
PROGRAMMING LANGUAGES

PRELIMINARY EXERCISES

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Chapter 1: Variables and Operators

Question 1.

Select from the list below all those that can be used as variable names in C++.

- ☐ texture ☐ while ☐ medição ☐ ff23 ☐ first_name ☐ _you ☐ 4you
☐ Height ☐ main ☐ distância ☐ ShgT ☐ age.mother ☐ max weight

Question 2.

The programs shown below contain errors that the compiler detects. Carefully analyze each one and indicate what the errors are. First, try to find each error without typing the code into the computer.

(a) There are 3 errors

```
int Main()
{
    // I will write
    my code here
}
```

(b) There are 8 errors

```
#include <iostream>

int main()
{
    Int a == 2.5;
    string s = Pedro Cruz;
    Int b = -5;
    char c = "y"
    bool a = true;
    return 0;
}
```

(c) There is 1 error

```
int main()
{
    height = 1.7;
    double height;
    int Age = 8;

    return 0;
}
```

(d) There are 3 errors

```
#include <iostream>

int main()
{
    int children;
    cin << "Number of children:";
    cout >> children;

    return 0;
}
```

(e) There are 4 errors

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

int main()
{
    double height = 1.7;
    const int Age = 8;
    string name = 'Pedro Cruz';
    Height = 2;
    Age = 10;
    Weight = 56;

    return 0;
}
```

(f) There are 8 errors

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

int main()
{
    int age;
    string name;
    cout << "Age: ";
    cin << Age;
    cout << "Name: ";
    cin << name;

    cin << name << is << age << years old.
    return 0;
}
```

(g) There are 3 errors

```
int main()
{
    int a = 7, b = 5, c = 2;
    string e;

    e = !( a = 2c ) || b >= a + c;
    return 0;
}
```

(h) There are 4 errors

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

int main()
{
    string first_Name; surname;
    cout << "First Name: ";
    cin >> first_Nam;
    cout << "Surname: ";
    cin >> Surname;

    cout << "Hi" First_Name;
    cout << " " Surname << \n;
    return 0;
}
```

Question 3.

Indicate the value of all variables at the end of the program.

(a)

```
int main()
{
    int a = 6;
    int b = 10;
    int c = 2;

    a = b + c + 1;
    b = a % c;
    c = 5;
    a = c - 3 * b;
    c = b / a;
    return 0;
}
```

(b)

```
int main()
{
    int a = 7, b = 5, c = 2;
    bool e_1, e_2, e_3, e_4, e_5;

    e_1 = a % 5 == c && !( b < c ) || a == c;
    e_2 = !(a % 5 == c && b < c ) && a == c;
    e_3 = a / b / c > 1 && a > c;
    e_4 = a <= b || b >= c && a == c - b || a / b == c;
    e_5 = !( !a == 2*c ) || b >= a + c;

    return 0;
}
```

(c)

```
int main()
{
    int a = 5;
    int b = 5;
    int c = 2;

    a = ( b / c * a - b ) % 5;
    ++b;
    c--;
    a += b;
    b -= c;
    return 0;
}
```

(d)

```
int main()
{
    int a = 5;
    double b = 1.5;
    double c;
    double d;
    int e = 2;
    int f;

    f = a / e;
    c = a / e;
    a += c;
    ++e;
    e *= 2;
    b = b + (double) ( a - 1 ) / ( e - 4 );

    return 0;
}
```

Question 4.

Consider the following variables:

```
int a = 5, b = 3, c = 4.3;
double d = 2, e = 2.5;
```

Indicate, if possible, the result of the operations a/b , a/c , a/d , d/e , $a\%b$, $a\%c$, $a\%d$, $e\%a$.

Chapter 2: Control Structures

Question 5.

For each of the programs below, indicate the output that is printed on the screen.

(a)

```
int main()
{
    int a = 8, b = 10, c = 5;

    if( a > b ){
        b -= c;
    }else{
        ++b;
    }
    if( (a+b) % 2 != 0)
        a = 1;

    cout << a + b + c << endl;
    return 0;
}
```

(b)

```
int main()
{
    int a = 5;

    if( a <= 5 ){
        ++a;
    }else if( a < 10 ){
        a = 20;
    }else
        a = 0;

    cout << a;
    return 0;
}
```

(c)

```
int main()
{
    for(int i = 1; i<=5; ++i){
        int s = 0;
        if(i % 2 == 0)
            s += 1;
        else
            s += 5;
        cout << s;
    }
    return 0;
}
```

(d)

```
int main()
{
    int n = 10;
    for(int i = 1; i<=n; ++i){
        cout << n % i;
        if(i % 5 == 0)
            n = 5;
    }
    if(n == 1000){
        cout << "***";
    }

    return 0;
}
```

(e)

```
int main()
{
    int s=0;
    int n;
    cout << "n= ";
    cin >> n; //n=10 //-5 //1

    for(int i=n; i>0; i--){
        if(i>5)
            s += i;
        else
            s -= i;
    }
    cout << s;
    return 0;
}
```

(f)

```
int main()
{
    int a = 1, b = 5, c = 2;

    do{
        c *= 2;
        --b;
    }while ( b > 2 );

    if ( 10*a <= c )
        for(int i = 1; i<5; ++i)
            a += 2;
    else
        --b;

    ++b;
    cout << a + b + c << endl;
    return 0;
}
```

(g)

```
int main()
{
    int n = 5;
    string message= "";
    int k = 0;
    while(k<n){
        ++k;
        if(k==0)
            message += "a";
        else
            if(k<5)
                message += "b";
            else
                message += "c";
    }
    cout << message;
    return 0;
}
```

(h)

```
int main()
{
    int n = 5;
    int valor = 0;
    int k = 1;
    while(k<n){
        if(k<3){
            for(int i=0; i<n/2; ++i)
                valor += 2*i;
        }else{
            for(int i=n; i>3; --i)
                valor += i;
        }
        ++k;
    }
    cout << valor;
    return 0;
}
```

(i)

```
int main()
{
    int s=1;
    int r=1;
    int n=7;

    for( int i = 1; i<n; ++i ){
        if( i < 4 ){
            s += i;
            r += 5;
            ++i;
        }else if( i < 6 ){
            s = 10;
            r = r % 3;
        }else{
            s*=2;
        }
    }
    cout << "\n s =" << s
         << " e r =" << r;
    return 0;
}
```

(j)

```
int main()
{
    int n = 4;
    int valor = 0;

    for(int i = 1; i < n; ++i)
        for(int j = 1; j <= i; ++j){
            cout << i << " " << j << " "
                 << i - j << "\n";
            valor += i - j;
        }
    cout << valor << endl;
    return 0;
}
```

Question 6.

Each of the programs below contains one error. Identify it.

(a)

```
int main(){
    int a;
    cout << "a: ";
    cin >> a;

    if( a > 10){
        cout << "A";
    }else{
        if ( a > 1 ){
            cout << "B";
        }else{
            cout << "C";
        }
    }else{
        cout << "D";
    }

    return 0;
}
```

(b)

```
int main(){
    int a = 1;
    int b = 3;

    while( a < 10 ){
        if ( a%2 == 0 ) {
            ++a;
            b *= 2;
        }
    }
    cout << "b: " << b << endl;
    cout << "a: " << a;

    return 0;
}
```

Question 7.

Write a program equivalent to the one below using i) a *while* loop and ii) a *for* loop.

```
int main(){
    int a;
    int sum = 0;

    do{
        cout << "Value";
        cin >> a;
        sum += a;
    }while( a<1000 );

    cout << "The sum is " << sum;
    return 0;
}
```

Chapter 3: Indexed Variables

Question 8.

Indicate which vectors **v**, **u** and **w** are obtained at the end of the program.

```
int main()
{
    vector<int> v(3);
    v.push_back(1);
    v.push_back(2);
    v.push_back(3);

    vector<int> u(5);
    u[1] = 5;
    u[2] = 10;
    u[3] = 1;
    u[4] = 9;
    u.resize(7);

    return 0;
}
```

```
int main()
{
    vector<int> w(2);
    w.at(0) = 1;
    w.at(1) = 6;
    w.push_back(7);
    w.push_back(8);
    w.resize(3);

    return 0;
}
```

Question 9.

Check whether there is any error in the programs below and, if not, indicate what the vector **v** looks like at the end of the program's execution.

(a)

```
int main()
{
    vector<int> v = {2, 8, 3, 1, 5};
    for(size_t i=0; i<v.size(); ++i){
        if( i % 2 == 0 )
            v.at(i+1) = v[i];
        else
            v.at(i) = i+1;
    }

    return 0;
}
```

(b)

```
int main()
{
    vector<int> v = {2, 8, 3, 1, 5, 7};
    for(size_t i=1; i<v.size()-1; ++i){
        if( v[i] > v[i+1] ){
            v[i] = v[i+1];
            v[i+1] = v[i];
        }
    }

    return 0;
}
```

(c)

```
int main()
{
    vector<int> v = {5, 1, 8, 6};
    for(size_t i = 0; i < v.size() - 1; ++i){
        for(size_t j = i + 1; j < v.size(); ++j){
            if( v[j] > v[i] ){
                int a = v[i];
                v[i] = v[j];
                v[j] = a;
            }
        }
    }
    return 0;
}
```

Question 10.

This program was supposed to remove the element `x` from the vector, but it has an error. Identify it and correct it

```
int main()
{
    vector<int> v = {2, 3, 3, 1, 5, 3};
    int x = 3;
    int n = v.size();

    for(int i = 0; i < n; ++i)
        if( v[i] == x ){
            for(int k=i; k<n-1; ++k)
                v[k] = v[k+1];
            --n;
        }
    for(int i=0; i<n; ++i)
        cout << v[i] << " ";

    return 0;
}
```

Chapter 4: Functions

Question 11.

Indicate what is printed on the screen.

```
(a)
int Algo(int y, int z){
    int m = y;
    if( m >= z/2 + 5 )
        m = z;
    return m;
}

int Thing(int a, int b){
    int m = Algo(a, b);
    return m + 4;
}

void Any(int x1){
    int x2 = 0;
    if( x1 > 10 )
        cout << x1 + 2;
    else
        cout << x1 + x2;
}

int Works(int x2){
    return x2 * x2;
}

int main(){
    int x1 = 2;
    int x2 = -3;
    Any( Thing( Works(x1), x2) );
    return 0;
}
```

(b)

```
string letter(int a){
    if(a<0)
        return "A";
    else if(a<=100){
        if(a%2==0)
            return "B";
        else if(a%3==0)
            return "C";
    }else
        return "D";
    return "E";
}

int main(){
    vector<int> v = {10,-5,17,99};
    for(size_t i=1; i<v.size(); ++i)
        cout << letter(v[i]);

    return 0;
}
```

(c)

```
int Rice(int n){
    if( n == 1 )
        return 1;
    else
        return n * Rice(n-1);
}

int main(){
    cout << Rice(4);
    return 0;
}
```

Question 12.

Indicate which of the function calls in the main function are correct (by line number).

```
1.  int Watermelon(int y, string z){ ... }
2.  string Cabbage(double a){ ... }
3.  void Parsley(int x1){ ... }
4.
5.  int main(){
6.      int x = 2, y = -3;
7.      string s = "A"
8.      int z = Watermelon(s, x);
9.      s = Cabbage(6);
10.     string msg = s + to_string( Watermelon(4, "you") )
11.     cout << Parsley(3);
12.     Cabbage(-2.5);
13.     Parsley( Watermelon( 8, Cabbage(1) ) );
14.     Parsley( Cabbage(2.5) )
15.     y = Watermelon(4);
16.     y += Watermelon(-1, "x");
17.     y = Parsley(-2);
18.     return 0;
19. }
```

Question 13.

Indicate the values of the variables a, b and c at the end of the program's execution.

```
int Change(int& y, int z){
    y += z;
    z += y;
    return abs(y-z);
}

int Square(int& a){
    return a*a;
}

void AdditiveInverse(int x){
    x *= -1;
}

int main(){
    int a = 2, b = 3;

    int c = Change(a, b);
    cout << a << " " << b << " " << c << endl;

    AdditiveInverse(a);
    AdditiveInverse(b);
    AdditiveInverse(c);
    cout << a << " " << b << " " << c << endl;

    c += Square(a) + Square(b);
    cout << a << " " << b << " " << c << endl;

    c -= Change(b, a);
    cout << a << b << c << endl;

    return 0;
}
```

Solutions

Chapter 1: Variables and Operators

1. texture, ff23, first_name, Height, _you, ShgT.

```
2. (a) int main() {  
        // I will write  
        // my code here  
        return 0;  
    }
```

```
(b) #include <iostream>  
using namespace std;  
int main() {  
    double a = 2.5;  
    string s = "Pedro Cruz";  
    int b = -5;  
    char c = 'y';  
    bool x = true;  
    return 0;  
}
```

```
(c) int main(){  
    double height;  
    height = 1.7;  
    int Age = 8;  
    return 0;  
}
```

```
(d) #include <iostream>  
using namespace std;  
int main() {  
    int children;  
    cout << "Number of children: ";  
    cin >> children;  
    return 0;  
}
```

```
(e) #include <iostream>  
using namespace std;  
int main() {  
    double height = 1.7;
```

```

    const int Age = 8;
    string nome = "Pedro Cruz";
    height = 2;
    Age = 10    //the variable Age is constant, so it cannot be changed
    Weight = 56;    //variable Weight is not declared
    return 0;
}

```

```

(f) #include <iostream>
    using namespace std;
    int main() {
        int age;
        string name;
        cout << "Age: ";
        cin >> age;
        cout << "name: ";
        cin >> name;
        cout << name << " is " << age << " years old";
        return 0;
    }

```

```

(g) int main(){
    int a = 7, b = 5, c = 2;
    bool e;
    e = !( a == 2*c ) || b >= a + c;
    return 0;
}

```

```

(h) #include <iostream>
    using namespace std;
    int main(){
        string first_Name, Surname;
        cout << "First Name: ";
        cin >> first_Name;
        cout << "Surname: ";
        cin >> Surname;
        cout << "Hello " << first_Name << " " << Surname << "\n";
        return 0;
    }

```

3. (a) $a = 2$, $b = 1$ and $c = 0$.
 (b) $e_1 = \text{true}$, $e_2 = \text{false}$, $e_3 = \text{false}$, $e_4 = \text{false}$ and $e_5 = \text{true}$.
 (c) $a = 6$, $b = 5$ and $c = 1$.
 (d) $a = 7$, $b = 4.5$, $c = 2$, $d = ?$, $e = 6$ and $f = 2$.
4. $a/b = 1$, $a/c = 1$, $a/d = 2.5$, $d/e = 0.8$, $a\%b = 2$, $a\%c = 1$, $a\%d$ is not possible, $e\%a$ is not possible.

Chapter 2: Control Structures

5. (a) 17
(b) 6
(c) 51515
(d) 00120***
(e) 25, 0, -1
(f) 28
(g) bbbbc
(h) 22
(i) $s = 20$ and $r = 2$
(j) 1 1 0
2 1 1
2 2 0
3 1 2
3 2 1
3 3 0
4
6. (a) An `if` statement cannot have two `else` branches.
(b) Infinite loop.
7. -

Chapter 3: Indexed Variables

8. $v=(0, 0, 0, 1, 2, 3)$, $u=(0, 5, 10, 1, 9, 0, 0)$, $w=(1, 6, 7)$
9. (a) `out_of_range`
(b) (2, 3, 1, 1, 5, 7)
(c) (8, 6, 5, 1)
10. It is necessary to modify the value of `i` in some cases.

Chapter 4: Functions

11. (a) 1
(b) AEC
(c) 24
12. Lines 9, 10, 13 and 16.
13. 5 3 3
5 3 3
5 3 37
5 8 32