = 0; i <= 2; i++)
    cout << x[i][j];
cout << endl;

```

Answer:

Problem 244 For each of the following short segments of a program write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```

double x = 4, y = 8;
bool z = (x > y && y > x);
if (z) cout << y / x;
else cout << x / y;
cout << endl;

```

Answer:

(ii)

```

char Int = 'b';
Int = Int - 1;
cout << Int << endl;

```

Answer:

(iii)

```

int i = 1;
while (++i < 10) {
    cout << i++ << endl;
}

```

Answer:

(iv)

```

int x[3][3] = {{4,7,10}, {11,15,19}, {1,2,3}};
for (int i = 0; i <= 2; i++)
    cout << x[i][2 - i];
cout << endl;

```

Answer:

(v)

```

string x[3] = {"CS111", "Exam", "Hello"};
for (int j = 1; j <= 3; j++) for (int i = 0; i <= 2; i++)
    cout << x[i][j];
cout << endl;

```

Answer:

Problem 245 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```

int main() {
    string name; int x, y, array[20];
    name = enterName(); // Reads a name entered by the user
    cout << lastChar(name); // Print the last character
    enterNumbers(x, y); // Ask for and read in values for x and y
    cout << power(x, y); // x raised to the power y
                        // answer is decimal to allow for negative powers
    cout << reverse(name); // Prints the name backwards
                        // so Fred would be printed as derF
    randomize(array, 20); // fill the array with random numbers
    return 0;
}

```

(a) Title line for **lastChar**

Answer:

(b) Title line for **enterNumbers**

Answer:

(c) Title line for **power**

Answer:

(d) Title line for **reverse**

Answer:

(e) Title line for **randomize**

Answer:

Problem 246 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part:

```
int x[10], z[10][10], r, c;
```

(i) Increase every entry of x by 1.

(ii) Set r to be a random integer between c and $c + 10$. (The random integer should be determined by an appropriate C++ function.)

(iii) Print the sum of all 100 entries of the 2-dimensional array z .

(iv) Print the last 5 entries of the array x .

(v) Swap column number 2 with column number 3 in the 2-dimensional array z .

Problem 247 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
3. The program prints the first n squares and their sum.

For example, if the user enters 4 for n the program should produce the following output.

```
1 4 9 16
sum to 30
```

Answer:

Problem 248 Write a function called *boeing* that prints a parameter with additional digits of 7 before each digit and at the end of the number. (So that a parameter 4 would be printed as 747 and a parameter 666 would be printed as 7676767.)

For example, a program that uses the function *boeing* follows.

```
int main() {
    boeing(4);      cout << endl;    // prints 747
    boeing(66);     cout << endl;    // prints 76767
    boeing(7);      cout << endl;    // prints 777
    boeing(1000);   cout << endl;    // prints 717070707
    return 0;
}
```

Answer:

Problem 249 Consider the following C++ program.

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

int recursive(int x[], int n) {
    if (n <= 0 || n > 10) return 0;
    if (n == 1) return x[0];
    if (n <= 3) return x[n - 1] + recursive(x, n - 1);
    x[0]++;
    return recursive(x, n - 3);
}

int main() {
    int x, a[10] = {1,2,3,4,5,6,7,8,9,10};
    cout << "Enter a number: ";
    cin >> x;
    cout << recursive(a, x) << endl;
    return 0;
}
```

What is the output from the program in response to the following user inputs.

- (a) The user enters 0

Answer:

- (b) The user enters 1

Answer:

(c) The user enters 3

Answer:

(d) The user enters 5

Answer:

(e) The user enters 10

Answer:

Problem 250 Write a complete C++ program that does the following.

1. It asks the user to enter positive integers a and b that are each at most 100.
2. The program reads in a table of integers with a rows and b columns as entered by the user.
3. The program determines and prints the minimum entry in each column of the table.
4. The program then prints the average value of these minimum entries.

For example, the following represents one run of the program.

```
Enter integers for r and c (at most 100):    2 2
```

```
Enter 2 rows of 2 integers:
```

```
 1 4
```

```
 2 0
```

```
The minimum entries in the columns are:  1 0
```

```
The average minimum entry is :  0.5
```

Answer:

Problem 251 Write **title lines** for the functions that are called by the following main program. **Do not supply the blocks for the functions.**

```
int main() {
    string name;
    name = enterName();           // Reads a name entered by the user
    greet(name);                 // Says hello to the user
    cout << numberAs(name);      // Finds the number of As in the name
    string theClass[20];
    enterNames(theClass, 20);    // Enter the names of all students
    sort(theClass, 20, "decreasing"); // sort names into decreasing
                                    // alphabetical order

    printNames(theClass, 20);
    return 0;
}
```

(a) Title line for **enterName**

Answer:

(b) Title line for **greet**

Answer:

(c) Title line for **numberAs**

Answer:

(d) Title line for **enterNames**

Answer:

(e) Title line for **sort**

Answer:

Problem 252 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part. All other necessary variables should be declared and initialized.

```
int x, y, table[100][100];
string name;
```

- (i) Print the larger of integer variables called x and y .
- (ii) Print the numbers $10\ 9\ 8$ to the file *out.txt*. (In this part you need to declare a variable to access the file.)
- (iii) Read a line of text from the user and print the word *Yes* if it contains the substring *Freddy*.
- (iv) Print the sum of all the numbers in column number 0 of a 2-dimensional array called *table*. (The array *table* has 100 rows and 100 columns.)
- (v) Print 8 random **negative** integers to the screen. (The random integers should be determined by using an appropriate C++ function.)

Problem 253 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
 2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
 3. The program prints an $n \times (2n - 1)$ pattern of * symbols in the shape of a large triangle.
- For example, if the user enters 4 for n the program should print the following picture.

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

Answer:

Problem 254 Write a function called *oddDigits* that determines the number of odd digits in an integer parameter. For example, a program that uses the function *oddDigits* follows. (In this example, the number 10 has one odd digit namely 1; the number 26 has no odd digits; the number 19683 has three odd digits namely 1, 9 and 3.)

```
int main() {
    cout << oddDigits(10) << endl;    // prints 1
    cout << oddDigits(26) << endl;    // prints 0
    cout << oddDigits(19683) << endl; // prints 3
    return 0;
}
```

Answer:

Problem 255 For each of the following short segments of a program write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
int x = 4, y = 5;
if (x <= y && y <= x) cout << "Yes";
else cout << "No";
```

Answer:

(ii)


```
int x = 4, y = 5;
cout << (x / y + 1.0) << endl;
```

Answer:

(iii)

```
for (int i = 1; i <= 10; i++) {
    cout << i << endl;
    i++;
}
```

Answer:

(iv)

```
int x[3][3] = {{1,3,5}, {2,4,6}, {7,8,9}};
for (int i = 0; i <= 2; i++) for (int j = 0; j <= 2; j++)
    if (i == j) cout << x[i][j];
```

Answer:

(v)

```
int x[3][3] = {{1,3,5}, {2,4,6}, {7,8,9}};
for (int j = 0; j <= 2; j++) for (int i = 0; i <= 2; i++)
    cout << x[i][j];
cout << endl;
```

Answer:

Problem 256 Write a complete C++ program that does the following.

1. It asks the user to enter positive integers a and b that are each at most 20.
2. The program generates random integer values between 1 and 6 as the entries in a table with a rows and b columns.
3. The program then prints the table.
4. The program prints a picture with a rows and b columns. The character printed in row i and column j is X or O according as the entry of the table in row i and column j is even or odd.

For example, the following represents one run of the program.

```
Enter integers for r and c (at most 20):    2 2
The table has been generated as:
6 3
1 3
The picture is:
XO
OO
```

Answer:

Problem 257 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Include declarations for any variable that you use.

- (i) Print the word *output* to the file *out.txt*.
- (ii) Print a random negative integer to the screen. (The random integer should be determined by using an appropriate C++ function.)
- (iii) Read a line of text from the user and print the word *Yes* if it contains at most 7 characters.
- (iv) Print the last but one character of the string s .
- (v) Print the average of integer variables called x and y .

Problem 258 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
 2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
 3. The program prints an $n \times (2n - 1)$ pattern of * symbols in the shape of a large upside down triangle.
- For example, if the user enters 4 for n the program should print the following picture.

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

Answer:

Problem 259 Write a function called *reverse* that reverses the entries in an array.

For example, a program that uses the function *reverse* follows.

```
int main() {
    int a[5] = {3, 1, 4, 1, 5};
    reverse(a, 5);
    cout << a[0] << a[1] << a[2] << a[3] << a[4];    // prints 51413
    return 0;
}
```

Answer:

Problem 260 Write a complete C++ program that does the following.

1. It asks the user to enter positive integers r and c that are at most 100.
 2. The program reads in a table of integers with r rows and c columns as entered by the user.
 3. The program prints out all values of an integer x for which the entries in row x have a sum of 7.
- For example, the following represents one run of the program.

```
Enter integers for r and c (at most 100):    3 2
Enter 3 rows of 2 integers:
3 4
1 0
8 -1
The following rows add to 7:  0 2
```

Answer:

Problem 261 Consider the following C++ program.

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

string recursive(string s) {
    if (s.length() < 3) return s;
    if (s.length() < 5) return "a";
    return recursive(s.substr(3));
}
```

```
int main() {
    string x;
    cout << "Enter a string: ";
    cin >> x;
    cout << recursive(x) << endl;
    return 0;
}
```

What is the output from the program in response to the following user inputs.

(a) The user enters *Hi*

Answer:

(b) The user enters *Hello*

Answer:

(c) The user enters *Goodbye*

Answer:

(d) The user enters *12345678*

Answer:

(e) The user enters *1234 5678*

Answer:

Problem 262 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```
venus> g++ prog.cpp
venus> a.out input1.txt input2 out.txt
```

For each of the following short segments of the program *prog.cpp* write exactly what output is produced. Each answer should consist of those symbols printed by the given part of the program and nothing else.

(i)

```
int x = 4, y = 5;
cout << ++x + y--;
```

Answer:

(ii)

```
int main(int argc, char *argv[]) {
    cout << argv[1];
}
```

Answer:

(iii)

```
for (int i = 2; i >= 0; i--) {
    for (int j = 0; j < i; j++) cout << "*";
    cout << endl;
}
```

Answer:

(iv)

```
int c = 4, d = 5;
c = d;
d = c;
cout << c << " " << d;
```

Answer:

(v)

```
for (int i = 2; i >= 0; i--)
    for (int j = 0; j < i; j++) cout << "*";
cout << endl;
```

Answer:

Problem 263 Write title lines (header lines or prototypes) for the following functions. Do not supply the blocks for the functions.

(a) A function called **firstChar** which returns the first character of a string.

Answer:

(b) A function called **power** that returns an integer power of a double precision decimal number.

Answer:

(c) A function called **As** which returns the number of times the letter *A* appears in a string.

Answer:

(d) A function called **randomEven** which is to create and return a random even number.

Answer:

(e) A function called **inOrder** which is to determine whether an array of strings is in alphabetical order.

Answer:

Problem 264 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer.
2. The program reads a value n entered by the user. If the value is not legal, the program repeatedly makes the user type in another value until a legal value of n has been entered.
3. The program prints an $n \times (2n - 1)$ pattern of * symbols in the shape of a large letter *V*.

For example, if the user enters 4 for n the program should print the following picture.

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

Answer:

Problem 265 Write a function called *sort* that sorts three integer parameters into decreasing order.

For example, a program that uses the function *sort* follows.

```
int main() {
    int a = 2, b = 7, c = 1;
    sort(a, b, c);
    cout << a << b << c << endl;    // prints 721
    return 0;
}
```

Answer:

Problem 266 Write a complete C++ program that does the following.

1. It asks the user to enter positive integers r and c that are at most 100.
 2. The program reads in a table of integers with r rows and c columns as entered by the user.
 3. The program prints out all values of an integer x for which row x and column x of the table have the same sum.
- For example, the following represents one run of the program.

```
Enter integers for r and c (at most 100):    3 2
Enter 3 rows of 2 integers:
 3 2
 1 0
 1 1
The row and column sums are equal at 0.
```

(Note the program prints 0 because row 0 sums to $3 + 2 = 5$ and column 0 sums to $3 + 1 + 1 = 5$.)

Answer:

Problem 267 Consider the following C++ program.

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

string recursive(string s) {
    if (s.length() < 3) return s;
    if (s.length() < 6) return "a";
    return recursive(s.substr(4));
}

int main() {
    string x;
    cout << "Enter a string: ";
    cin >> x;
    cout << recursive(x) << endl;
    return 0;
}
```

What is the output from the program in response to the following user inputs.

(a) The user enters *Hi*

Answer:

(b) The user enters *5*

Answer:

(c) The user enters *five*

Answer:

(d) The user enters *string*

Answer:

(e) The user enters *recursive*

Answer:

Problem 268 Suppose that a C++ program called *prog.cpp* is compiled and correctly executed on venus with the instructions:

```
venus> g++ prog.cpp
venus> a.out input1.txt input2 out.txt
```


Answer:

Problem 270 Write C++ statements to carry out the following tasks.

Do not write complete programs, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part:

```
string f, l;
```

Declare any other variables that you use.

- (i) Write the strings *f* and *l* as the first two lines of the file *data.txt*.
- (ii) Print the message *Hello Freddy* if the input file *input.txt* begins with the string *Freddy*. Otherwise do nothing.
- (iii) Convert the string *f* to upper case letters and then print it.
- (iv) Print the number of times that the uppercase letter *F* appears in the string *f*.
- (v) Swap the strings stored in the variables *f* and *l*.

Problem 271 Consider the following C++ program.

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

int main(){

    int i;
    string words[4] = {"zero", "one", "two", "three"};

    for (i = 1; i <= 4; i++) cout << words[4 - i] << " ";           // line A
    cout << endl;

    i = 0;
    while( i + 1 < 4){ cout << words[i+1] << " "; i++; }          // line B
    cout << endl;

    for(i = 0; i < words[1].length(); i++) cout << (words[i])[0]; // line C
    cout << endl;

    return 0;
}
```

- (a) What is the output from the loop at line A?

Answer:

- (b) What is the output from the loop at line B?

Answer:

- (c) What is the output from the loop at line C?

Answer:

Problem 272 Write a function called *thirdDigit*. The function has an integer parameter and returns the third digit in its parameter. If the parameter is less than 100 the function returns 0 because there is no third digit.

For example, a program that uses the function follows.

```
int main() {
    cout << thirdDigit(777) << " " << thirdDigit(2048) << " " << thirdDigit(500125) << endl;
    return 0;
}
```

It should print: 7 4 0

Answer:

Problem 273 Write a function called *sixCount* that returns a count of the number of entries that are equal to 6 in a 2-dimensional array with 6 columns. The function should use a parameter to specify the array and parameters for the row count and column count.

For example, a program that uses the function *sixCount* follows.

```
int main() {
    int arr[2][6] = {{6,4,3,1,2,2}, {6,6,5,2,3,6}}; // array has 4 entries of 6
    cout << sixCount(arr, 2, 6) << endl; // prints 4
    return 0;
}
```

Answer:

Problem 274 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer n .
2. If n is not positive, it prints an error message and exits.
3. Otherwise it calculates and prints the product of the digits of n .

Here is an example of how the program should work:

```
Enter a positive integer n: 373
The product of its digits is 63
```

In this example the product is $3 \times 7 \times 3$ which is 63.

Answer:

Problem 275 Write a complete C++ program that does the following.

1. It asks the user to enter a positive integer n .
2. It reads n from the user and exits if n is not positive.
3. It prints out an $n \times n$ checkerboard pattern made from the characters X and O .

Here is an example of how the program should work:

```
Give me a positive integer: 3
XOX
OXO
XOX
```

In a checkerboard pattern, the horizontal and vertical neighbors of each X are O s, and the horizontal and vertical neighbors of each O are X s.

Answer:

Problem 276 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part:

```
string f, l, name;
```

Declare any other variables that you use.

- (i) From the input file *data.txt*, read a first name to *f* and a last name to *l*.
- (ii) Print the second character in *f* to an output file *output.txt*.
- (iii) Convert the string *f* to lower case letters and then print it.
- (iv) Check whether the string *f* contains the letters *Fred* as a substring. If it does, print the message *Hello Freddy* . Otherwise do nothing.
- (v) Concatenate the strings *f* and *l* separated by a space into the string *name*.

Problem 277 Consider the following C++ program.

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

void mystery(int x[][4], int a, int b, int k) {
    for (int r = 0; r <= a; r++) for (int c = 0; c <= b; c++)
        x[r][c] = k;
}

void print(int x[][4], int s) {
    for (int r = 0; r < s; r++) {
        for (int c = 0; c < s; c++) cout << x[r][c];
        cout << endl;
    }
    cout << endl;
}

int main() {
    int x[4][4];
    mystery(x, 3, 3, 0); print(x, 4);
    mystery(x, 1, 2, 1); print(x, 4);
    mystery(x, 3, 1, 2); print(x, 3);
    mystery(x, 3, 2, 3); print(x, 1);
    return 0;
}
```

(a) What is the output from the first call to the function print?

Answer:

(b) What is the output from the second call to the function print?

Answer:

(c) What is the output from the third call to the function print?

Answer:

(d) What is the output from the fourth call to the function print?

Answer:

Problem 278 Write header lines (prototypes) for the following functions. **Do not attempt to supply the blocks for the functions.**

(a) A function called **lastChar** which uses a string as input and returns the last character in the string.

Answer:

(b) A function called **isSquare** that tests whether an integer is a perfect square. (For example, 16 is a perfect square, but -5 is not.)

Answer:

(c) A function called **addTwo** which uses as input an array of integers. The task of the function is to add 2 to every element in the array.

Answer:

(d) A function called **exchangeArrays** which uses two arrays of integers that have the same capacity and exchanges the entries between them.

Answer:

(e) A function called **exchange** which exchanges the values of two integers.

Answer:

Problem 279 Write a function called *sevenUp*. The function has an integer parameter and calculates an answer by turning any digit equal to 7 in the input to an 8.

For example, a program that uses the function follows.

```
int main() {
    cout << sevenUp(777) << " " << sevenUp(471) << " " << sevenUp(50) << endl;
    return 0;
}
```

It should print: 888 481 50

Answer:

Problem 280 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter 9 integers as the entries of a 3×3 table.
2. The program reads the 9 entries, row by row and prints the table.
3. If every row and column of the table have the same sum then the program adds the message: *MAGIC*.

Here is an example of how the program should work:

```
Enter 9 entries of a 3 x 3 table:  10 14 18  15 16 11  17 12 13
```

```
10 14 18
15 16 11
17 12 13
```

```
MAGIC
```

This example is magic because each row and each column has a sum of 42.

Answer:

Problem 281 Write a complete C++ program that does the following.

1. It asks the user to enter some positive integers.
2. It reads positive integers from the user.
3. As soon as the user enters a non-positive integer, the program stops reading.
4. The program reports the sum of all the positive numbers that it read.

Here is an example of how the program should work:

```
Give me some positive integers:   1 12 1 100 -1000
sum: 114
```

Answer:

Problem 282 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part:

```
string f, l;
```

- (i) Read a first name to f and a last name to l . Then, print out the string f followed by the string l on another line.
- (ii) Print the second character in f .
- (iii) Convert the string f to upper case letters and then print it.
- (iv) Read a word into f from a user. If the program can find the smaller string "reddy" within the string f , print the word "Hello", otherwise do nothing.
- (v) Print the last character of l .

Problem 283 Consider the following C++ program.

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

void mystery(char x[][4], int a, int b, char k) {
    for (int r = a; r <= b; r++) for (int c = a; c <= b; c++)
        x[r][c] = k;
}

void print(char x[][4], int s) {
    for (int r = 0; r < s; r++) {
        for (int c = 0; c < s; c++) cout << x[r][c];
        cout << endl;
    }
    cout << endl;
}

int main() {
    char x[4][4];
    mystery(x, 0, 3, 'X'); print(x, 4);
    mystery(x, 1, 2, 'Y'); print(x, 4);
    mystery(x, 2, 3, 'Z'); print(x, 4);
    mystery(x, 3, 2, '0'); print(x, 4);
    return 0;
}
```

(a) What is the output from the first call to the function print?

Answer:

(b) What is the output from the second call to the function print?

Answer:

(c) What is the output from the third call to the function print?

Answer:

(d) What is the output from the fourth call to the function print?

Answer:

Problem 284 Write header lines (prototypes) for the following functions. **Do not attempt to supply the blocks for the functions.**

(a) A function called **isPrime** that tests whether an integer is prime. (For example, 7 is prime, but 9 is not.)

Answer:

(b) A function called **firstChar** which uses a string as input and returns the first character in the string.

Answer:

(c) A function called **printThree** which uses as input an array of integers. The task of the function is to print the first three elements of the array.

Answer:

(d) A function called **printChess** which uses as input an 8×8 array of characters that represents a chess board. The task of the function is to print the board to output.

Answer:

(e) A function called **reverseWord** which is to use a string parameter and change it to become the string obtained by reversing its letters. (For example, an input string *was* would be changed to *saw*.)

Answer:

Problem 285 Write a function called *biggestEntry* that uses a two dimensional array (with 3 columns) and integer entries as its first parameter. It also uses parameters representing the row and column capacities. The function should return the value of the biggest entry in the array.

For example, a program that uses the function follows.

```
int main() {
    int x[2][3] = {{1,2,3},{4,7,3}};
    cout << biggestEntry(x, 2, 3) << endl;
    return 0;
}
```

It should print 7 (since 7 is the biggest entry in the array).

Answer:

Problem 286 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer value, n .
2. The program reads a value entered by the user. If n is not positive, the program should exit.
3. It prints out the number of digits in n .
4. It prints the number digits in the binary representation of n .

Here is an example of how the program should work:

Enter a positive integer n: 17
Digits in n: 2
Binary digits in n: 5

The number of binary digits is 5 because the binary representation of 17 is 10001. However, it is not necessary for your program to determine this binary representation.

Answer:

Problem 287 Write a complete C++ program that does the following.

1. It asks the user to enter 5 single digit positive integers.
2. If any number is out of range, it says: "That is too hard."
3. Otherwise it adds the numbers and prints their sum.

Here is an example of how the program should work:

```
Give me 5 single digit positive integers:  9 9 9 6 9
42
```

Answer:

Problem 288 Write C++ statements to carry out the following tasks. **Do not write complete programs**, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part:

```
int x;
string f, l;
```

- (i) Read a user's first name to f and their last name to l .
- (ii) Print out the string f followed by the string l with a space between them.
- (iii) Set x to be $1 - 2 + 3 - 4 + 5 - \dots + 999$. The formula involves all integers from 1 to 999. Odd numbers are added, even numbers subtracted.
- (iv) Repeatedly double x , until the value of x exceeds 1024.
- (v) Read a word into f from a user. If the word is "Freddy", print output saying "Hello", otherwise do nothing.

Problem 289 Consider the following C++ program.

```

#include <iostream>
using namespace std;

void mystery(string array[], int p[], int q) {
    if (q < 0) cout << "Help!" << endl;
    else if (q <= 2) cout << p[q] << endl;
    if (q > 2) {
        for (int i = 0; i <= q; i++) cout << array[p[i]] << " ";
        cout << endl;
    }
}

int main() {
    string x[5] = {"This", "is", "a", "dumb", "question"};
    int a[10] = {0, 4, 1, 3, 3, 3, 2, 2, 2, 2};
    mystery(x, a, -10);
    mystery(x, a, 0);
    mystery(x, a, 1);
    mystery(x, a, 3);
    mystery(x, a, 5);
    return 0;
}

```

(a) What is the output from the first call to the function `mystery`?

Answer:

(b) What is the output from the second call to the function `mystery`?

Answer:

(c) What is the output from the third call to the function `mystery`?

Answer:

(d) What is the output from the fourth call to the function `mystery`?

Answer:

(e) What is the output from the fifth call to the function `mystery`?

Answer:

Problem 290 Write header lines (prototypes) for the following functions. **Do not attempt to supply the blocks for the functions.**

(a) A function called **isLeapYear** that tests whether an integer represents a leap year. (For example, 2008 is a leap year, but 2007 is not.)

Answer:

(b) A function called **temperatureDifference** which uses as input two double precision values that represent the temperature in New York measured in degrees Fahrenheit and the temperature in Paris measured in degrees Celsius. The function is to calculate and return the difference between the temperatures in degrees Fahrenheit.

Answer:

(c) A function called **addCurve** which uses as input an array of integer test scores. The task of the function is to add 10 to every score in the array.

Answer:

(d) A function called **printTicTacToe** which uses as input a 3×3 array of characters that represents a Tic-Tac-Toe game. The task of the function is to print the board to output.

Answer:

(e) A function called **reverseDigits** which is to use an integer parameter and return the integer obtained by reversing the digits in the parameter.

Answer:

Problem 291 Write a function called *biggestDigit* that uses an integer input parameter and returns the largest digit in the input. The input should be assumed to be positive.

For example, a program that uses the function follows.

```
int main() {
    cout << biggestDigit(1760) << endl;
    return 0;
}
```

It should print 7 (since 7 is the biggest digit in 1760).

A little extra credit will be given for good recursive solutions.

Answer:

Problem 292 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer value, n that is at most 100.
2. The program reads a value entered by the user. If n is not positive, or n is greater than 100, the program should exit.
3. It prints out all numbers between 1 and 1000 for which the sum of the digits is exactly n .

For example, if the user chooses 13 for n , the program should print out 49 because $4 + 9 = 13$. It would also print 58, 67, and other numbers with the same digit sum. It would not print 48 or 50.

(Suggestion: It might be convenient to write a function called *digitSum*.)

Answer:

Problem 293 Write a complete C++ program that does the following.

1. It asks the user to enter a (single) first name.
2. The program stores the name, but if it is "Freddy", the program changes it to "you".
3. The program says hello to the user, using their name (or changed version).

Here is an example of how the program should work:

```
Who are you?    Max
Hello Max.
```

Answer:

Problem 294 Write C++ statements to carry out the following tasks. Do not write complete programs, just give a single line, or a few lines of C++ instructions. Assume that the following variables have been declared, and if necessary have values, for each part:

```
int x;
string s;
```

- (i) Read a user's first name to s and their age to x .
- (ii) Print out the number of characters in the string s .
- (iii) Set x to be $1^3 + 2^3 + \dots + 71^3$, the sum of the cubes of the numbers from 1 to 71.
- (iv) Repeatedly generate and add a random value between 1 and 6 to x , until the value of x exceeds 100.
- (v) Read a complete line of text into s from a user. If their text includes a substring "Queens", print output saying "College", otherwise do nothing.

Problem 295 Consider the following C++ program.

```

#include <iostream>
using namespace std;

void mystery(int &p, int q) {
    int temp = p;
    p = q;
    q = temp;
}

int main() {
    int p, q;
    for (p = 0; p < 5; p++) cout << p; cout << endl;
    for (q = 0; q < 5; ++q) cout << q;
    cout << endl;
    for (p = 3; p < 6; p++)
        for (q = 1; q <= 3; q++)
            cout << p - q; cout << endl;
    p = 4; q = 14;
    mystery(q, p);
    cout << p << " " << q << endl;
    p = 4; q = 14;
    cout << ++p - q-- << endl;
    return 0;
}

```

What is the output from the program?

Problem 296 Write header lines (prototypes) for the following functions. Do not attempt to supply the blocks for the functions.

(a) A function called **numberDigits** that is to return the number of digits of an integer.

Answer:

(b) A function called **differenceMax** which is to return the difference between the maximum entries in two arrays of integers. (Do not assume that the arrays have the same capacities.)

Answer:

(c) A function called **swap** which is used to swap two values of type double.

Answer:

(d) A function called **firstCharacter** which is to return the first character in a string.

Answer:

(e) A function called **median** which is to return the median (middle valued) entry in an array that holds an odd number of integer entries.

Answer:

Problem 297 Write a function called *plusTax* that uses parameters that specify a price (in cents) and a tax rate (as a percentage). The function calculates the amount of tax, rounded to the nearest cent. (Half cents must round up.) It adds the tax to the price and returns the result.

For example, a program that uses the function follows.

```

int main() {
    int cost = 100;           // cost is 100 cents
    double taxRate = 4.8;    // tax is at 4.8 percent
    cout << "With tax that is " << plusTax(cost, taxRate) << " cents." << endl;
    return 0;
}

```


It should find a tax of 4.8 cents, round up to 5 cents and print:

With tax that is 105 cents.

Answer:

Problem 298 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer value, n that is at most 100.
2. The program reads a value entered by the user. If n is not positive, or n is greater than 100, the program should exit.
3. The program reads n integers from the user and then prints their last digits in reverse order of input.

For example, a run of the program might be as follows:

```
What is n? 7
Enter 7 numbers: 143 259 63 17 12 8 9
9 8 2 7 3 9 3
```

Answer:

Problem 299 Write a complete C++ program that first asks a user to do a simple math problem of your choosing. The user enters an answer and the program grades it as right or wrong.

For example the program might ask about 6×9 and respond to an incorrect answer of 42 as follows:

```
What is 6 x 9?
42
Wrong!
```

Your program can always ask the same question. **Answer:**

Problem 300 Write a complete C++ program that asks a user to enter the prices of 100 different grocery items (each price as a decimal showing dollars and cents). The program calculates and prints the total cost of the items.

Answer:

Problem 301

Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer value, x .
2. The program reads a value entered by the user. If the value is not positive, the program repeatedly makes the user type in another value until a positive value of x has been entered. (Note positive means greater than 0.)
3. The program prints out x squares on top of each other, the first with size 1, the second with size 2, and so on.

For example, if the user enters 3 for x the program should print:

```
*
**
**

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

Problem 302 Write a function called *percent* that uses two parameters x and y and returns the ratio x/y as a percentage.

For example, a program that uses the function *percent* follows.

```
int main() {  
    double z;  
    z = percent(1.5, 3.0);  
    cout << z << endl;  
}
```

It should print:

50.0

because $1.5/3 = 1/2 = 50\%$.

Answer:

Problem 303 Write a C++ function called *range* that returns the difference between the largest and smallest elements in an array.

It should be possible to use your function in the following program. (The output from this program is 10 because the difference between the largest element 13 and the smallest element 3 is $13 - 3 = 10$).

```
main() {
    int data[6] = {11, 12, 11, 3, 12, 13};
    int x;
    x = range (data, 6);
    // data is the array to search, 6 is the number of elements of the array
    cout << "The range is: " << x << endl;
}
```

Answer:

Problem 304 Consider the following C++ program.

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

void mystery(int data[], int p, int q) {
    data[p] = data[q];
    data[q] = 0;
}

void print(int data[], int p) {
    for (int i = 0; i < p; i++)
        cout << data[i] << " ";
    cout << endl;
}

main() {
    int scores[8] = {3, 1, 4, 1, 5, 9, 2, 6};
    int quiz[7] = {0, 1, 2, 3, 4, 5, 6};
    print(quiz, 4);
    print(scores, 4);
    mystery(scores, 3, 4);
    print(scores, 8);
    for (int i = 0; i < 3; i++)
        mystery(quiz, i, i+ 1);
    print(quiz, 7);
}
```

What is the output from the program?

Problem 305 Write C++ functions called *elementSwap* and *swap* that swap either the values of two elements of an array or the values of two variables.

It should be possible to use your function in the following program. (The output from this program is: 4 3 because the values of *x* and *y* are exchanged.)

```
main() {
    int a[6] = {11, 12, 11, 3, 12, 13};
    int x = 3, y = 4;
    elementSwap(a, 0, 5);
    swap(x, y);
    cout << x << " " << y << endl;
}
```

Answer:

Problem 306 Write a complete C++ program that asks a user to enter the 10 quiz scores for each student in a class of 30 students. For each of the 10 quizzes, the program decides which student(s) have got the highest scores and prints their numbers. (Hint: Store quiz data in a table.)

Sample output might look like:

Top Scores:

Quiz 0: Students: 5 17 23

Quiz 1: Students: 2 11 17 26

Quiz 2: Students: 2 17 23 26 27

and so on....

Answer:

Problem 307 Consider the following C++ program. What is the output?

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

main() {
    int i = 1, j = 1, k = 1;
    while (i < 10)
        cout << i++;
    cout << endl;
    while (j < 10)
        cout << ++j;
    cout << endl;
    while (++k < 10)
        cout << k++;
    cout << endl;

    return 0;
}
```

Problem 308 Write a complete C++ program that does the following:

1. It generates two random numbers x and y each between 1 and 100. (You should use the functions *rand* and *srand*.)
2. It adds x and y to make a secret code.
3. It prints the secret code.

For example, if the program generated the numbers $x = 11$ and $y = 13$ which add to 24, the output would be:

The secret code is 24.

Answer:

Problem 309 Write a complete C++ program that does the following. (Programs that correctly carry out some of the tasks will receive partial credit.)

1. It asks the user to enter a positive integer value, x .
2. The program reads the value entered by the user.
3. If the value is not positive, the program terminates. Otherwise, the program prints a checkerboard pattern that forms a square of side x .

For example, if the user enters 5 for x the program should print the following diagram with 5 lines.

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

(Hint: How is an even numbered row printed? How about an odd numbered row?)

Answer:

Problem 310 Write a C++ function called *negSum* that returns the sum of all negative elements in an array of integers.

It should be possible to use your function in the following program. (The output from this program is -12 because the negative elements -5 , -4 , and -3 have a sum of $-12 = -5 + (-4) + (-3)$.)

```
main() {
    int data[6] = {-5, -4, 1, 3, 2, -3};
    int x;
    x = negSum (data, 6);
    // data is the array to search, 6 is the number of elements of the array
    cout << "The negative sum is: " << x << endl;
}
```

Answer:

Problem 311 Write header lines (prototypes) for the following functions. Do not supply the blocks for the functions.

(a) A function called **isOdd** that is used to decide whether an integer is odd.

Answer:

(b) A function called **max** which determines the largest of 3 double precision values.

Answer:

(c) A function called **swap** which is used to swap two integer values.

Answer:

(d) A function called **total** which is to find the sum of all entries in an array of integers.

Answer:

(e) A function called **maxIndex** which is to find the index of the largest element in an array of double precision values.

Answer:

(f) A function called **sort** which is to sort an array of integers into order.

Answer:

Problem 312 Write a complete C++ program that:

1. Asks a user to enter the number of students in a class and the number of quizzes taken by the class.
2. If either of these numbers is less than 1 or more than 99 the program should exit.
3. The program should then prompt the user to enter all of the scores for each of the quizzes, starting with all scores for Quiz 1, followed by all scores for Quiz 2 and so on.
4. The program should print the number of the student with the highest total.

Number students and quizzes starting at 1.

A sample run of the program might look like:

How many students: 3
How many quizzes: 4

Enter scores for Quiz 1: 10 7 0
Enter scores for Quiz 2: 10 10 0
Enter scores for Quiz 3: 10 6 0
Enter scores for Quiz 4: 10 9 0

Student 1 got the highest total.

Answer: