1. Following figure shows a right triangle with a hypotenuse of length C and angle θ. From elementary trigonometry, the length of sides A and B are given by A = C cos θ and B = C sin θ. Calculate the lengths of sides A and B given the hypotenuse C and angle θ.

θ

C

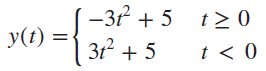
A

B

1. The potential energy of an object due to its height above the surface of the Earth is given

by the equation PE = mgh, where m is the mass of the object, g is the acceleration due to gravity, and h is the height above the surface of the Earth. The kinetic energy of a moving object is given by the equation KE = ½ mv2, where m is the mass of the object and v is the velocity of the object. Write a C++ statement for the total energy (potential plus kinetic) possessed by an object in the Earth’s gravitational field.

1. Write C++ statements required to calculate y(t) from the equation



for a user-supplied value of t.

1. Write a C++ program to convert all uppercase characters in a user-supplied character string to lowercase, without changing the uppercase and non-alphabetic characters in the string. Assume that your computer uses the ASCII collating sequence.
2. A mathematical operation between two vectors is the cross product. The cross product of two vectors V1 = Vx1 i + Vy1 j + Vz1 k and V2 = Vx2 i + Vy2 j + Vz2 k is a vector quantity defined by the equation:

V1 × V2 = (Vy1Vz2 − Vy2Vz1)i + (Vz1Vx2 − Vz2Vx1)j +(Vx1Vy2 − Vx2Vy1)k

Write a C++ program that will read two vectors V1 and V2 into arrays in computer memory, and then calculate their cross product according to the equation given above. Test your program by calculating the cross product of vectors V1 = 5i − 3j + 2k and V2 = 2i + 3j + 4k.

1. It is often useful to be able to simulate the throw of a fair die. Write a C++ function dice() that simulates the throw of a fair die by returning some random integer between 1 and 6 every time that it is called.
2. Minima and Maxima of a Function Write a subroutine that attempts to locate the maximum and minimum values of an arbitrary function f(x) over a certain range. The function being evaluated should be passed to the subroutine as a calling argument. The subroutine should have the following input arguments:

first\_value — The first value of x to search

last\_value — The last value of x to search

num\_steps — The number of steps to include in the search

func — The name of the function to search

The subroutine should have the following output arguments:

xmin — The value of x at which the minimum was found

min\_value — The minimum value of f(x) found

xmax — The value of x at which the maximum was found

max\_value — The maximum value f(x) found

1. Create a data type called “polar” to hold a complex number expressed in polar (z, θ) format as shown in Figure 12-8. The derived data type will contain two components, a magnitude z and an angle θ, with the angle expressed in degrees. Write two functions that convert an ordinary complex number into a polar number, and that convert a polar number into an ordinary complex number.
2. From elementary geometry, we know that two points uniquely determine a line as long as they are not coincident. Write a function that accepts two values of type “point”, and returns a value of type “line” containing the slope and y-intercept of the line. If the two points are identical, the function should return zeros for both the slope and the intercept.
3. Two graphical shapes can be grouped together to form new shape. The so formed new shape can be combined with other shapes to form still a new shape. This can keep going on. Develop object model such that such relationship should be possible to imitate in memory.
4. Write a program that converts infix equation to postfix equation.
5. Write a function that accepts a real input array and returns a pointer to the largest value in the array.
6. Write a function that accepts a pointer to a real input array and returns a pointer to the largest value in the array.
7. Write a version of the insertion sort program that inserts the real input values into a doubly linked list. Test the program by creating 50 random values between −1000.0 and 1000.0, and sorting them with the program. Print out the sorted values in both ascending and descending order.
8. Create an abstract class called vec, which includes instance variables x and y, and abstract methods to add and subtract two vectors. Create two subclasses, vec2d and vec3d, that implement these methods for 2D and 3D vectors, respectively. Class vec3d must also define the additional instance variable z. Write a test program to demonstrate that the proper methods are called polymorphically when vec objects are passed to the addition and subtraction methods.