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Part 1

```
clc;
clear all;
close all;

alpha = 0;
lambda = 2;
P_standard = 101.325 * 10^3;
P = P_standard;
T_standard = 298;
T_series = 25:5:1000;
T_series = T_series + 273;

for i=1:length(T_series)
    T = T_series(i);
    [eta.LHV(i), eta.HHV(i), eta.actual(i)] = lucio(T, P, alpha, lambda);
    eta.carnot(i) = (1 - (T_standard / T));
end

% Something (might be) wrong with these values
% Plotting for Part 1
figure;
plot(T_series, eta.LHV * 100, T_series, eta.HHV * 100,...
     T_series, eta.actual * 100, T_series, eta.carnot * 100);
xlabel('Temperature (K)');
ylabel('Efficiency (%)');
legend('LHV', 'HHV', '\DeltaH', '\eta_c','Location','Southeast');
title('First Law Efficiency vs. Temperature');
set(gcf, 'color', 'w');
plotfixer;
```

Part 2

```
T_values = [80,220,650,800] + 273; % K
lambda_range = 1:0.5:10;
P_range = 1:1:40; % atm
alpha = 0;

% Change pressure, keep lambda constant
lambda = 2;
for i=1:length(T_values)
    T = T_values(i);
```

```
    for j = 1:length(P_range)
        P = P_range(j) * P_standard;
        eta.p(i, j) = lucio(T, P, alpha, lambda);
    end
end

% Plotting for Part 2a
figure;
plot(P_range, eta.p(1, :) * 100, P_range, eta.p(2, :) * 100,...
     P_range, eta.p(3, :) * 100, P_range, eta.p(4, :) * 100);
xlabel('Pressure (atm)');
ylabel('Efficiency (%)');
legend('80^{\circ}C', '220^{\circ}C', '650^{\circ}C', '800^{\circ}C',...
    'Location','Southeast');
title('First Law Efficiency vs. Pressure');
set(gcf, 'color', 'w');
plotfixer;

% Change lambda, keep pressure constant
P = P_standard;
for i=1:length(T_values)
    T = T_values(i);
    for j = 1:length(lambda_range)
        lambda = lambda_range(j);
        eta.lambda(i, j) = lucio(T, P, alpha, lambda);
    end
end

% Plotting for Part 2b
figure;
plot(lambda_range, eta.lambda(1, :) * 100, lambda_range, ...
     eta.lambda(2, :) * 100, lambda_range, eta.lambda(3, :) * 100,...
     lambda_range, eta.lambda(4, :) * 100)
xlabel('Lambda (-)');
ylabel('Efficiency (%)');
legend('80^{\circ}C', '220^{\circ}C', '650^{\circ}C', '800^{\circ}C',...
    'Location','Southeast');
title('First Law Efficiency vs. Lambda');
set(gcf, 'color', 'w');
plotfixer;
```

Part 3

```
lambda = 2; %makes lambda constant again
T_values = 298:1:373;
for i = 1:length(T_values)
    T = T_values(i);
    [alpha(i), RH(i)] = relHumidity(T, lambda);
end
figure;
plot(T_values, RH);
xlabel('Temperature (K)');
ylabel('Relative Humidity');
```

```
title('Relative Humidity vs. Temperature');
set(gcf, 'color', 'w');
plotfixer;
```

Part 4

```
T_values = 298:1:373;
lambda = 2;
P = P_standard;
for i = 1:length(T_values)
    T = T_values(i);
    [alpha_curr, RH_curr] = relHumidity(T, lambda);
    alpha_100 = john(T, lambda);
    eta.dry(i) = lucio(T, P, 0, lambda);
    eta.hundred(i) = lucio(T, P, alpha_100, lambda);
    eta.sat(i) = lucio(T, P, alpha_curr, lambda);
end

figure
plot(T_values, eta.dry * 100, T_values, eta.hundred * 100,...
     T_values, eta.sat * 100, '--k');
xlabel('Temperature (K)');
ylabel('Efficiency (%)');
title('First Law Efficiency vs. Temperature');
legend('Dry Hydrogen and Air', 'RH = 100% at Inlet', 'Saturation at Exit');
set(gcf, 'color', 'w');
plotfixer;
```

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