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```
% AMTH350
% Solving a third order ODE
%Md Rakib Hossain, 20 March, 2022
clear all;
close all;
clc;
```

question a

The ODE can be converted to the following system of three first-order ODEs:

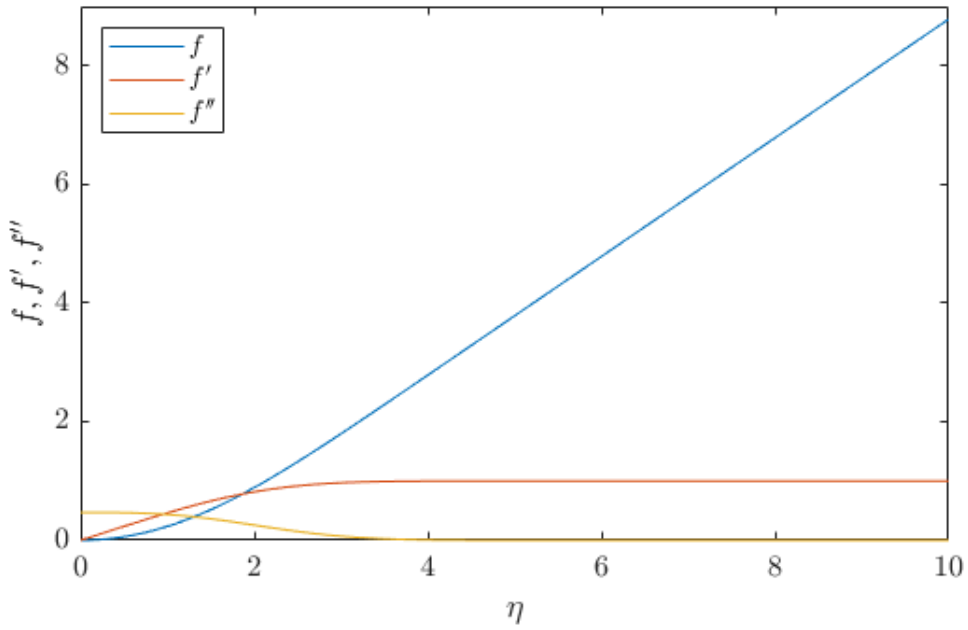
d X ----- = Y d eta

d Y ----- = Z d eta

d Z ----- = - X Z d eta

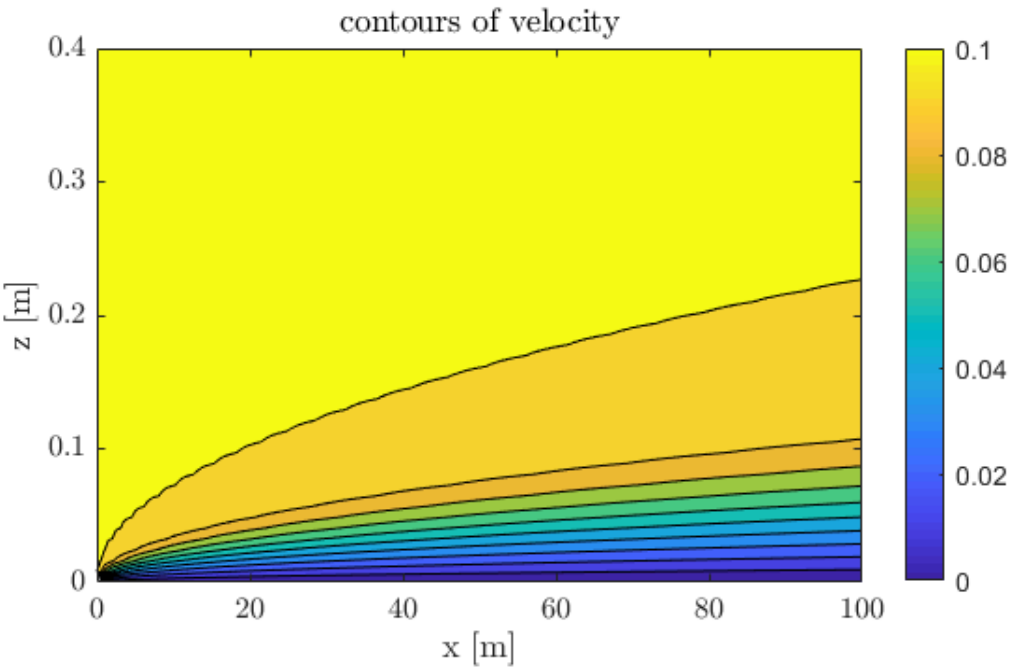
question b

```
eta_end = 10;
y0 = [0; 0; 0.4696];
[eta y] = ode45(@blasius_ode, [0 eta_end], y0);
figure
plot(eta, y(:,1), eta, y(:,2), eta, y(:,3));
xlim([0 10])
ylim([0 9])
xlabel('$\eta$','interpreter','latex')
ylabel('$f, f'', f''''$','interpreter','latex')
legend({'$f
$', '$f''$', '$f''''$'},'interpreter','latex', 'location', 'NorthWest')
set(gca,'Fontsize',12)
latex_fig(12, 5, 3)
```



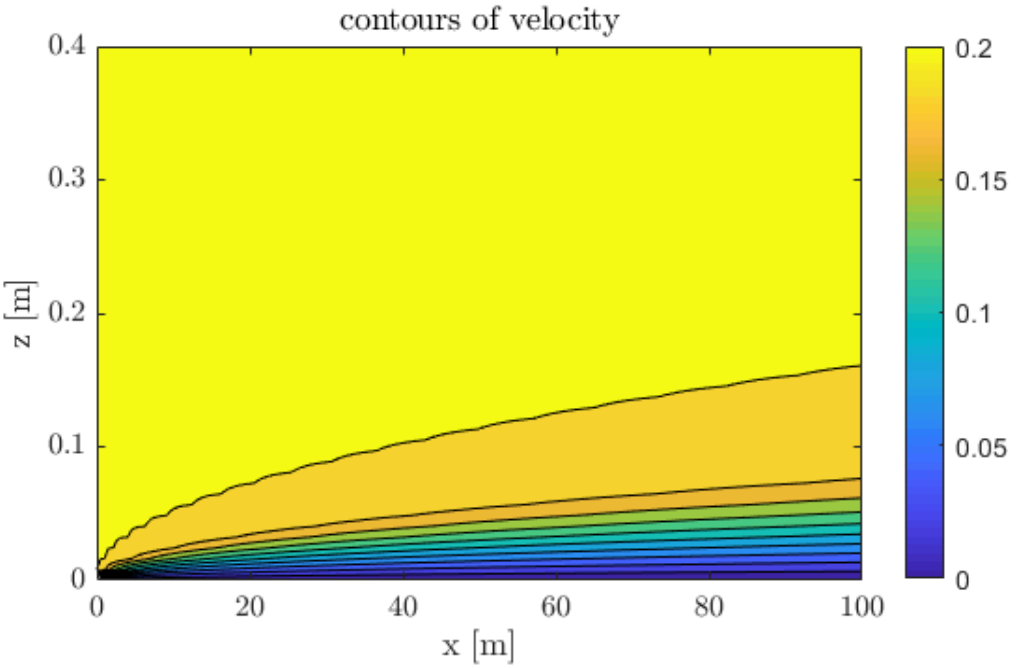
question c

```
Uinfty = 0.1;
nu = 1e-6;
x = linspace(0, 100,200);
z = linspace(0, 0.8);
[X Z] = meshgrid(x, z);
% OPTION 1: Calculate u using a for-loop:
u = zeros(size(X));
for i=1:length(x)
for j=1:length(z)
Eta = Z(j,i) .* sqrt(Uinfty ./ (2 * nu * X(j,i)));
Eta = min(Eta, eta_end); % limit the value of Eta to eta_end to avoid
% NaNs in the output of interp1.
u(j, i) = Uinfty * interp1(eta, y(:,2), Eta);
end
end
% OPTION 2: Calculate u using vectorized expressions
Eta = Z .* sqrt(Uinfty ./ (2 * nu * X));
Eta(Eta > eta_end) = eta_end;
u = interp1(eta, Uinfty * y(:,2), Eta);
% plot the velocity profile
figure;
contourf(X, Z, u);
ylim([0 0.4])
xlabel('x [m]')
ylabel('z [m]')
title('contours of velocity')
colorbar
set(gca,'Fontsize',12)
latex_fig(12, 5, 3)
```



question d

```
Uinfty = 0.2;
nu = 1e-6;
x = linspace(0, 100,200);
z = linspace(0, 0.8);
[X Z] = meshgrid(x, z);
% OPTION 1: Calculate u using a for-loop:
u = zeros(size(X));
for i=1:length(x)
for j=1:length(z)
Eta = Z(j,i) .* sqrt(Uinfty ./ (2 * nu * X(j,i)));
Eta = min(Eta, eta_end); % limit the value of Eta to eta_end to avoid
% NaNs in the output of interp1.
u(j, i) = Uinfty * interp1(eta, y(:,2), Eta);
end
end
% OPTION 2: Calculate u using vectorized expressions
Eta = Z .* sqrt(Uinfty ./ (2 * nu * X));
Eta(Eta > eta_end) = eta_end;
u = interp1(eta, Uinfty * y(:,2), Eta);
% plot the velocity profile
figure;
contourf(X, Z, u);
ylim([0 0.4])
xlabel('x [m]')
ylabel('z [m]')
title('contours of velocity')
colorbar
set(gca,'Fontsize',12)
latex_fig(12, 5, 3)
```



Published with MATLAB® R2018b