ME 1020 Engineering Programming with MATLAB

Problem 4.42:

42. The height and speed of a projectile (such as a thrown ball) launched with a speed of v_0 at an angle A to the horizontal are given by

$$h(t) = v_0 t \sin A - 0.5gt^2$$
$$v(t) = \sqrt{v_0^2 - 2v_0 gt \sin A + g^2 t^2}$$

where g is the acceleration due to gravity. The projectile will strike the ground when $h(t) = 0$, which gives the time to hit $t_{hit} = 2(v_0/g) \sin A$.

Use the `switch` structure to write a MATLAB program to compute the maximum height reached by the projectile, the total horizontal distance traveled, or the time to hit. The program should accept as input the user's choice of which quantity to compute and the values of v_0, A, and g. Test the program for the case where $v_0 = 40$ m/s, $A = 30^0$, and $g = 9.81$ m/s^2.

```
% Problem 4.42
clear
clc
disp('Problem 4.42: Scott Thomas')

disp('Friction Force Computer')
v0 = input('Input Initial Velocity (m/s): ');
A = input('Input Angle to Horizontal (degrees): ');
g = input('Input Acceleration due to Gravity (m/s^2): ');

disp('To Determine Maximum Height, Type 1')
disp('To Determine Horizontal Distance Traveled, Type 2')
disp('To Determine Time to Hit, Type 3')

timehit = 2*v0/g*sin(pi*A/180);
time = linspace(0,timehit,100);
height = v0*time.*sin(pi*A/180) - 0.5*g*time.^2;
heightmax = max(height);
distance = v0^2/g*sin(2*pi*A/180);

 quantity = input('Input Desired Quantity: ');
 switch quantity
     case 1
         disp('Maximum Height (m)')
         heightmax
     case 2
         disp('Horizontal Distance Traveled (m)')
         distance
     case 3
         disp('Time to Hit (s)')
         timehit
     otherwise
         disp('Incorrect Response')
 end

```

```
Problem 4.42: Scott Thomas
Friction Force Computer
Input Initial Velocity (m/s): 40
Input Angle to Horizontal (degrees): 30
Input Acceleration due to Gravity (m/s^2): 9.81
To Determine Maximum Height, Type 1
To Determine Horizontal Distance Traveled, Type 2
To Determine Time to Hit, Type 3
Input Desired Quantity: 1
Maximum Height (m)

heightmax =

   20.3853

fx >>
```

```
Problem 4.42: Scott Thomas
Friction Force Computer
Input Initial Velocity (m/s): 40
Input Angle to Horizontal (degrees): 30
Input Acceleration due to Gravity (m/s^2): 9.81
To Determine Maximum Height, Type 1
To Determine Horizontal Distance Traveled, Type 2
To Determine Time to Hit, Type 3
Input Desired Quantity: 2
Horizontal Distance Traveled (m)

distance =

  141.2478

fx >>
```

```
Problem 4.42: Scott Thomas
Friction Force Computer
Input Initial Velocity (m/s): 40
Input Angle to Horizontal (degrees): 30
Input Acceleration due to Gravity (m/s^2): 9.81
To Determine Maximum Height, Type 1
To Determine Horizontal Distance Traveled, Type 2
To Determine Time to Hit, Type 3
Input Desired Quantity: 3
Time to Hit (s)

timehit =

    4.0775

fx >>
```

```
Problem 4.42: Scott Thomas
Friction Force Computer
Input Initial Velocity (m/s): 40
Input Angle to Horizontal (degrees): 30
Input Acceleration due to Gravity (m/s^2): 9.81
To Determine Maximum Height, Type 1
To Determine Horizontal Distance Traveled, Type 2
To Determine Time to Hit, Type 3
Input Desired Quantity: 4
Incorrect Response
>>
```