Assignment 2

GNG1106 Fall 2016

Stella Odagwe

October 2nd, 2016

Question 1
A).

Working memory

logicVar	~~?~~ ~~1~~ ~~0~~ 1
X	~~?~~ 1.200000
Y	~~?~~ 10.500000

A).

Working memory

main()		fxy (double, double)	
resistor1	~~?~~ 1.500000	r1	1.500000
resistor2	~~?~~ 3.200000	r2	3.200000
resistor3	~~?~~ 4.700000	r3	4.700000
netResistance	~~?~~ 0.838974	netResistance	~~? 0.666667~~ ~~0.979167~~ ~~1.191933~~ 0.838974

Question 2

Develop a program that gets from the user, the initial velocity of the missile and the desired altitude and displays the range of departure angles $\phi 0$ in degrees [degrees = radians(180/π)] to

$$\phi_0 = \arcsin\left((1+\alpha)\sqrt{1-\frac{\alpha}{1+\alpha}\left(\frac{v_e}{v_0}\right)^2}\right)$$

reach the desired altitude +/- 2%. The formula used is;
The code was written as per required in the assignment sheet.
The source code for the program is shown below;

```
//Develop a program that gets from the user, the initial
velocity of the missile and the desired altitude and displays
the range of departure angles ϕ0 in degrees [degrees =
radians(180/π)] to reach the desired altitude +/- 2%.

#include <stdio.h>
#include <math.h>
#define R 6371                          // defines the value for R
globally
#define Escape_Velocity 11.2            // defines the value for the
escape velocity globally
#define PI 3.141592654                  // defines the value for PI
globally

struct Global                           //Defines structure with
structTypeName Global
{
    double min, max;                    //Declares structure members
min and max
};



struct Global Angle(double Altitude, double Initial_Velocity)
//Defines structure type (Function Angle)
{
    struct Global Departure_Angle, Alpha;
//Declares variables to store calculation values in

    Alpha.min = (Altitude - (0.02 * Altitude))/R;           //An
altitude range implies an Alpha range because Altitude =
Alpha*R. Here a value is assigned to the minimum value of Alpha
```

```
    Alpha.max = (Altitude + (0.02 * Altitude))/R;           //
Here a value is assigned to the maximum value of Alpha

    //minimum departure angle is calculated using maximum
Atltitude hence max Alpha
    Departure_Angle.min = (Escape_Velocity/Initial_Velocity) *
(Escape_Velocity/Initial_Velocity);
    Departure_Angle.min = (Alpha.max/(1+Alpha.max)) *
Departure_Angle.min;
    Departure_Angle.min = sqrt(1-Departure_Angle.min);
    Departure_Angle.min =
asin((1+Alpha.max)*Departure_Angle.min);
    Departure_Angle.min = (180/PI)*Departure_Angle.min;

    //maximum departure angle is calculated using minimum
Atltitude hence min Alpha
    Departure_Angle.max = (Escape_Velocity/Initial_Velocity) *
(Escape_Velocity/Initial_Velocity);
    Departure_Angle.max = (Alpha.min/(1+Alpha.min)) *
Departure_Angle.max;
    Departure_Angle.max = sqrt(1-Departure_Angle.max);
    Departure_Angle.max =
asin((1+Alpha.min)*Departure_Angle.max);
    Departure_Angle.max = (180/PI)*Departure_Angle.max;


    return Departure_Angle; //Returns Departure angles to main
}

int main()
{
    double Initial_Velocity, Altitude;  //Variables are declared
in main()
    struct Global Departure_Angle;

    printf("Please enter the initial velocity of the missile in
km/s: ");   //Initial Velocity is requested from User
    scanf("%lf", &Initial_Velocity);        //Value is assigned
to Initial_Velocity

    printf("Please enter the desired altitude of the missile in
Kilometers: ");//Altitude is requested from User
    scanf("%lf", &Altitude);                //Value is assigned
to Altitude
```

```
    Departure_Angle = Angle(Altitude,
Initial_Velocity);        //Calls on function (struct) Angle to
calculate min and max Departure angles

    //Min and Max values are printed to user
    printf("For initial velocity %.02lf km/s and desired
altitude %.02lf km +/- 2%% the departure angle must be between
%.03lf and %.03lf", Initial_Velocity, Altitude,
Departure_Angle.min, Departure_Angle.max);

    return 0;
}
```

As expected, the program calculates correctly the range of values for Alpha with the parameters (Altitude and Initial Velocity) provided in the assignment sheet. The table below shows the parameters and their output for each test scenario;

Test Scenario	Desired Altitude (km)	Initial Velocity v0 (km/s)	Min range (degrees)	Max range (degrees)
1	1000	5.5	49.351	50.495
2	2100	6.5	42.225	43.942
3	3800	7.5	39.510	41.858
4	5200	8.4	53.485	55.558

Table 1. Test Scenario results

Also, the output showing the results of all the test cases in the table above are shown below;

```
Please enter the initial velocity of the missile in
km/s: 5.5
Please enter the desired altitude of the missile in
Kilometers: 1000
For initial velocity 5.50 km/s and desired altitude
1000.00 km +/- 2% the departure angle must be
between 49.351 and 50.495
```

Figure 1. Output for test scenario 1

```
Please enter the initial velocity of the missile in
km/s: 6.5
Please enter the desired altitude of the missile in
Kilometers: 2100
For initial velocity 6.50 km/s and desired altitude
2100.00 km +/- 2% the departure angle must be
between 42.225 and 43.942
```

Figure 2. Output for test scenario 2

```
Please enter the initial velocity of the missile in
km/s: 7.5
Please enter the desired altitude of the missile in
Kilometers: 3800
For initial velocity 7.50 km/s and desired altitude
3800.00 km +/- 2% the departure angle must be
between 39.510 and 41.858
```

Figure 3. Output for test scenario 3

```
Please enter the initial velocity of the missile in
km/s: 8.4
Please enter the desired altitude of the missile in
Kilometers: 5200
For initial velocity 8.40 km/s and desired altitude
5200.00 km +/- 2% the departure angle must be
between 53.485 and 55.558
```

Figure 4. Output for test scenario 4