BTPollllpllpopopollllo

Student ID: 2021UTM0183

BTP Report

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Ex: 1 : Compute the steady-state momentum flux τ_{yx} in lb_f/ft^2 when the lower plate velocity V in Fig. 1.1-1 is 1 ft/s in the positive x direction, the plate separation Y is 0.001 ft, and the fluid viscosity μ is 0.7 cp.

$$\frac{dv_x}{dy} = \tau_{yx}$$

```
% Ex:1.1-1: Compute steady state momunntum flux
% Given:
sep = 0.001; % plate separation in ft
vel = 1;     %plate velocity in ft/s
mu =  0.7;    % Viscosity in cp
mu = mu*2.0886*10^(-5); % Viscosity in lbs/ft^2
m_flux = mu*vel/sep;    % dv/dy = V/Y bcz velocity profile is linear
fprintf('The steady-state momentum flux is : %d lb/ft^2 \n', m_flux);
```

Ex: 2.2-2 : Rework the falling film problem for a position-dependent viscosity $\mu = \mu_0 e^{-\alpha x/\delta}$, which arieses when the film is nonisothermal, as in the condensation of a vapor on a wall. Here μ_0 is the viscosity at the surface of the film and α is a constant that describes how rapidly μ decreases as x increases. Such a variation could arise in the flow of a condensate down a wall with a linear temperature gradient through the film.

$-\mu \frac{dv_z}{dx} = \rho \text{gx} \cos\beta$ => f(x)= $\frac{dv_z}{dx}$ = $-\frac{\rho \text{gx} \cos\beta}{\mu_0}$ $e^{\alpha x/\delta}$ at x = δ, v_z = 0

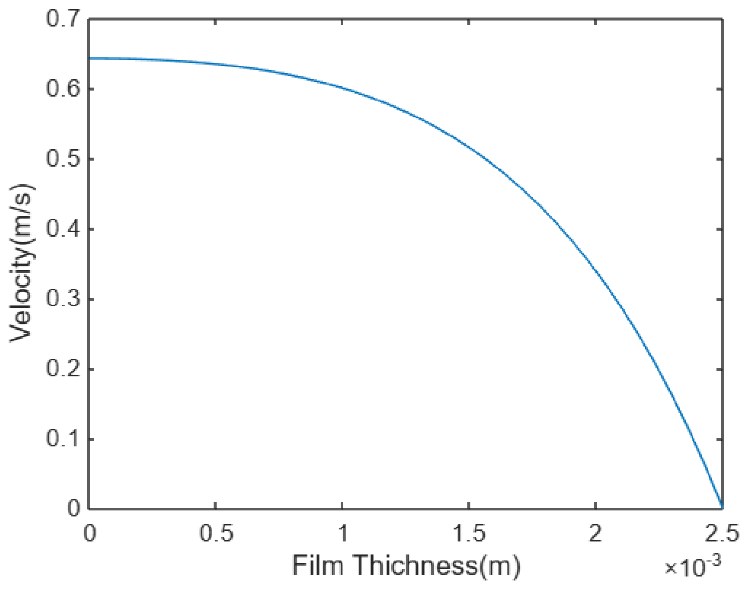
find v_z at x =0 ?

```
rho = 0.8*10^3;             % Density (kg/m^3)
g = 9.8;                    % Gravitational acceleration(m/s^2)
beta = 0;                  % Angle(degree)
mu = 0.16;                % viscosity(kg/m.s)
delta = 2.5*10^-3;          % film thickness(m)
alpha = 2;                  % Constant a

c = rho * g * cosd(beta) / mu;


% Define the function to integrate
fun = @(x) x .* exp(alpha * x / delta);

% Compute the integral
vel =  -c* integral(fun, delta, 0.5*10^-3);
```

```
% velocity
fprintf('The velocity is :%d m/s \n', vel);
```

```
The velocity is :6.342553e-01 m/s
```

```
% Graph Plot
x_values = linspace(delta, 0, 100);
v_values = zeros(size(x_values));
for i = 1:length(x_values)
    v_values(i) = -c * integral(fun, delta, x_values(i));
end

figure;
plot(x_values, v_values);
xlabel('Film Thichness(m)');
ylabel('Velocity(m/s)');
```



Ex: 2.2-2 : Falling film problem for a viscosity μ

$-\mu\frac{dv_z}{dx} = \rho gx\cos\beta$ => f(x)= $\frac{dv_z}{dx}$ = $-\frac{\rho gx\cos\beta}{\mu}$, at x = δ, v_z = 0

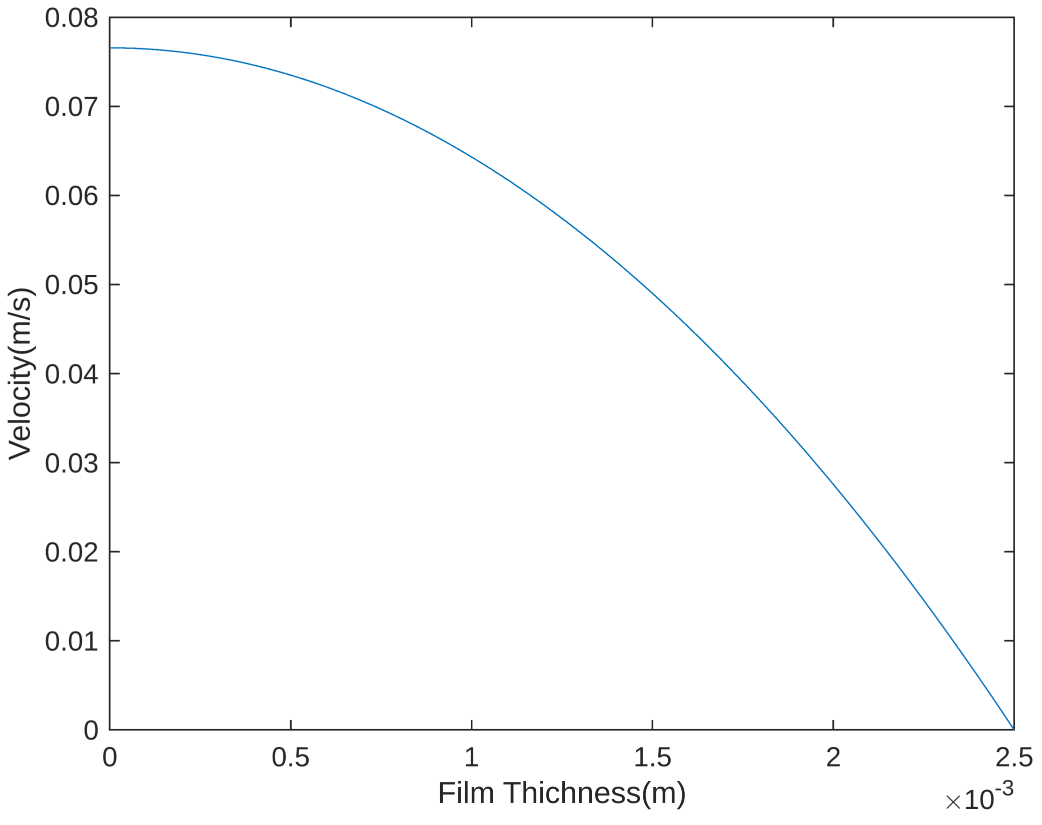
find v_z at x = 0 ?

```
rho = 0.8*10^3;              % Density (kg/m^3)
g = 9.8;                     % Gravitational acceleration(m/s^2)
beta = 60;                   % Angle(degree)
mu = 0.16;                 % viscosity(kg/m.s)
delta = 2.5*10^-3;           % film thickness(m)
%alpha = 2;                   % Constant a
```

```
c = rho * g * cosd(beta) / mu;


% Define the function to integrate
fun = @(x) x;

% Compute the integral
vel =  -c* integral(fun, delta, 0);

% velocity
fprintf('The velocity is :%d m/s \n', vel);
```

```
The velocity is :7.656250e-02 m/s
```

```

% Graph Plot
x_values = linspace(delta, 0, 100);  % descretizing thickness
v_values = zeros(size(x_values)); % Empty vector for velocity
for i = 1:length(x_values)
    v_values(i) = -c * integral(fun, delta, x_values(i));
end

figure;
plot(x_values, v_values);
xlabel('Film Thichness(m)');
ylabel('Velocity(m/s)');
```

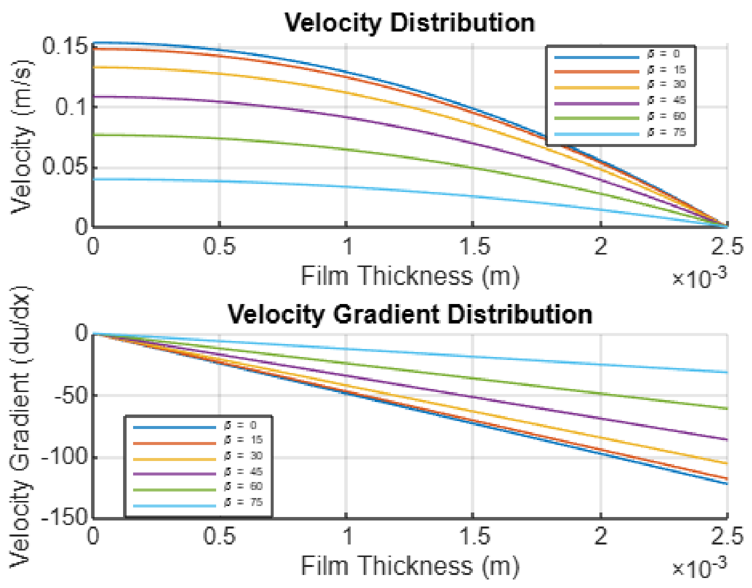


Ex: : Falling film problem for a viscosity μ

$-\mu \frac{dv_z}{dx} = \rho$gx cos$\beta$ => f(x)= $\frac{dv_z}{dx}$ = $-\frac{\rho g x \cos\beta}{\mu}$, at x = δ, v_z = 0

find v_z at x = 0 for different values of β?

```
% Constants
rho = 0.8 * 10^3;           % Density (kg/m^3)
g = 9.8;                    % Gravitational acceleration (m/s^2)
delta = 2.5 * 10^-3;        % Film thickness (m)
mu = 0.16;                  % Constant viscosity (Pa.s)
beta_values = [0, 15, 30, 45, 60, 75]; % Beta values

% Prepare the plot
figure;
subplot(2, 1, 1);
hold on;
xlabel('Film Thickness (m)');
ylabel('Velocity (m/s)');
title('Velocity Distribution');
grid on;

subplot(2, 1, 2);
hold on;
xlabel('Film Thickness (m)');
ylabel('Velocity Gradient (du/dx)');
title('Velocity Gradient Distribution');
grid on;

% Loop through each beta value
num_samples = length(beta_values);
yMesh = linspace(0, delta, 100);  % Film thickness values

for i = 1:num_samples
    % Extract the current beta value
    beta = beta_values(i);

    % Calculate constant c
    c = rho * g * cosd(beta);

    % Define the differential equation system with variable viscosity
    % u(1) = u (velocity)
    % u(2) = du/dy (velocity gradient)
    dydx = @(y, u) [u(2); -c / mu];   % [du/dy; d^2u/dy^2]

    % Define the boundary conditions
    % ua(2) = du/dy at y=0 -> 0
    % ub(1) = u at y=delta -> 0
    bc = @(ua, ub) [ua(2);  % du/dy = 0 at y=0
                    ub(1)]; % u = 0 at y=delta

    % Initial guess for the solution
    uInit = @(y) [0; 0]; % Initial guess for [u; du/dy]

    % Solve the boundary value problem
    sol = bvp4c(dydx, bc, bvpinit(yMesh, uInit));

    % Extract the solution
    y = sol.x;
    u_values = sol.y(1, :);   % Velocity values
    dudx_values = sol.y(2, :); % Velocity gradient values

    % Plot the velocity distribution
    subplot(2, 1, 1);
    plot(y, u_values, 'DisplayName', ['\beta = ', num2str(beta)]);

    % Plot the velocity gradient distribution
    subplot(2, 1, 2);
    plot(y, dudx_values, 'DisplayName', ['\beta = ', num2str(beta)]);
end

% Finalize the plots
subplot(2, 1, 1);
legend('show', 'Location', 'best', 'FontSize',4);
hold off;

subplot(2, 1, 2);
legend('show', 'Location', 'best','FontSize',4);
hold off;
```



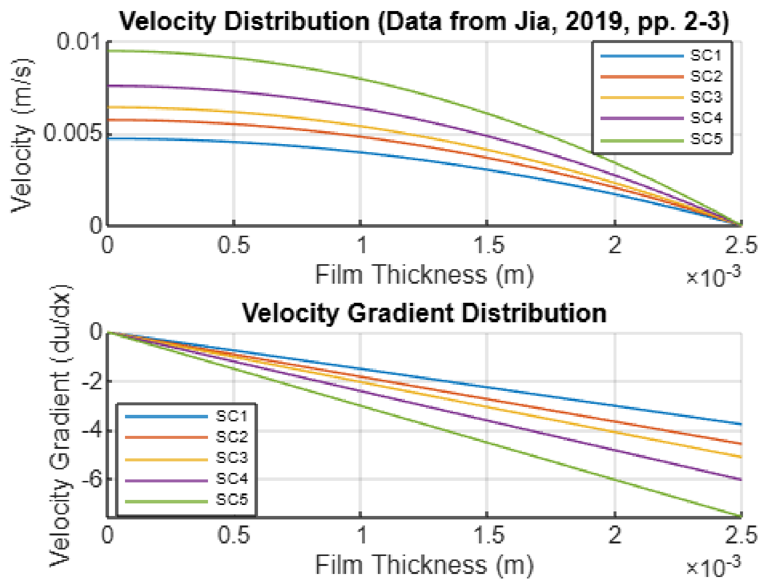
Ex: : Falling film problem for a viscosity μ

$-\mu\frac{dv_z}{dx} = \rho$gx cos$\beta$ => f(x)= $\frac{dv_z}{dx}$ = $-\frac{\rho \mathrm{gxcos}\beta}{\mu}$, at x = δ, v_z = 0

find v_z at x = 0 for various viscosity values, calculated using Jia (2019, pp. 2-3).?

```
% Read the data from the Excel file
data = readtable("Jia_2019_viscosity_results.xlsx", 'VariableNamingRule',
'preserve');

% Constants
rho = 0.8 * 10^3;           % Density (kg/m^3)
g = 9.8;                    % Gravitational acceleration (m/s^2)
h = 60;                     % Angle (degrees)
delta = 2.5 * 10^-3;        % Film thickness (m)

% Prepare the plot
figure;
subplot(2, 1, 1);
hold on;
xlabel('Film Thickness (m)');
ylabel('Velocity (m/s)');
title('Velocity Distribution (Data from Jia, 2019, pp. 2-3)');
grid on;

subplot(2, 1, 2);
hold on;
xlabel('Film Thickness (m)');
ylabel('Velocity Gradient (du/dx)');
title('Velocity Gradient Distribution');
grid on;

% Loop through each sample's viscosity data
num_samples = height(data);
yMesh = linspace(0, delta, 100);  % Film thickness values

for i = 1:num_samples
    % Extract base viscosity and sample name for the current slag
    mu = data.Viscosity(i);           % Base viscosity of the current slag
    sample_name = data.Sample{i};       % Sample name of the current slag
(adjust column name if different)

    % Calculate constant c
    c = rho * g * cosd(h);

    % Define the differential equation system with variable viscosity
    % u(1) = u (velocity)
    % u(2) = du/dy (velocity gradient)
    dydx = @(y, u) [u(2); -c /mu];   % [du/dy; d^2u/dy^2]
```

```matlab
    % Define the boundary conditions
    % ua(2) = du/dy at y=0 -> 0
    % ub(1) = u at y=delta -> 0
    bc = @(ua, ub) [ua(2);  % du/dy = 0 at y=0
                    ub(1)]; % u = 0 at y=delta

    % Initial guess for the solution
    uInit = @(y) [0; 0]; % Initial guess for [u; du/dy]

    % Solve the boundary value problem
    sol = bvp4c(dydx, bc, bvpinit(yMesh, uInit));

    % Extract the solution
    y = sol.x;
    u_values = sol.y(1, :);   % Velocity values
    dudx_values = sol.y(2, :); % Velocity gradient values

    % Plot the velocity distribution
    subplot(2, 1, 1);
    plot(y, u_values, 'DisplayName', sample_name);

    % Plot the velocity gradient distribution
    subplot(2, 1, 2);
    plot(y, dudx_values, 'DisplayName', sample_name);
end

% Finalize the plots
subplot(2, 1, 1);
legend('show', 'Location', 'best','FontSize',6);
hold off;

subplot(2, 1, 2);
legend('show', 'Location', 'best','FontSize',6);
hold off;
```



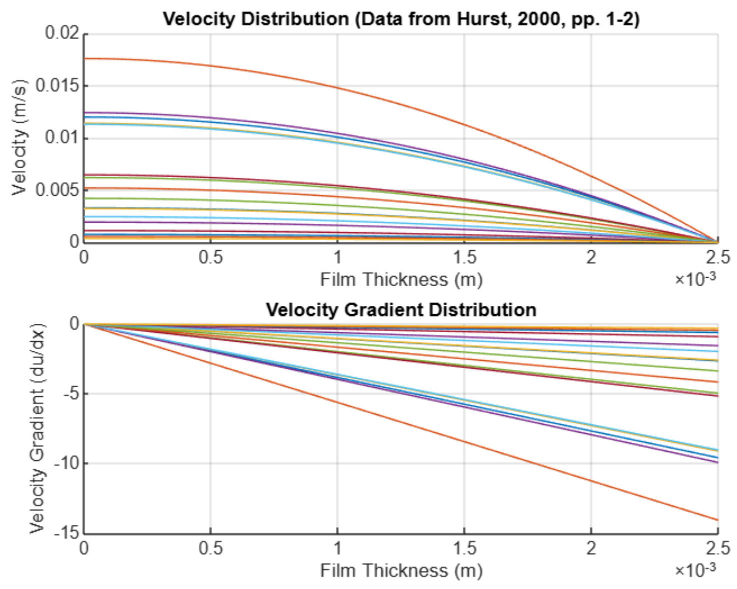
Ex: : Falling film problem for a viscosity μ

$-\mu \frac{dv_z}{dx} = \rho$gx cos$\beta$ => f(x)= $\frac{dv_z}{dx}$ = $-\frac{\rho \mathrm{gx} \cos\beta}{\mu}$, at x = δ, v_z = 0

find v_z at x = 0 for various viscosity values, calculated using Hurst, 2000, pp. 1-2.?

```
% Read the data from the Excel file
data = readtable("Hurst_2000_viscosity_results.xlsx", 'VariableNamingRule',
'preserve');

% Constants
rho = 0.8 * 10^3;          % Density (kg/m^3)
g = 9.8;                   % Gravitational acceleration (m/s^2)
h = 60;                    % Angle (degrees)
delta = 2.5 * 10^-3;       % Film thickness (m)

% Prepare the plot
figure;
subplot(2, 1, 1);
hold on;
xlabel('Film Thickness (m)');
ylabel('Velocity (m/s)');
title('Velocity Distribution (Data from Hurst, 2000, pp. 1-2)');
grid on;

subplot(2, 1, 2);
hold on;
xlabel('Film Thickness (m)');
ylabel('Velocity Gradient (du/dx)');
title('Velocity Gradient Distribution');
```

```
grid on;

% Loop through each sample's viscosity data
num_samples = height(data);
yMesh = linspace(0, delta, 100);  % Film thickness values

for i = 1:num_samples
    % Extract base viscosity and sample name for the current slag
    mu = data.Viscosity(i);           % Base viscosity of the current slag
    sample_name = data.Melt{i};       % Sample name of the current slag
(adjust column name if different)

    % Calculate constant c
    c = rho * g * cosd(h);

    % Define the differential equation system with variable viscosity
    % u(1) = u (velocity)
    % u(2) = du/dy (velocity gradient)
    dydx = @(y, u) [u(2); -c /mu];   % [du/dy; d^2u/dy^2]

    % Define the boundary conditions
    % ua(2) = du/dy at y=0 -> 0
    % ub(1) = u at y=delta -> 0
    bc = @(ua, ub) [ua(2);  % du/dy = 0 at y=0
                    ub(1)]; % u = 0 at y=delta

    % Initial guess for the solution
    uInit = @(y) [0; 0]; % Initial guess for [u; du/dy]

    % Solve the boundary value problem
    sol = bvp4c(dydx, bc, bvpinit(yMesh, uInit));

    % Extract the solution
    y = sol.x;
    u_values = sol.y(1, :);   % Velocity values
    dudx_values = sol.y(2, :); % Velocity gradient values

    % Plot the velocity distribution
    subplot(2, 1, 1);
    plot(y, u_values, 'DisplayName', sample_name);

    % Plot the velocity gradient distribution
    subplot(2, 1, 2);
    plot(y, dudx_values, 'DisplayName', sample_name);
end
```



```
% Finalize the plots
%subplot(2, 1, 1);
%legend('show', 'Location', 'best','FontSize',3);
%hold off;

%subplot(2, 1, 2);
%legend('show', 'Location', 'best','FontSize',3);
%hold off;
```

Ex: 2.3-2 Obtain an expression for the mass rate of flow w for an ideal gas in laminar flow in a throughout.long circular tube. The flow is presumed to be isothermal. Assume that the pressure change through the tube is not very large, so that the viscosity can be regarded a constand

hugen-poiseuille euation for the small length d_z of the tube

mass rate flow(w) = $(-\frac{\pi\rho * R^4}{8\mu p_0})\,(-p\frac{dp}{dz})$

```
% given
mu = 0.492;             % viscosity in pa.s
L = 1;                  % tube lenght in ft
rho = 78.717;           % fluid density at z=L in lb/ft^3
p = 2.7579*10^5;        % final pressure at z=L in pa
p_0 = 5.51584*10^5;     % inital pressure at z=0 in pa
r = 4.167*10^3;         % tube radius in ft
rho_0 = p_0*rho/p;      % fluid density at z=0 in lb/ft^3
c = -(pi*r^4*rho_0)/(8*mu*p_0*L);
```

```
% Define the function to integrate
fun = @(p) p;

% Compute the integral
f_rate =  c* integral(fun,2.7579*10^5 , 5.51584*10^5);

% mass flow rate
fprintf('The mass rate of flow is :%d lb/s  \n', f_rate);
```

```
%1. Viscosity Calculation............Arman_2017

% Read input data from Excel
data = readtable("BTP.xlsx",'Sheet', 'Arman_2017','Range', 'A1:K18',
'VariableNamingRule', 'preserve');

% Preallocate output arrays
num_samples = height(data);
mu = zeros(num_samples, 1); % Store calculated viscosity
alpha = zeros(num_samples, 1);    % Store alpha values
b = zeros(num_samples, 1);        % Store parameter b

% Loop through each sample
for i = 1:num_samples
    % Extract mol% composition for the current sample
    SiO2 = data.SiO2(i);
    Al2O3 = data.Al2O3(i);
    CaO = data.CaO(i);
    MgO = data.MgO(i);
    FeO = data.FeO(i);
    Fe2O3 = data.Fe2O3(i);
    Tot_comp = SiO2+Al2O3+CaO+MgO+FeO+Fe2O3;
    T = data.Temperature(i)+273; % Temperature in Kelvin
    %Normalized mol% compositions
    SiO2=SiO2/Tot_comp ;
    Al2O3=Al2O3/Tot_comp;
    CaO=CaO/Tot_comp;
    MgO=MgO/Tot_comp;
    FeO=FeO/Tot_comp;
    Fe2O3=Fe2O3/Tot_comp;
    % Calculate x_g, x_m, and x_a
    x_g = SiO2 ;
    x_m = FeO + CaO + MgO;
    x_a = Al2O3 + Fe2O3;

    % Avoid division by zero for alpha calculation
    if (x_m + x_a) == 0
        alpha(i) = NaN; % Mark as invalid if division by zero
        mu(i) = NaN;
        continue; % Skip this sample
    end
    % Calculate alpha (α)
    alpha(i) = x_m / (x_m + x_a);
    % Compute parameter b
    b0 = 13.8 + 39.9355 * alpha(i) - 44.049 * alpha(i)^2;
    b1 = 30.481 - 117.1505 * alpha(i) + 139.9978 * alpha(i)^2;
    b2 = -40.9429 + 234.0486 * alpha(i) - 300.04 * alpha(i)^2;
    b3 = 60.7619 - 153.9276 * alpha(i) + 211.1616 * alpha(i)^2;

    b = b0 + b1 * SiO2 + b2 * SiO2^2 + b3 * SiO2^3;

    % Calculate parameter a (in Pa·s/K)
    a = exp(-0.29 * b - 11.57);

    % Compute viscosity using Weyman equation
    mu(i) = a * T * exp(b*1000/T);
end

% Combine results into a table
result = data;
result.Alpha = alpha;      % Add alpha values
result.Viscosity = mu; % Add viscosity values

% Display results
disp(result);
```

```
              Series                          Sample            Fe3+/Fet_tot    SiO2    Al2O3    CaO    MgO
    _____________________________    ____________________    ____________    ____    _____    ____    ____

    {'Coal slag'                 }    {'Coal Valley (CV)' }        0.56        61.5    13.9     14.2     3.6
    {'Coal slag'                 }    {'Tanito Harum (TH)'}        0.47        57.8      16      9.2     4.8
    {'Coal slag'                 }    {'Malinau (MA)'     }        0.52        54.6      15        8     6.3
    {'Coal slag'                 }    {'Adaro (AD)'       }         NaN          39      10     24.5    16.4
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CA10.40'          }         NaN          40      10       50       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CA20.40'          }         NaN          40      20       40       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CA30.40'          }         NaN          40      30       30       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CF08.39'          }         0.8        39.2       0       49       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CAF15.11.39'      }        0.76        38.6    14.5       29       0
    {'(50-x)CaO-xA2O3-50SiO2'}    {'CA00.50'          }         NaN          50       0       50       0
    {'(50-x)CaO-xA2O3-50SiO2'}    {'CA12.50'          }         NaN          50    12.5     37.5       0
    {'(50-x)CaO-xA2O3-50SiO2'}    {'CF07.49'          }        0.69        48.5       0     38.8       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'CA00.60'          }         NaN          60       0       40       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'CA10.60'          }         NaN          60      10       30       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'MA10.60'          }         NaN          60      10        0      30
    {'(40-x)RO-xA2O3-60SiO2' }    {'CF07.58'          }        0.71        58.3       0     29.2       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'CF14.57'          }        0.74        57.1       0       19       0
```

```
% Save results to Excel
output_filename = 'Arman_2017_viscosity_results.xlsx';
writetable(result, output_filename);
disp(['Results saved to ', output_filename]);
```

```
Results saved to Arman_2017_viscosity_results.xlsx
```

```
%1. Viscosity Calculation............Arman_2017

% Read input data from Excel
data = readtable("BTP.xlsx",'Sheet', 'Arman_2017','Range', 'A1:K18',
'VariableNamingRule', 'preserve');

% Preallocate output arrays
num_samples = height(data);
mu = zeros(num_samples, 1); % Store calculated viscosity
alpha = zeros(num_samples, 1);    % Store alpha values
b = zeros(num_samples, 1);        % Store parameter b

% Loop through each sample
for i = 1:5%num_samples
    % Extract mol% composition for the current sample
    SiO2 = data.SiO2(i);
    Al2O3 = data.Al2O3(i);
    CaO = data.CaO(i);
    MgO = data.MgO(i);
    FeO = data.FeO(i);
    Fe2O3 = data.Fe2O3(i);
    Tot_comp = SiO2+Al2O3+CaO+MgO+FeO+Fe2O3;
    T = data.Temperature(i)+273; % Temperature in Kelvin
    %Normalized mol% compositions
    SiO2=SiO2/Tot_comp ;
    Al2O3=Al2O3/Tot_comp;
    CaO=CaO/Tot_comp;
    MgO=MgO/Tot_comp;
    FeO=FeO/Tot_comp;
    Fe2O3=Fe2O3/Tot_comp;
    % Calculate x_g, x_m, and x_a
    x_g = SiO2 ;
    x_m = FeO + CaO + MgO;
    x_a = Al2O3 + Fe2O3;

    % Avoid division by zero for alpha calculation
    if (x_m + x_a) == 0
        alpha(i) = NaN % Mark as invalid if division by zero
        mu(i) = NaN;
        continue; % Skip this sample
    end
    % Calculate alpha (α)
    alpha(i) = x_m / (x_m + x_a);
    % Compute parameter b
    b0 = 13.8 + 39.9355 * alpha(i) +244.049 * alpha(i)^2
    b1 = 30.481 - 117.1505 * alpha(i) + 139.9978 * alpha(i)^2
    b2 = -240.9429 + 234.0486 * alpha(i) - 300.04 * alpha(i)^2
    b3 = 60.7619 - 153.9276 * alpha(i) + 211.1616 * alpha(i)^2

    b = b0 + b1 * SiO2 + b2 * SiO2^2 + b3 * SiO2^3

    % Calculate parameter a (in Pa·s/K)
    a = exp(-0.2693 * b - 13.9751)

    % Compute viscosity using Weyman equation
    mu(i) = a * T * exp(b*1000/T);
end
```

```
b0 =
114.7671
b1 =
9.0466
b2 =
-204.6515
b3 =
41.3345
b =
48.5083
a =
1.8088e-12
b0 =
99.2768
b1 =
7.2964
b2 =
-200.0330
b3 =
37.5343
b =
39.5903
a =
1.9971e-11
b0 =
103.8232
b1 =
7.7486
b2 =
-201.2641
b3 =
38.5669
b =
49.0041
a =
1.5827e-12
b0 =
159.2085
b1 =
16.6372
b2 =
-223.0958
b3 =
55.6945
b =
133.9529
a =
1.8372e-22
b0 =
216.5581
b1 =
30.0763
b2 =
-254.2635
b3 =
79.1289
b =
192.9707
a =
2.2999e-29
```

```
% Combine results into a table
result = data;
result.Alpha = alpha;      % Add alpha values
result.Viscosity = mu; % Add viscosity values

% Display results
disp(result);
```

```
             Series                      Sample             Fe3+/Fet_tot    SiO2    Al2O3    CaO     MgO
    ___________________________    _____________________    ____________    ____    _____    ____    ____

    {'Coal slag'              }    {'Coal Valley (CV)' }        0.56        61.5    13.9     14.2     3.6
    {'Coal slag'              }    {'Tanito Harum (TH)'}        0.47        57.8      16      9.2     4.8
    {'Coal slag'              }    {'Malinau (MA)'     }        0.52        54.6      15        8     6.3
    {'Coal slag'              }    {'Adaro (AD)'       }         NaN          39      10     24.5    16.4
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CA10.40'          }         NaN          40      10       50       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CA20.40'          }         NaN          40      20       40       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CA30.40'          }         NaN          40      30       30       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CF08.39'          }         0.8        39.2       0       49       0
    {'(60-x)CaO-xA2O3-40SiO2'}    {'CAF15.11.39'      }        0.76        38.6    14.5       29       0
    {'(50-x)CaO-xA2O3-50SiO2'}    {'CA00.50'          }         NaN          50       0       50       0
    {'(50-x)CaO-xA2O3-50SiO2'}    {'CA12.50'          }         NaN          50    12.5     37.5       0
    {'(50-x)CaO-xA2O3-50SiO2'}    {'CF07.49'          }        0.69        48.5       0     38.8       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'CA00.60'          }         NaN          60       0       40       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'CA10.60'          }         NaN          60      10       30       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'MA10.60'          }         NaN          60      10        0      30
    {'(40-x)RO-xA2O3-60SiO2' }    {'CF07.58'          }        0.71        58.3       0     29.2       0
    {'(40-x)RO-xA2O3-60SiO2' }    {'CF14.57'          }        0.74        57.1       0       19       0
```

```
% Save results to Excel
output_filename = 'Arman_2017_viscosity_results.xlsx';
writetable(result, output_filename);
disp(['Results saved to ', output_filename]);
```

```
Results saved to Arman_2017_viscosity_results.xlsx
```

```
%4. Viscosity Calculation...........Hurst_2000

% Read input data from Excel
data = readtable("BTP.xlsx",'Sheet', 'Hurst_2000','Range', 'A1:L18',
'VariableNamingRule', 'preserve');

% Preallocate output arrays
```

```
num_samples = height(data);
mu = zeros(num_samples, 1); % Store calculated viscosity
alpha = zeros(num_samples, 1);    % Store alpha values
b = zeros(num_samples, 1);        % Store parameter b

% Loop through each sample
for i = 1:num_samples
    A = data.A(i);  %Viscosity Parameter
    B = data.B(i);  %Viscosity Parameter
    R = 8.314  %gas constant in J⊠K−1⊠mol−1
    T_1 = data.T_1(i)+273; % Temperature in Kelvin
    mu(i)= exp(A + B/T_1);    %Viscosity in Pa.s
end

% Combine results into a table
result = data;
result.Viscosity = mu; % Add viscosity values in Pa.s

% Display results
disp(result);

% Save results to Excel
output_filename = 'Hurst_2000_viscosity_results.xlsx';
writetable(result, output_filename);
disp(['Results saved to ', output_filename]);
```

```
%5. Viscosity Calculation...........Jia_2019

% Read input data from Excel
data = readtable("BTP.xlsx",'Sheet', 'Jia_2019','Range', 'A1:D6',
'VariableNamingRule', 'preserve');

% Preallocate output arrays
num_samples = height(data);
mu = zeros(num_samples, 1); % Store calculated viscosity
alpha = zeros(num_samples, 1);    % Store alpha values
b = zeros(num_samples, 1);        % Store parameter b

% Loop through each sample
for i = 1:num_samples
    ln_A = data.lnA(i);  %Viscosity Parameter
    R = 8.314  %gas constant in J⊠K−1⊠mol−1
    T_1 = data.T_1(i); % Temperature in Kelvin
    E_a = data.E_a(i);
    ln_mu = ln_A + (E_a*1000)/(R*T_1);
    mu(i) = exp(ln_mu);       %Viscosity in Pa.s
end

% Combine results into a table
```

```
result = data;
result.Viscosity = mu; % Add viscosity values in Pa.s

% Display results
disp(result);

% Save results to Excel
output_filename = 'Jia_2019_viscosity_results.xlsx';
writetable(result, output_filename);
disp(['Results saved to ', output_filename]);
 o
```