Numeric data types and arithmetic operations

Variable. A variable is a storage location with a name. In C++ you have to specify the type of the values that can be stored.

```
type_name variable_name;
type_name variable_name = initial_value;
```

Listing 1: Variable definition

```
int cans_per_pack;
double can_volume = 0.355;
```

Listing 2: Variable example

Table 1: Numeric data types

Type	Description	Range*	Size*
int	integer ($\mathbb{Z}$)	$[-2147483648, 2147483647]$	4 bytes
unsigned	unsigned integer	$[0, 4294967295]$	4 bytes
short	short integer	$[-32768, 32767]$	2 bytes
long long	long with two times bigger capacity	$[-9223372036854775808, 9223372036854775807]$	8 bytes
double	double-precision floating-point ($\mathbb{R}$)	$\pm 10^{308}$, about 15 significant decimal digits	8 bytes
float	single-precision floating-point	$\pm 10^{38}$, about 7 significant decimal digits	4 bytes

* The values of the columns **Range** and **Size** depend on the particular platform being used.

In Listing 3 a program which calculates the total volume of six-pack of cans is given.

```
#include <iostream>

using namespace std;

int main()
{
    int cans_per_pack = 6;      // number of cans in a pack
    double can_volume = 0.355;  // liters in a can
    // calculate the content of a pack in liters
    double pack_volume = cans_per_pack * can_volume;
    cout << "The pack cotains " << pack_volume << " liters." << endl;

    return 0;
}
```

Listing 3: volume01.cpp

Exercise 1. Modify the program in Listing 3 in the following manner:

- Line 7: replace `int cans_per_pack = 6;` with `int cans_per_pack;` What is the program output? **Do not forget to initialize your variables.**
- The number of cans in a pack and the volume of a can must be provided by the user from the standard input.
- Define a variable `can_price` to contain the price of a single can. Read the value from the standard input and print out the price of the whole pack.

Constants. A constant is a named value, that cannot be changed.

```
const type_name constant_name = initial_value;
```

Listing 4: Constant definition

```
const double PI = 3.14159265;
```

Listing 5: Constant example

Compile and run the program in Listing 6 which calculates the total value of coins, given the coin quantities.

```
1  #include <iostream>
2
3  using namespace std;
4
5  int main()
6  {
7      const double PENNIES_VAL = 0.01;
8      const double NICKELS_VAL = 0.05;
9      const double DIMES_VAL = 0.10;
10     const double QUARTERS_VAL = 0.25;
11
12     cout << "How many pennies do you have? ";
13     int pennies;
14     cin >> pennies;
15
16     cout << "How many nickels do you have? ";
17     int nickels;
18     cin >> nickels;
19
20     cout << "How many dimes do you have? ";
21     int dimes;
22     cin >> dimes;
23
24     cout << "How many quarters do you have? ";
25     int quarters;
26     cin >> quarters;
```

```
27
28      double total =      // total value of coins
29          pennies * PENNIES_VAL +
30          nickels * NICKELS_VAL +
31          dimes * DIMES_VAL +
32          quarters * QUARTERS_VAL;
33
34      cout << "Total value = " << total << endl;
35
36      return 0;
37  }
```

Listing 6: coins01.cpp

Exercise 2. Modify the program in Listing 6. Instead of the variables `pennies`, `nickels`, `dimes` and `quarters`, use a single variable `count`.

Table 2: Arithmetic operations

Operation	Description
+	addition
-	subtraction
*	multiplication
/	division and integer division
%	modulus (integer division reminder)

Table 3: Compound assignment

Compound expression	Equivalent
`a += 42;`	`a = a + 42;`
`a -= 42;`	`a = a - 42;`
`a *= 42;`	`a = a * 42;`
`a /= 42;`	`a = a / 42;`
`a %= 42;`	`a = a % 42;`

Exercise 3. Write a program which displays the result of the following arithmetic operations:
`7.0 / 4.0` `7 / 4.0` `7.0 / 4` `7 / 4` `7 % 4` `7 + 4 * 2`

Problems

1. Using `#include <cmath>` before `using namespace std;` write a program that calculates $\sqrt{a}$, $a \in \mathbb{R}$, $a > 0$. More information about `cmath` can be found for example here: http://www.cplusplus.com/reference/clibrary/cmath/

2. Given the radius $r \in \mathbb{R}$, $r > 0$ of a circle, calculate is perimeter and area. More information of the geometric shape circle can be found here: http://mathworld.wolfram.com/Circle.html

3. Given the lengths of the sides $a, b, c \in \mathbb{R}_+$ of a triangle ($0 < a \leq b \leq c$ and $a + b > c$). Then the area of the triangle is given by the Heron's formula:

   $$S = \sqrt{p(p-a)(p-b)(p-c)}.$$

   Write a program which calculates a triangle area using the Heron's formula.