**SA1 Interim Report 1**

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**Exercise 1:**

**Listing of ueintbit.m:**

function f = ueintbit(xa,ua,xb,ub)

u\_bar = (ua+ub)/2;

du = ub-ua;

dx = xb-xa;

f = dx \* (u\_bar^5 + (5 \* u\_bar^3 \*du^2)/6 + (u\_bar \* du^4)/16);

**Listing of script:**

clear

close all

x = (0:.01:1);

ue = ones(length(x));

Re = 2500;

thwaites = 0;

theta\_t = zeros(1,length(x));

theta\_b = zeros(1,length(x));

for i = 2:length(x)

thwaites = thwaites + ueintbit(x(i-1),ue(i-1),x(i),ue(i));

theta\_t(i) = (0.45/Re \* ue(i)^(-6) \* thwaites)^0.5;

theta\_b(i) = 0.664/(Re^0.5) \* x(i)^0.5;

end

mycolors = [1 0 0; 0 0 1];

hold on

plot(x,theta\_t)

plot(x,theta\_b)

**A graph of a curve

AI-generated content may be incorrect.**legend('Thwaites', 'Blasius','Location','southeast')

ax = gca;

ax.ColorOrder = mycolors;

ylabel('θ/L')

xlabel('x/L')

**Momentum thickness plot:**

**Exercise 2:**

**Listing of script:**

clear

close all

dx = .01;

x = (0:dx:1);

ue = zeros(1,length(x));

Re = 1 \* 10^6;

duedx = -0.2;

n = length(x);

laminar = true;

for i = 1:length(x)

ue(i) = 1 + x(i)\*duedx;

end

thwaites = 0;

theta\_t = zeros(1,length(x));

%theta\_b = zeros(1,length(x));

i = 1;

while laminar && i < n

i = i + 1;

thwaites = thwaites + ueintbit(x(i-1),ue(i-1),x(i),ue(i));

theta\_t(i) = (0.45/Re \* ue(i)^(-6) \* thwaites)^0.5;

Rethet = Re \* ue(i) \* theta\_t(i);

m = -Re \* theta\_t(i)^2 \* duedx;

H = thwaites\_lookup(m);

He = laminar\_He(H);

if log(Rethet) >= 18.4\*He - 21.74

laminar = false;

disp([x(i) Rethet/1000])

end

end

**Transition locations and Reϴ value:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | d(ue/U)/d(x/L) | | |
| ReL | -0.2 | 0 | 0.2 |
| 1 x 106 | x/L = 0.58 , Reϴ = 567 | No Transition | No Transition |
| 10 x 106 | x/L = 0.24 , Reϴ = 1080 | x/L = 0.37 , Reϴ = 1290 | No Transition |
| 100 x 106 | x/L = 0.04 , Reϴ = 1350 | x/L = 0.04 , Reϴ = 1342 | x/L = 0.04 , Reϴ = 1334 |

**Exercise 3:**

**Listing of script:**

clear

close all

dx = .01;

x = (0:dx:1);

ue = zeros(1,length(x));

Re = 1.8 \* 10^6;

duedx = -0.5;

n = length(x);

laminar = true;

int = 0;

ils = 0;

for i = 1:length(x)

ue(i) = 1 + x(i)\*duedx;

end

thwaites = 0;

theta\_t = zeros(1,length(x));

theta\_b = zeros(1,length(x));

i = 1;

while laminar && i < n

i = i + 1;

thwaites = thwaites + ueintbit(x(i-1),ue(i-1),x(i),ue(i));

theta\_t(i) = ( 0.45/Re \* ue(i)^(-6) \* thwaites)^0.5;

Rethet = Re \* ue(i) \* theta\_t(i);

m = -Re \* theta\_t(i)^2 \* duedx;

H = thwaites\_lookup(m);

He = laminar\_He(H);

if log(Rethet) >= 18.4\*He - 21.74

int = i;

laminar = false;

elseif m >= 0.09

ils = i;

laminar = false;

end

end

format shortE;

if int ~= 0

disp(['Natural transition at ' num2str(x(int)) ...

' with Rethet ' sprintf('%.1e', Rethet)]) %2sf

end

if ils ~= 0

disp(['Separation at ' num2str(x(ils)) ...

' with Rethet ' sprintf('%.1e', Rethet)])

end

**Separation locations:**

|  |  |
| --- | --- |
| ReL | x/L location at separation |
| 103 | 0.25 |
| 104 | 0.25 |
| 105 | 0.25 |

Transition supplants separation at ReL = 1.8 x 106.