```
% Kathryn Atherton
% ABE 202 Homework
% Alcohol Metabolism

function ABE202homework20417
    % dose
    D = 8 * 46.2 * 0.5 * 0.78924;

    [t,y] = ode45(@metmodel, [0 24], [0;0;0], [], D);
    figure(1)
    plot(t,y(:,2))
    hold on
    plot (t,y(:,3))
    title('Alcohol and Acetaldehyde Concentrations')
    xlabel('Time, hours')
    ylabel('Concentrations, g/ml')
    legend('Alcohol', 'Acetaldehyde')

    peakethanol = max(y(:,2));
    peakacetaldehyde = max(y(:,3));
    maxtimeethanol = find(y(:,2) == peakethanol);
    maxtimeacetaldehyde = find(y(:,3) == peakacetaldehyde);
    timeethanol = t(maxtimeethanol);
    timeacetaldehyde = t(maxtimeacetaldehyde);

    D = 0;
    peakethanoldrive = 0;

    while peakethanoldrive < 0.08
        D = D + 1;
        [t,y] = ode45(@metmodel, [0 24], [0;0;0], [], D);
        peakethanoldrive = max(y(:,2));
    end

    drinks = D / (46.2 * 0.5 * 0.78924);

    D = 0;
    peakethanoldrivehet = 0;

    while peakethanoldrivehet < 0.08
        D = D + 1;
        [t,y] = ode45(@metmodelhet, [0 24], [0;0;0], [], D);
        peakethanoldrivehet = max(y(:,2));
    end

    drinkshet = D / (46.2 * 0.5 * 0.78924);

    D = 0;
    peakethanoldrivehom = 0;

    while peakethanoldrivehom < 0.08
        D = D + 1;
```

```
        [t,y] = ode45(@metmodelhom, [0 24], [0;0;0], [], D);
        peakethanoldrivehom = max(y(:,2));
    end

    drinkshom = D / (46.2 * 0.5 * 0.78924);

    % Number One %
    fprintf('1): \n');
    fprintf('   Full equation for dB/dt: \n');
    fprintf('      dB/dt = Ka * I - (Vadhmax * B - A * Vadhrev) /
 (Kmadh + B + A * Kadhrev)\n');
    fprintf('   Full equation for dA/dt: \n');
    fprintf('      dA/dt = dAdt = ((Vadhmax * B - A * Vadhrev) /
 (Kmadh + B + A * Kadhrev)) - ((Valdhmax * A) / (Kmaldh + A))\n')
    fprintf('\n');

    % Number Two %
    fprintf('2): \n');
    fprintf('   Plot alcohol and acetaldehyde concentration for
 situation:\n');
    fprintf('      see plot.\n');
    fprintf('   Peak blood alcohol content:\n');
    fprintf('      %f M\n', peakethanol);
    fprintf('   Peak blood acetaldehyde content:\n');
    fprintf('      %f M\n', peakacetaldehyde);
    fprintf('   Time after consumption peak blood alcohol level
 occurs:\n');
    fprintf('      %f hrs\n', timeethanol);
    fprintf('   Time after consumption peak blood acetaldehyde level
 occurs:\n');
    fprintf('      %f hrs\n', timeacetaldehyde);
    fprintf('\n');

    % Number Three %
    fprintf('3): \n');
    fprintf('   Drinks to reach Indiana legal limit for driving:\n');
    fprintf('      %f drinks\n', drinks);
    fprintf('\n');

    % Number Four %
    fprintf('4): \n');
    fprintf('   Does slower ALDH rate affect blood alcohol content in
 mutants? \n');
    fprintf('      Yes, as the amount of acetaldehyde affects the dB/
dt equation (A). The mutation makes the dB/dt process slower, which
 keeps the blood-alcohol content higher, longer. \n');
    fprintf('   Number of drinks to reach legal limit for mutant
 genotypes: \n');
    fprintf('      Heterozygous: %f drinks\n', drinkshet);
    fprintf('      Homozygous: %f drinks\n', drinkshom);
    fprintf('\n');

    % Bonus %
    fprintf('Bonus): \n');
```

```
    fprintf('   Component used in hangover "cures": \n');
    fprintf('      ALDH\n');
    fprintf('   Why?\n');
    fprintf('      ALDH is the enzyme which breaks down the toxic
 byproduct of the breakdown of ethanol, acetaldehyde.\n');
    fprintf('      If ALDH malfunctions or is inhibited, acetaldehyde
 cannot be properly broken down, leading to adverse \n');
    fprintf('      side effects that are seen in hangovers.\n');
    fprintf('\n');

end

function dydt = metmodel(t,y,D)

    % Constants %
    Kemax = 10.2; % per hour
    a = 0.00167; % g^-2
    Ka = 25.1; % per hour
    V = 44.100; % ml
    Vm = 0.202; % mg/ml * hr
    Km = 0.0818; % %mg/ml
    Vadhmax = 0.184;
    Valdhmax = 0.246;
    Kadhrev = 1;
    Vadhrev = 3.26;
    Kmadh = 0.014; % %mg/ml
    Kmaldh = 0.0000528; % %mg/ml

    Ke = Kemax / (1 + a * D^2);

    % Amount of Alcohol in Places Tracked %

    I = y(1); % amount of alcohol in intestine
    B = y(2); % amount of alcohol in body/blood
    A = y(3); % amount of acetaldehyde in body/blood

    % determining F
    if D <= 11.2
        F = 0.785;
    elseif D <= 22.4
        F = 0.96;
    else
        F = 1;
    end

    % Differential Equations %

    dIdt = Ke * (F * D / V) * exp(-(Ke * t)) - Ka * I; % need to find
 I
    dBdt = Ka * I - (Vadhmax * B - A * Vadhrev) / (Kmadh + B + A *
 Kadhrev); % need to find B
    dAdt = ((Vadhmax * B) - (A * Vadhrev)) / (Kmadh + B + (A *
 Kadhrev)) - (Valdhmax * A) / (Kmaldh + A); % ???, need to find A
```

```
    dCadt = rA - (v0 * Ca / V);
    dCbdt = rB - (v0 * Cb0 - C

    dydt = [dIdt; dBdt; dAdt];
end

function dydt = metmodelhet(t,y,D)

    % Constants %
    Kemax = 10.2; % per hour
    a = 0.00167; % g^-2
    Ka = 25.1; % per hour
    V = 44.100; % ml
    Vm = 0.202; % mg/ml * hr
    Km = 0.0818; % %mg/ml
    Vadhmax = 0.184;
    Valdhmax = 0.246;
    Kadhrev = 1;
    Vadhrev = 3.26;
    Kmadh = 0.014; % %mg/ml
    Kmaldh = 0.0000528 * 0.7; % %mg/ml

    Ke = Kemax / (1 + a * D^2);

    % Amount of Alcohol in Places Tracked %

    I = y(1); % amount of alcohol in intestine
    B = y(2); % amount of alcohol in body/blood
    A = y(3); % amount of acetaldehyde in body/blood

    % determining F
    if D <= 11.2
        F = 0.785;
    elseif D <= 22.4
        F = 0.96;
    else
        F = 1;
    end

    % Differential Equations %

    dIdt = Ke * (F * D / V) * exp(-(Ke * t)) - Ka * I; % need to find
 I
    dBdt = Ka * I - (Vadhmax * B - A * Vadhrev) / (Kmadh + B + A *
 Kadhrev); % need to find B
    dAdt = ((Vadhmax * B) - (A * Vadhrev)) / (Kmadh + B + (A *
 Kadhrev)) - (Valdhmax * A) / (Kmaldh + A); % ???, need to find A

    dydt = [dIdt; dBdt; dAdt];
end

function dydt = metmodelhom(t,y,D)

    % Constants %
```

```
    Kemax = 10.2; % per hour
    a = 0.00167; % g^-2
    Ka = 25.1; % per hour
    V = 44.100; % ml
    Vm = 0.202; % mg/ml * hr
    Km = 0.0818; % %mg/ml
    Vadhmax = 0.184;
    Valdhmax = 0.246;
    Kadhrev = 1;
    Vadhrev = 3.26;
    Kmadh = 0.014; % %mg/ml
    Kmaldh = 0.0000528 * 0.55; % %mg/ml

    Ke = Kemax / (1 + a * D^2);

    % Amount of Alcohol in Places Tracked %

    I = y(1); % amount of alcohol in intestine
    B = y(2); % amount of alcohol in body/blood
    A = y(3); % amount of acetaldehyde in body/blood

    % determining F
    if D <= 11.2
        F = 0.785;
    elseif D <= 22.4
        F = 0.96;
    else
        F = 1;
    end

    % Differential Equations %

    dIdt = Ke * (F * D / V) * exp(-(Ke * t)) - Ka * I; % need to find
 I
    dBdt = Ka * I - (Vadhmax * B - A * Vadhrev) / (Kmadh + B + A *
 Kadhrev); % need to find B
    dAdt = ((Vadhmax * B) - (A * Vadhrev)) / (Kmadh + B + (A *
 Kadhrev)) - (Valdhmax * A) / (Kmaldh + A); % ???, need to find A

    dydt = [dIdt; dBdt; dAdt];
end
```

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Error using dbstatus
Error: File: /users/katherto/ABE202homework20417.m Line: 148 Column:
 31
Expression or statement is incorrect--possibly unbalanced (, {, or [.
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