QUESTION 1 [20 Marks]

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

$F_D = \frac{0.3V^2}{500+(lnV)^3} - 0.02V$ …….(1)

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

$F_D = mg$ …… (2)

taking the values of m and g to be 3.5 kg and 9.8 m/s2 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

Using fixed-Point iteration Method:

since equation (1) = equation (2) = F_D

Hence, $F_D = mg = \frac{0.3V^2}{500+(lnV)^3} - 0.02V$

m = 3.5 kg and g=9.8 m/s2

Hence, $F_D = mg = 3.5 \text{ X } 9.8 = 34.3$

Therefore,

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

making $F_D = 0$

$\frac{0.3V^2}{500+(lnV)^3} - 0.02V - 34.3 = 0$

Making V as subject of formula

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

$(0.02V + 34.3) \text{ X } (500 + (lnV)^3) = 0.3V^2$

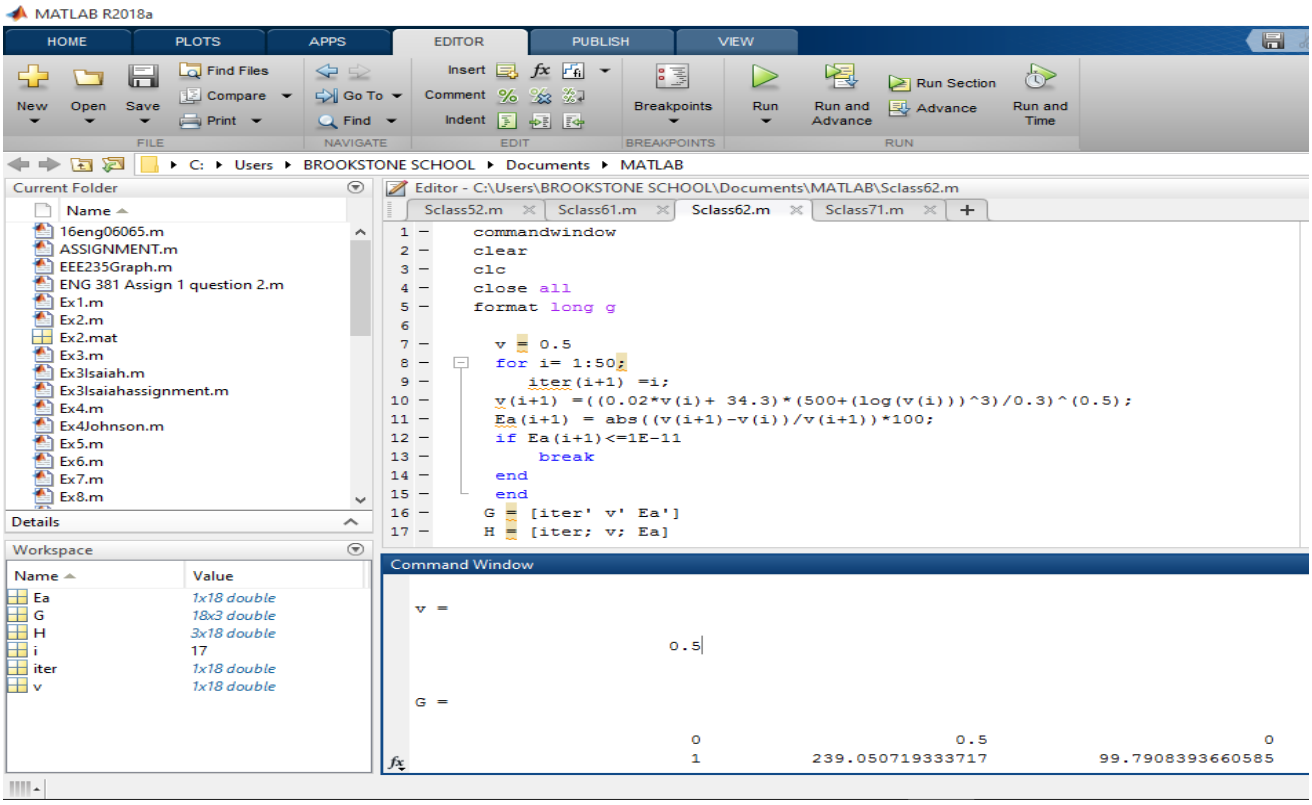
$((0.02V + 34.3) \text{ X } (500 + (lnV)^3))/0.3 = V^2$

V = (((0.02V +34.3) X ($500 + (lnV)^3$))/0.3)^(0.5)

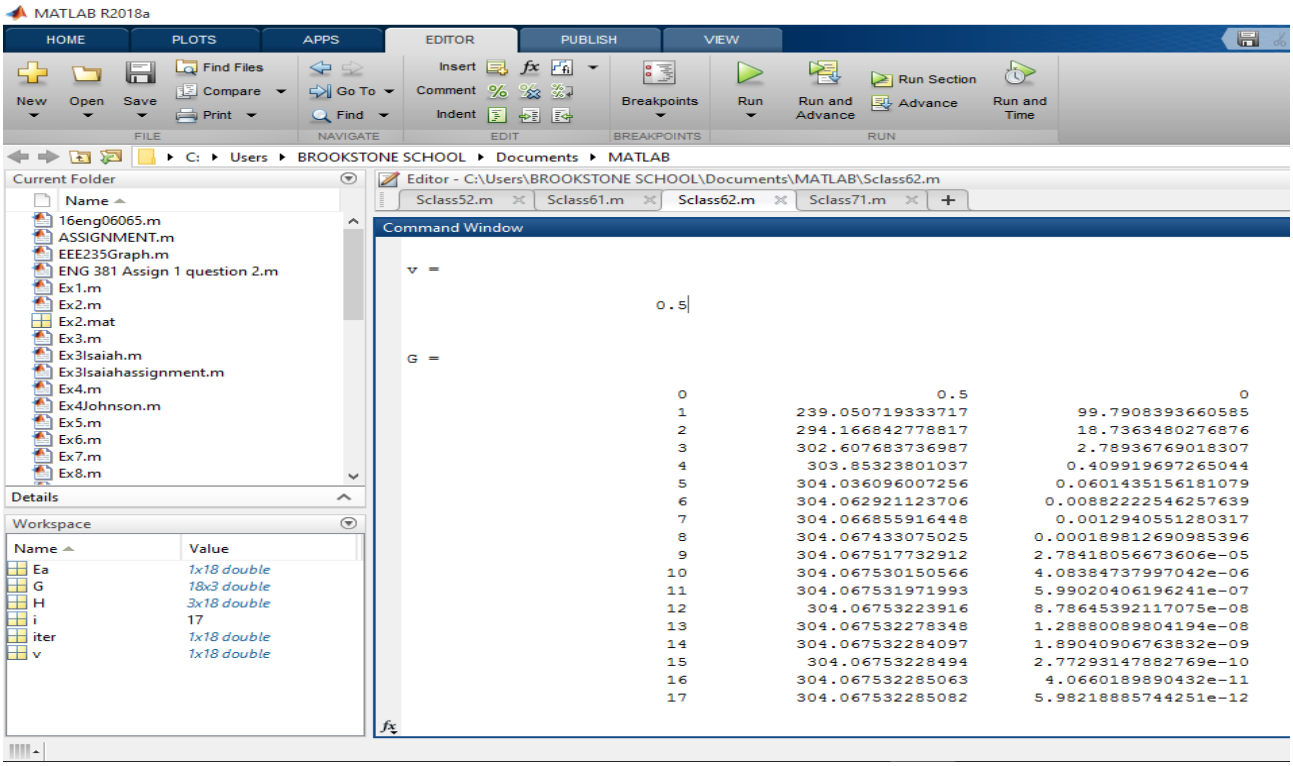
Vi+1 = (((0.02Vi +34.3) X ($500 + (lnVi)^3$))/0.3)^(0.5)

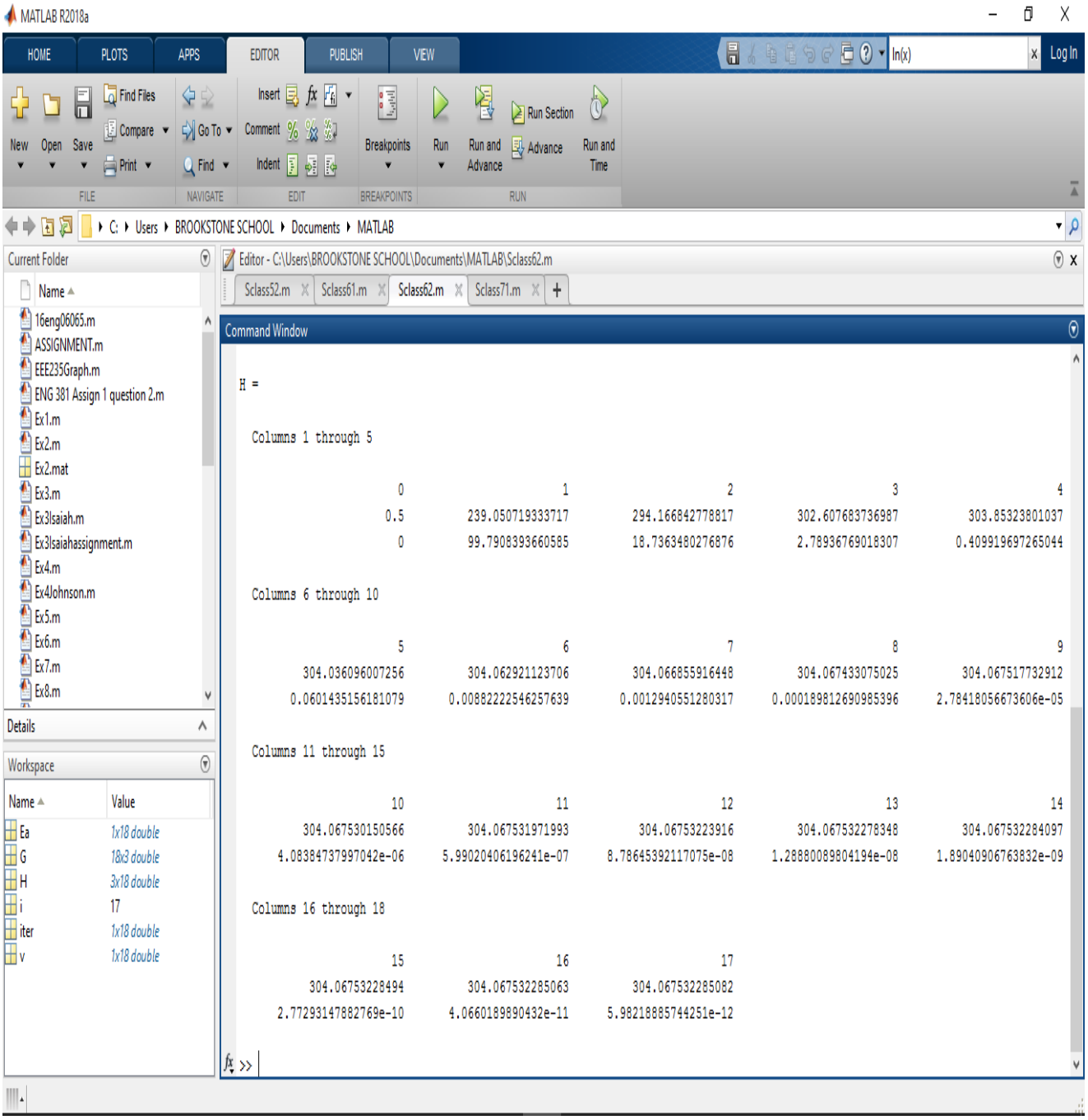
Ans = V = 304.0675323m/s

Codes for the Fixed-Point Iteration using MATLAB



RESULT OF THE CODE




MATLAB R2018a
HOME
PLOTS
APPS
EDITOR
PUBLISH
VIEW
ln(x)
Log In
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Find Files
Compare
Print
Go To
Find
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Comment
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Breakpoints
Run
Run and Advance
Run Section
Advance
Run and Time
FILE
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C: ▸ Users ▸ BROOKSTONE SCHOOL ▸ Documents ▸ MATLAB
Current Folder
Name
16eng06065.m
ASSIGNMENT.m
EEE235Graph.m
ENG 381 Assign 1 question 2.m
Ex1.m
Ex2.m
Ex2.mat
Ex3.m
Ex3Isaiah.m
Ex3Isaiahassignment.m
Ex4.m
Ex4Johnson.m
Ex5.m
Ex6.m
Ex7.m
Ex8.m
Details
Workspace
Name
Value
Ea 1x18 double
G 18x3 double
H 3x18 double
i 17
iter 1x18 double
v 1x18 double
Editor - C:\Users\BROOKSTONE SCHOOL\Documents\MATLAB\Sclass62.m
Sclass52.m
Sclass61.m
Sclass62.m
Sclass71.m
Command Window
H =
Columns 1 through 5
0 1 2 3 4
0.5 239.050719333717 294.166842778817 302.607683736987 303.85323801037
0 99.7908393660585 18.7363480276876 2.78936769018307 0.409919697265044
Columns 6 through 10
5 6 7 8 9
304.036096007256 304.062921123706 304.066855916448 304.067433075025 304.067517732912
0.0601435156181079 0.00882222546257639 0.0012940551280317 0.00018981269098539 6 2.7841805667360 6e-05
Columns 11 through 15
10 11 12 13 14
304.067530150566 304.067531971993 304.06753223916 304.067532278348 304.067532284097
4.08384737997042e-06 5.99020406196241e-07 8.78645392117075e-08 1.28880089804194e-08 1.89040906763832e-09
Columns 16 through 18
15 16 17
304.06753228494 304.067532285063 304.067532285082
2.77293147882769e-10 4.0660189890432e-11 5.98218885744251e-12
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