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% Kathryn Atherton
% ABE 301
% Quiz 10

clc
clear


VB = 5; % dimensions liters, assumed constant
VL = 0.4; % dimensions liters, assumed constant
F = 0.1; % dimensions L/min, assumed constant
k = 0.2; % dimensions 1/min

CBe_i = 1.5; % initial condition, dimensions gm/L
CLe_i = 1.5; % initial condition, dimensions gm/L

% Part A: Differential Equations
fprintf('Part A:\n');
fprintf('dCBe/dt = -(F * CBe / VB) + (F * CLe / VL)\n'); % volume/time
 * mass/volume / volume = mass/time.volume, dCBe(t)/dt
fprintf('dCLe/dt = (F * CBe / VB) - (F * CLe / VL) - k * CLe\n'); %
 volume/time * mass/volume / volume = mass/time.volume, 1/time * mass/
volume = mass/time.volume, dCLe(t)/dt

% Part B: Solve for CBe(t) and CLe(t)
fprintf('Part B:\n');
t0 = 0; % Initial time of body concentration point chosen
dt = 0.1; % Step Size
tfinal = 100; % Final time point for interval
tf = tfinal - dt; % Used for setting up end point in loop for x
 interval
finalCBet = [CBe_i]; % Array of CBe values
finalCLet = [CLe_i]; % Array of CLe values
i = 2; % Index for array of f(x) values
tvals = [t0]; % time value array
CBe = CBe_i;
CLe = CLe_i;

for t = t0:dt:tf %Find f(x) values at each stepping point until final
 point
    dCBe = -(F * CBe / VB) + (F * CLe / VL); %f'(x) value at specified
 point
    dCLe = (F * CBe / VB) - (F * CLe / VL) - k * CLe;
    intB = CBe + dCBe*dt; %f(xi+dx) = f(xi) + f'(xi)*dx
    intL = CLe + dCLe*dt;
    CBe = intB;  %Creates new f(x) to start from to find next point
    CLe = intL;
    finalCBet(i) = intB; %Adds found f(x) point to array of f(x)
 values
    finalCLet(i) = intL;
    j = t + dt;
    tvals(i) = j; %Add x values to array
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    i = i + 1; %Increases index array to next point
end

figure
plot(tvals, finalCBet, '-');
hold on
plot(tvals, finalCLet, '-');
title('Part B: Alcohol Concentration vs. Time');
xlim([0,100])
xlabel('Time, minutes');
ylabel('Alcohol Concentration, gmol/L');
legend('CBe', 'CLe', 'Location', 'best');

fprintf('See Figure 1\n');

% Part C: Time to become safe to drive
fprintf('Part C:\n');

CBe_max = 0.075;

t0 = 0; % Initial time of body concentration point chosen
dt = 0.1; % Step Size
tfinal = 100; % Final time point for interval
tf = tfinal - dt; % Used for setting up end point in loop for x
 interval
finalCBet = [CBe_i]; % Array of CBe values
finalCLet = [CLe_i]; % Array of CLe values
i = 2; % Index for array of f(x) values
tvals = [t0]; % time value array
CBe = CBe_i;
CLe = CLe_i;

while CBe > CBe_max
    dCBe = -(F * CBe / VB) + (F * CLe / VL); %f'(x) value at specified
 point
    dCLe = (F * CBe / VB) - (F * CLe / VL) - k * CLe;
    intB = CBe + dCBe*dt; %f(xi+dx) = f(xi) + f'(xi)*dx
    intL = CLe + dCLe*dt;
    CBe = intB;  %Creates new f(x) to start from to find next point
    CLe = intL;
    t = t + dt;
end

t = t - dt;
t = t / 60;

fprintf('The time it takes for the body to be sober enough to drive is
 %.2d hours.',t);

Part A:
dCBe/dt = -(F * CBe / VB) + (F * CLe / VL)
dCLe/dt = (F * CBe / VB) - (F * CLe / VL) - k * CLe
Part B:
See Figure 1
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Part C:
The time it takes for the body to be sober enough to drive is 8.23e+00
 hours.
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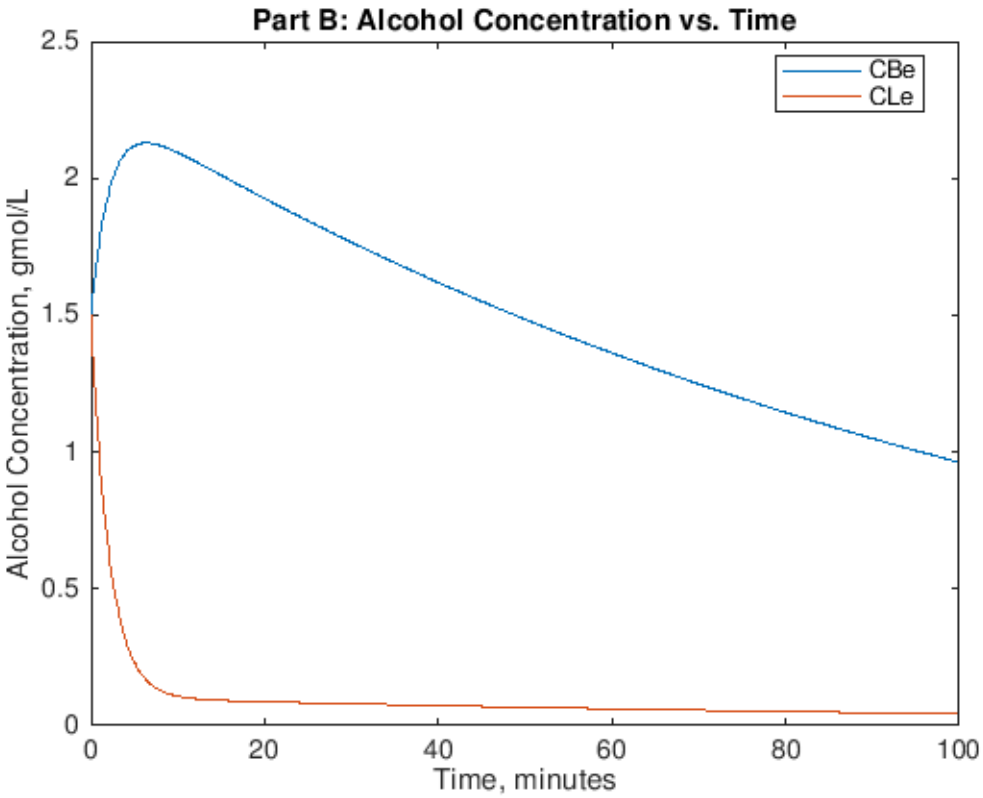

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