Math Library Functions

1. POWER

Raising a number to a power requires the use of a library function. Think of a library function as a piece of code that performs a specific operation. One of the many library functions is the <u>pow</u> function which raises a number to a power. For example,

area = pow(4.0, 2.0);

This statement contains a *call* to the pow function. The numbers inside the parentheses are *arguments*. Arguments are data being sent to the function. The pow function raises the first argument to the power of the second argument. In the example, 4 is raised to the power of 2, or 4^2 . The result is *returned* from the function and used in the statement where the function call appears. In this case, the value 16 is returned and assigned to the variable area.

To use this and all other math functions discuss below, you need to include the *cmath* library.

#include <cmath>

The math constant π is also available in the <cmath> library. It is M_PI.

2. Math Library Functions

Function	Example	Description
pow	y = pow(x, y);	Returns x ^y .
abs	y = abs(x);	Returns the absolute value of the argument.
exp	y = exp(x);	Returns the exponent of the argument.
round	y = round(x);	Returns the value of x rounded to the nearest whole number.
		If x is 2.8 then it will return 3.
sqrt	y = sqrt(x);	Returns the square root of the argument.
sin	y = sin(x);	Returns the sin of x where x is in radians.
cos	y = cos(x);	Returns the cos of x where x is in radians.

Examples:

 $cout \ll "sin(3.1415) = " \ll sin(3.1415) \ll endl;$

3. Random Numbers

This is a pseudo-random number generator. Not truly random; only statistically random.

You initialize the random number generator with a *seed*. If you use the same seed, you will always get the same sequence of numbers. (Good for debugging.)

```
#include <iostream>
#include <cstdlib> // for rand and srand
#include <ctime> // for the time function
using namespace std;
int main () {
    // get the system time to use as the seed
    unsigned int seed = time(0);
    // initialize the random number generator
    srand(seed);
    // generate and display three random numbers
    cout << rand() << endl;
    cout << rand() << endl;
    cout << rand() << endl;
    return 0;
}</pre>
```

4. **Exercises** (Problems with an asterisk are more difficult)

1. Area of a square

Ask the user to input the length for one side of a square. Calculate and print out the area of the square using that length. The equation for calculating the area of a square is

$$area = length^2$$

2. Area of a circle

Ask the user to input the radius for a circle. Calculate and print out the area of the circle using that radius. The equation for calculating the area of a circle is

area = πr^2

 π = the constant 3.1415. Use the constant M_PI defined in the cmath library,

r = the radius

3. * Compound interest formula

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

A = the total future amount

P = the starting principal amount

r = the annual interest rate

n = number of compounding periods per unit time

t = time in decimal years

is used to find the future amount (A) given the starting amount (P), annual interest rate (r), number of compounding periods (n) and number of years (t).

For example, the total future amount accrued on a starting principal of \$10,000 at a rate of 3.875% per year compounded 12 times per year over 7.5 years is \$13,366.37

$$A = 10000 \left(1 + \frac{0.03875}{12}\right)^{12(7.5)}$$
$$= 13366.37$$

Ask the user to enter the values for the four variables P, r, n and t, then calculate and print out A. Hint, you need to use the pow function.

4. * The Pythagorean Theorem

In a right triangle with sides A, B and hypotenuse C, the theorem states that

$$C = \sqrt{A^2 + B^2}$$

Ask the user to enter the length for the two sides A and B of a right angle triangle, then calculate and print out C, the length of hypotenuse (the third side). Hint, you need to use the pow and sqrt functions.

- 5. Write a program to print out 3 random numbers in the range from 0 to 7.
- 6. Write a program to print out 5 random numbers in the range from 4 to 9.

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