NAME: ABBEY FLOURISH OBARI-AKASE

MATRIC NUMBER: 16/ENG04/001

DEPARTMENT: ELECTRICAL/ELECTRONICS ENGINEERING

COURSE: ENG382 ASSIGNMENT 1

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A flat plate of mass m falling freely in air with velocity V is subjected to downward gravitional force and an upward frictional drag force due to air. If the drag force, F_D, is given by Equation (1)

$$F_D = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v \quad \text{------ (1)}$$

and the terminal velocity is reached when the drag force equals the gravitational force, that is,

$$F_D = mg \quad \text{------ (2)}$$

taking the values of m and g to 3.5kg and $9.8\ m/s^2$ respectively, using a guess value of $V_0 = 0.5\ m/s$, and employing fixed-point iteration method, develop a MATLAB program to estimate the terminal velocity. Take the absolute percentage relative error tolerance to be less than or equal to 1E-11

SOLUTION

$$F_D = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v$$

$F_D = mg$.

∀ Terminal Velocity is reached when the drag force = gravitational force

$m = 3.5$, $g = 9.8\ m/s^2$

$\Longrightarrow F_D = mg = 3.5 \times 9.8 = 34.3$

Equating F_D in equation (1) and (2)

$$F_D = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v = 34.3$$

$$F_D = \frac{0.3v^2}{500 + (\ln v)^3} = 34.3 + 0.02v$$

$$\frac{0.3V^2}{500 + (\ln V)^3} = 34.3 + 0.02V$$

$$0.3V^2 = (34.3 + 0.02V)(500 + (\ln V)^3)$$

making V^2 subject of gomula;

$$V^2 = \frac{(34.3 + 0.02v)(500 + (\ln v)^3)}{0.3}$$

$$V_{ith} = \sqrt{\frac{(34.3 + 0.02v)(500 + (\ln v)^3)}{0.3}}$$

$V = 0.5$

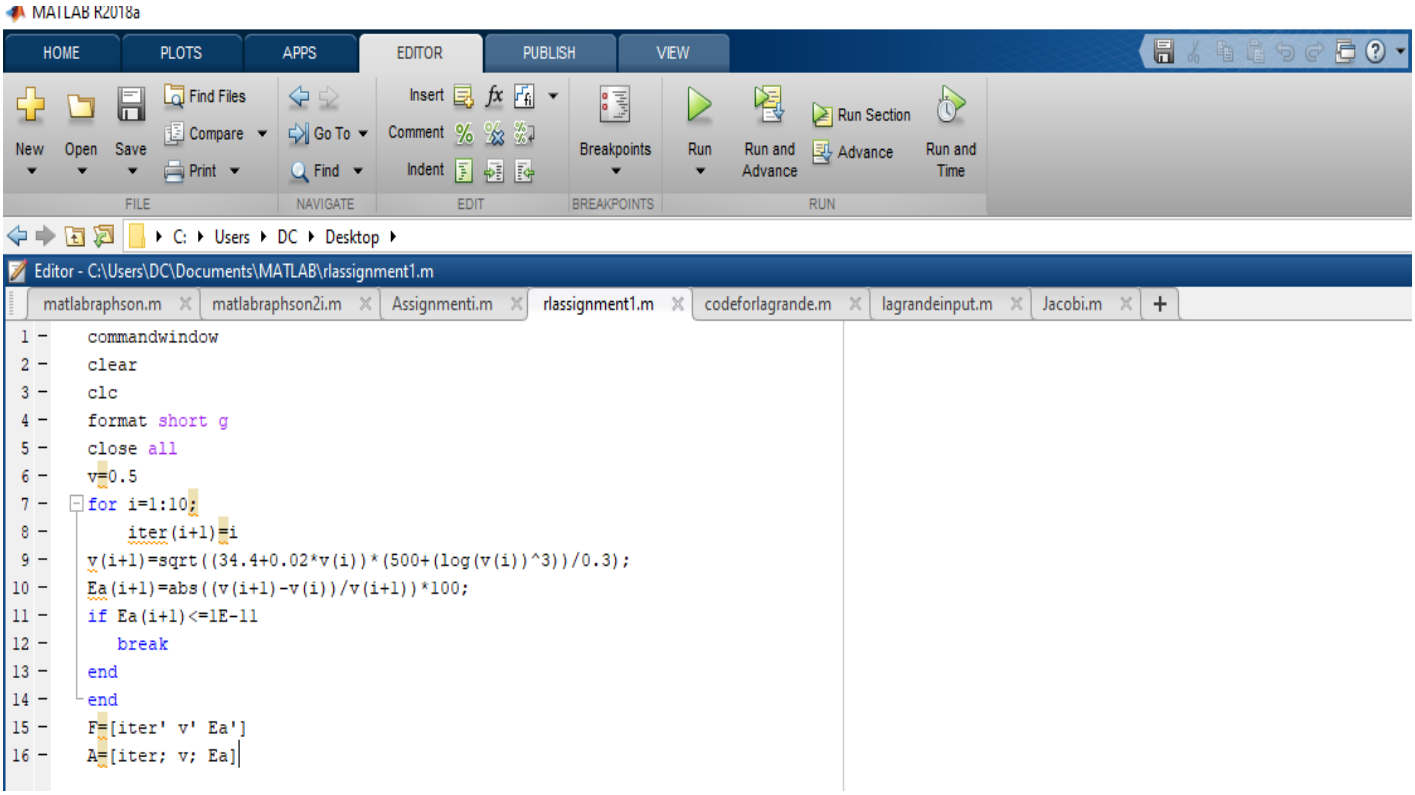
$$V_{ith} = \sqrt{\frac{[34.3 + 0.02(0.5)][500 + (\ln(0.5))^3]}{0.3}}$$

~~$= 239.0507$~~

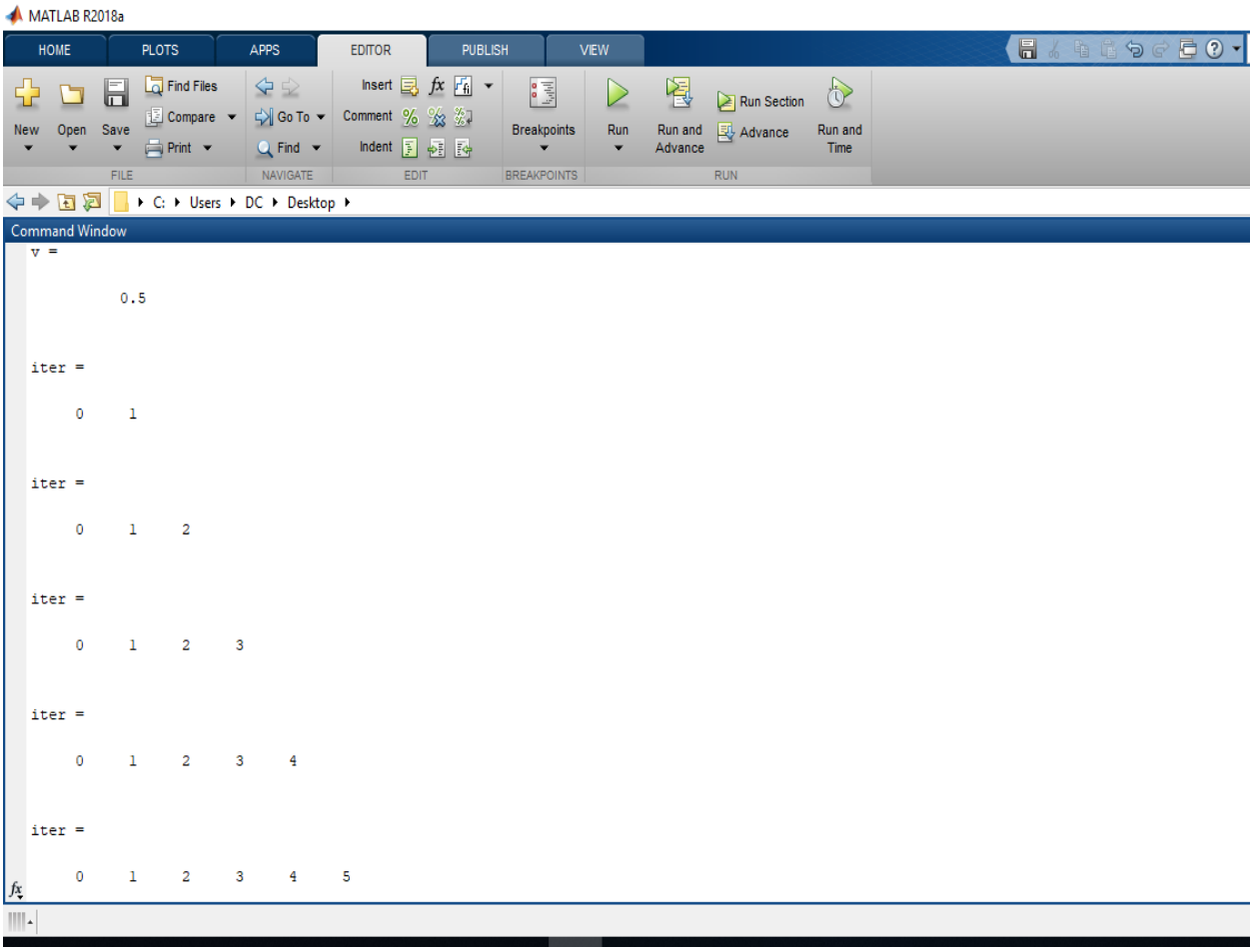
$= 304.0675323 \text{ m/s}$

MATLAB CODE AND RESULT

CODE:



RESULT: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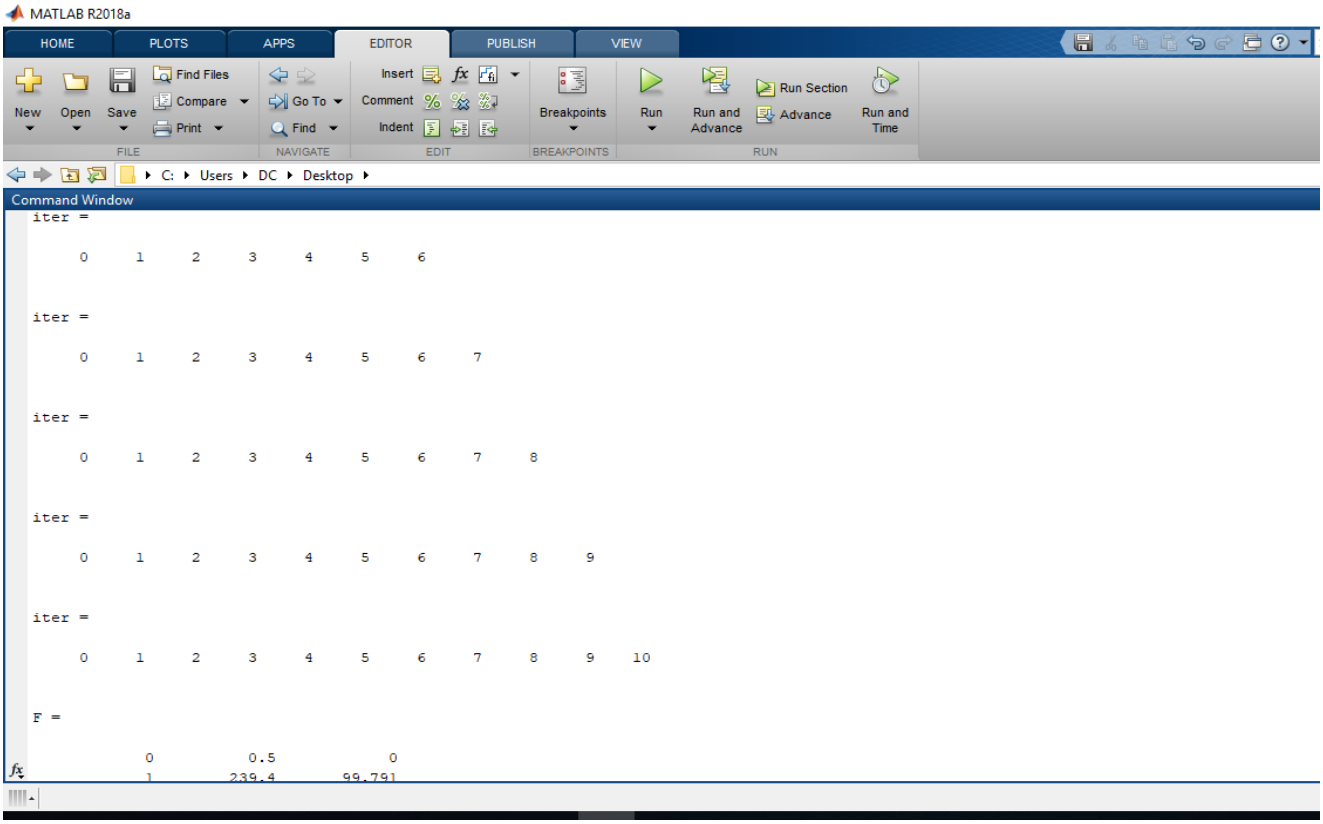
Run and Advance
Run Section
Advance
Run and Time
FILE
NAVIGATE
EDIT
BREAKPOINTS
RUN
C: ▸ Users ▸ DC ▸ Desktop ▸
Command Window
v =
0.5
iter =
0 1
iter =
0 1 2
iter =
0 1 2 3
iter =
0 1 2 3 4
iter =
0 1 2 3 4 5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Advance
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FILE
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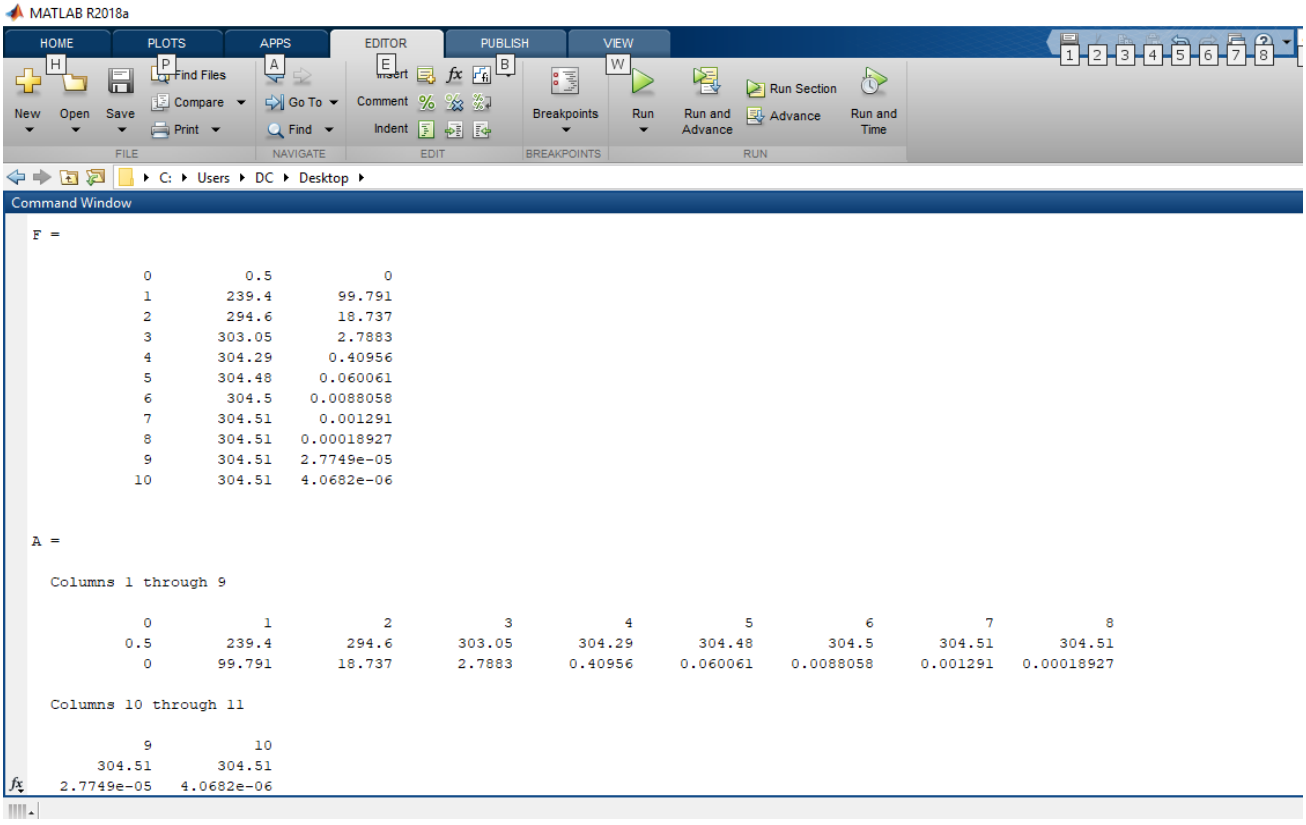
C: ▸ Users ▸ DC ▸ Desktop ▸
Command Window
iter =
0 1 2 3 4 5 6
iter =
0 1 2 3 4 5 6 7
iter =
0 1 2 3 4 5 6 7 8
iter =
0 1 2 3 4 5 6 7 8 9
iter =
0 1 2 3 4 5 6 7 8 9 10
F =
0 0.5 0
1 239.4 99.791


MATLAB R2018a
HOME
PLOTS
APPS
EDITOR
PUBLISH
VIEW
C: ▸ Users ▸ DC ▸ Desktop ▸
Command Window
F =
0 0.5 0
1 239.4 99.791
2 294.6 18.737
3 303.05 2.7883
4 304.29 0.40956
5 304.48 0.060061
6 304.5 0.0088058
7 304.51 0.001291
8 304.51 0.00018927
9 304.51 2.7749e-05
10 304.51 4.0682e-06
A =
Columns 1 through 9
0 1 2 3 4 5 6 7 8
0.5 239.4 294.6 303.05 304.29 304.48 304.5 304.51 304.51
0 99.791 18.737 2.7883 0.40956 0.060061 0.0088058 0.001291 0.00018927
Columns 10 through 11
9 10
304.51 304.51
2.7749e-05 4.0682e-06

```
commandwindow
clear
clc
format short g
close all
v=0.5
for i=1:10;
    iter(i+1)=i
v(i+1)=sqrt((34.4+0.02*v(i))*(500+(log(v(i))^3))/0.3);
Ea(i+1)=abs((v(i+1)-v(i))/v(i+1))*100;
if Ea(i+1)<=1E-11
   break
end
end
F=[iter' v' Ea']
A=[iter; v; Ea]
```

RESULT

v =

0.5

iter =

0 1

iter =

0 1 2

iter =

0 1 2 3

iter =

0 1 2 3 4

iter =

0 1 2 3 4 5

iter =

0 1 2 3 4 5 6

iter =

0 1 2 3 4 5 6 7

iter =

0 1 2 3 4 5 6 7 8

iter =

0 1 2 3 4 5 6 7 8 9

iter =

0 1 2 3 4 5 6 7 8 9 10

F =

0	0.5	0
1	239.4	99.791
2	294.6	18.737
3	303.05	2.7883
4	304.29	0.40956
5	304.48	0.060061
6	304.5	0.0088058
7	304.51	0.001291
8	304.51	0.00018927
9	304.51	2.7749e-05
10	304.51	4.0682e-06

A =

Columns 1 through 9

0	1	2	3	4	5	6	7	8
0.5	239.4	294.6	303.05	304.29	304.48	304.5	304.51	304.51
0	99.791	18.737	2.7883	0.40956	0.060061	0.0088058	0.001291	0.00018927

Columns 10 through 11

9	10
304.51	304.51
2.7749e-05	4.0682e-06