

```

//
//
//
//
//
// Date: 9/1/2021
// Name: David Vermaak
//Project Description: This program takes the three sides of a triangle and calculates
various Germetric properties of the triangle, including the area, incircle radius,
circumcircle radius, and remaining area
// Inputs: The three sides of a triangle
// Outputs: Three angles (rad or deg), Area (units^2), and radius (units)
//*****

#include <iostream>          //This header containing cout and cin
#include <conio.h>           //This header declares getch which pauses until a key is pushed
#include <math.h>            //This header allows for the use of more complex mathematical
operators
#include <string>            //This header enables string functions

using namespace std; //introduces namespace std

int main ( )
{
// initializes the variables of the sides and angles of the triangle
double side_A, side_B, side_C, angle_A, angle_B, angle_C;

// initializes the variables of the Area, incircle radius, circumcircle radius, and remaining
area
double Area, AreaIR, AreaOR, InRadius, OutRadius, rArea, s;

const float pi = acos(-1.0); // sets up a constant for the value of pi

int choice; //initializes a variable for the menu

char angle; //initializes a character used to choose radian or degree output
string Angle = " radians ";

string units; //initializes a string used to choose the units for the output

// prompts user for input
cout << "This program takes the three sides of a triangle and calculates various Germetric
properties"
<< "\n\nPlease enter the units yor side lengths are in, eg. meters\n";
cin >> units;
units = " " + units; //adds a space before the string for better legibility

cout << "Please enter the three side lengths of your triangle :\n\n";

cout <<"          C \n"; //provides the user with a visual of the triangle
cout <<"      / \ \ \n"; //this helps with understanding where the angles and
cout <<"      / \ \ \n"; //sides are in relation to each other
cout <<"    a/      \ \b \n";
cout <<"      /      \ \ \n";
cout <<"    /      \ \ \n";
cout <<"  /_____ \ \ \n";
cout <<" B      c      A \n\n\n";

cout << "side a: ";
cin >> side_A;
cout << "\n side b: ";
cin >> side_B;
cout << "\n side c: ";
cin >> side_C;

//this statement checks if the values are within acceptable parameters

```

```

if (side_A < 0 || side_B < 0 || side_C < 0 )
{ cout << "\n Error.\n A negative value for any of the triangles sides is not allowed.\n
Program terminated.";

return 1; }

else if (side_A > (side_B + side_C) || side_B > (side_A + side_C) || side_C > (side_B +
side_A) )
{ cout << "\n Error.\n One of the sides of the triangle exceeds parameters.\n Program
terminated.";

return 1; }

else

    //calculates the angles by law of sines
    angle_A = acos((pow(side_B, 2) + pow(side_C, 2) - pow(side_A, 2))/(2 * side_B *
side_C));
    angle_B = acos((pow(side_A, 2) + pow(side_C, 2) - pow(side_B, 2))/(2 * side_A *
side_C));

    //pi is the total number of radians in a triangle so c = total-(a+b)
    angle_C = (pi)-(angle_A + angle_B);

    //initial calculations of the area using s, the semi-perimeter (Heron's Formula)
    s = 0.5*(side_A + side_B + side_C);
    Area = sqrt(s*(s-side_A)*(s-side_B)*(s-side_C));

do    //creates a loop for the menu that returns the user here after each switch choice
{
    // display menu
    cout << "\n\nPlease choose one of the following options to continue: (1,2,3,4)\n";
    cout << "(1): Find the 3 angles of the triangle, and the triangle area \n";
    cout << "(2): Find the largest incircle radius, and the remaining interior area of
the triangle \n";
    cout << "(3): Find the circumcircle radius, and the remaining interior area of the
circumcircle \n";
    cout << "(4): Quit \n\n";
    cout << "Enter your choice :";

    //get user input for use in the switch choice
    cin >> choice;
    cout << "\n";

    switch(choice) //easy way to set up a menu where it jumps to the correct line
    //depending on the value of choice the user inputs
    {

        case 1:

            cout << "Would you like the angles displayed in radians (r) or degrees
(d)?\n (r or d): \n\n";
            cin >> angle;

            if (angle == 'd') //if user wants degrees will convert radians
to degrees
            {
                angle_A = angle_A * ( 180/ pi);
                angle_B = angle_B * ( 180/ pi);
                angle_C = angle_C * ( 180/ pi);
                Angle = " degrees ";
            }

```

```

//visual so the user can better understand the other outputs
cout <<"          C \n";
cout <<"        /  \\ \n";
cout <<"       /    \\ \n";
cout <<"      a/      \\b \n";
cout <<"     /        \\ \n";
cout <<"    /          \\ \n";
cout <<"   /-----\\ \n";
cout <<"  B         c         A \n\n\n";

```

```

cout << "The three angles are A = " << angle_A << Angle
<< " B = " << angle_B << Angle
<< " and C = " << angle_C << Angle
<< "\nThe area of the triangle is: " << Area << units << " squared"
<< " \n \n To return to the menu press enter";

```

```

getch();          //pauses until a key is pressed
system("cls");    //clears the console screen
break;           //goes to the end of the switch statment

```

```

case 2:
    cout << " Finding the largest incircle radius, and the remaining interior
area of the triangle\n";

```

```

InRadius = ((2 * Area)/(side_A + side_B + side_C));
AreaIR = pi * (pow(InRadius, 2));
rArea = Area - AreaIR;

```

```

//visual so the user can better understand the other outputs
cout <<"          C \n";
cout <<"        /  \\ \n";
cout <<"       /    \\ \n";
cout <<"      a/      \\b \n";
cout <<"     /        \\ \n";
cout <<"    /          \\ \n";
cout <<"   /-----\\ \n";
cout <<"  B         c         A \n\n\n";

```

```

cout << "The largest incircle radius is: " << InRadius << units
<< " \nand the remaining interior area of the triangle = " << rArea <<
units << " squared"
<< " \n \n To return to the menu press enter";

```

```

getch();
system("cls");
break;

```

```

case 3:

```

```

OutRadius = sqrt((side_A * side_B * side_C)/((side_A + side_B + side_C) *
(side_B + side_C - side_A)
* (side_C + side_A - side_B) * (side_A + side_B - side_C)));
AreaOR = pi * (pow(OutRadius, 2));
rArea = Area - AreaOR;

```

```

//visual so the user can better understand the other outputs
cout <<"          . ^ C . \n";
cout <<"          . ^ C . \n";

```

```

cout <<"          /\|\\          \n";
cout <<"      .  /  |  \\  .  \n";
cout <<"      a/    |    \\b  \n";
cout <<"      .  |    \\  .  \n";
cout <<"      *R2    \n";
cout <<"      .  |    \\  .  \n";
cout <<"      .  /  |  \\  .  \n";
cout <<"      B  --- c  A  \n";
cout <<"      .      .  \n";
cout <<"      .      \n";
cout <<"      \n";
cout <<"\n\n The circumcircle radius is: " << OutRadius
<<"\nand the remaining interior area of the circumcircle = "
<< rArea << units <<" squared"
<<"\n\n To return to the menu press enter";

    getch();
    system("cls");
    break;

```

```

        default:    //catch-all case that ends the program if any number other than (1,2,3)
is entered
        cout <<"Program has ended\n";

        return 0;

    }

}

while(choice != 1 || 2 || 3);    //keeps the loop going while conditions are right

return 0;
}

```