Introduction To Engineering – Tutorial - 05

#	Student ID	Student Name	Grade (10)
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Q1

The monthly saving P that has to be deposit in a saving account that pays an annual interest rate of r in order to save a total amount of F in N years can be calculated by the formula:

$$P = \frac{F(r/12)}{(1+r/12)^{12N}-1}$$

Calculate the monthly saving that has to be deposit in order to save \$100,000 in 5, 6, 7, 8, 9, and 10 years if the annual interest rate is 4.35%. Display the results in a two-column table where the first column is the number of years and the second column is the monthly deposit.

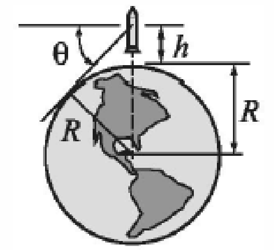
Sol 1

```
>> clear, clc
format bank
F=100000; r=4.35; years=5:10;
%convert percent to decimal
r=r/100;
monthly_deposit=F*(r/12)./((1+r/12).^(12*years)-1);
tbl=[years' monthly_deposit'];
disp(' Monthly')
disp(' Years Deposit')
disp(tbl)
```

```
 Monthly
Years Deposit
          5.00        1494.99
          6.00        1218.02
          7.00        1020.55
          8.00         872.78
          9.00         758.13
         10.00         666.67

>>
```

Q2

A rocket flying straight up measures the angle θ with the horizon at different heights *h*. Write a MATLAB program in a script file that calculates the radius of the earth *R* (assuming the earth is a perfect sphere) at each data point and then determines the average of all the values.



h (km)	4	8	12	16	20	24	28	32	36	40
θ (deg)	2.0	2.9	3.5	4.1	4.5	5.0	5.4	5.7	6.1	6.4

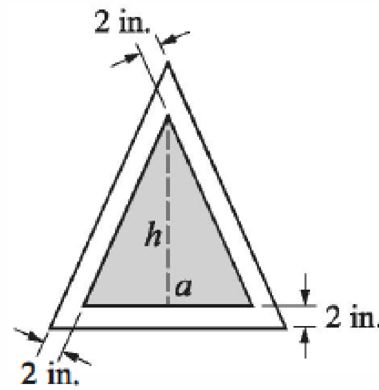
Sol 2

```
>> clear, clc
format short g
h=4:4:40; theta=[2 2.9 3.5 4.1 4.5 5 5.4 5.7 6.1 6.4];
R=h.*cosd(theta)./(1-cosd(theta));
average=mean(R);
disp('The average estimated radius of the earth in km is:')
disp(average)
```

```
The average estimated radius of the earth in km is:
         6363.1

>>
```

Q3

An isosceles triangle sign is designed to have a triangular printed area of 600 in.^{2} (shaded area with a base length of a and height of h in the figure). As shown in the figure, there is a 2 in. gap between the sides of the triangles. Write a MATLAB program that determine the dimensions a and h such that the overall area of the sign will be as small as possible. In the program define a vector a with values ranging from 10 to 120 with increments of 0.1. Use this vector for calculating the corresponding values of h and the overall area of the sign. Then use MATLAB's built-in function `min` to find the dimensions of the smallest sign.



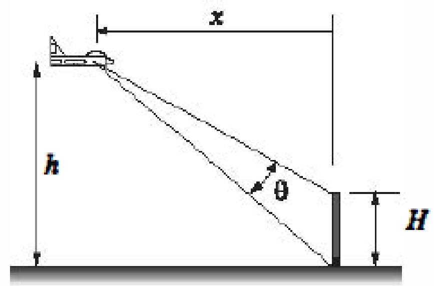
Sol 3

```
>> clear, clc
a=10:.1:120;
h=2*600./a;
theta=atan(a./(2*h));
height=h+2+2./sin(theta);
base=2*height.*tan(theta);
[min_area indx] = min(0.5*base.*height);
inner_base=a(indx)
inner_height=h(indx)
outer_base=base(indx)
outer_height=height(indx)
```

```
inner_base =

     37.2

inner_height =

   32.258

outer_base =

   44.124

outer_height =

   38.262

>>
```

Q4

An airplane is flying at a height of h = 900 ft while watching a target that is 70 ft tall (H = 70 ft), as shown in the figure. The best view of the target is when θ is maximum. Write a MATLAB program that determines the distance x at which θ is maximum. Define a vector x with elements ranging from 50 to 1500 with spacing of 0.5. Use this vector to calculate the corresponding values of θ. Then use MATLAB's built-in function `max` to find the value of x that corresponds to the largest value of θ.



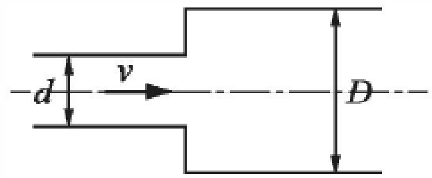
Sol 4

```
>> clear, clc
H=70; h=900;
x=50:.5:1500;
theta=atan(h./x)-atan((h-H)./x);
[max_th indx]=max(theta);
disp('The best target view occurs at a distance in feet of')
disp(x(indx))
```

```
The best target view occurs at a distance in feet of
      864.5

>>
```

Q5

The pressure drop Δp in Pa for a fluid flowing in a pipe with a sudden increase in diameter is given by:



$$\Delta p = \frac{1}{2}\left[1-\left(\frac{d}{D}\right)^2\right]^2 \rho v^2$$

where ρ is the density of the fluid, v, the velocity of the flow, and d and D are defined in the figure. Write a program in a script file that calculates the pressure drop Δp. When the script file is executed it request the user to input the density in kg/m^3, the velocity in m/s, and values of the non-dimensional ratio d/D as a vector. The program displays the inputted values of ρ and v followed by a table with the values of d/D in the first column and the corre-

Sol 5

```
>> clear, clc
rho=input('Please input the fluid density in kg/m^3: ');
v=input('Please input the fluid velocity in m/s: ');
d_ratio=input('Please input the pipe diameter ratio as a vector [x x x]: ');
delP=0.5*(1-d_ratio.^2).^2*rho*v^2;
fprintf('\nFor gasoline with a density of %.0f kg/m^3 and a flow ',rho)
fprintf('velocity of %.1f m/s\n\n',v)
tbl=[d_ratio;delP];
disp(' delta P')
disp(' d/D (Pa)')
fprintf(' %3.1f %6.1f\n',tbl)
```

```
Please input the fluid density in kg/m^3: 737
Please input the fluid velocity in m/s: 5
Please input the pipe diameter ratio as a vector [x x x]: [.9:-.1:.4 .2]
```

```
For gasoline with a density of 737 kg/m^3 and a flow velocity of 5.0 m/s

 delta P
 d/D (Pa)
 0.9  332.6
 0.8 1193.9
 0.7 2396.2
 0.6 3773.4
 0.5 5182.0
 0.4 6500.3
 0.2 8490.2
>>
```