```
%AER1216_Assignment3_q1
clear

%% Background Information

rho_s = 1.2250;
temp_s = 288.16;

cl_max = 1.2;
S = 20; % in m2
W = 10000; %in N
AR = 10;
cd_0 = 0.03;
epsilon = 0.7;
K = 1/(pi*epsilon*AR);
cl_TR_min = sqrt(cd_0/K);
Ts = 5000; % in N

%% Part A

heights = 0:50:15000;

V_min = zeros(length(heights),1);
V_TR_min = zeros(length(heights),1);

for i = 1:length(heights)
    h_a = heights(i);
    rho_curr = atm(h_a); % Rho at current Height
    V_min(i) = sqrt(2*W/(S*cl_max*rho_curr));
    V_TR_min(i) = sqrt(2*(W/S)/(rho_curr*cl_TR_min));
end

plot(heights,V_TR_min);
hold on
plot(heights,V_min);
legend({'V optimal for TR min','V min'});
hold off

%% Part B

alt_b = zeros(5,1);
cr_max = zeros(5,1);
v_cr_max = zeros(5,1);

j = 1;
cr_max(length(cr_max)) = 1; % to initiate the loop
while cr_max(length(cr_max)) >= 0.5
    alt_b(j) = 50*(j-1);
    rho_curr = atm(alt_b(j)); % Rho at current Height
    T = (rho_curr/rho_s)*Ts;
    v_cr_max(j) = sqrt((T/S)*(1 +
sqrt(1+(12*cd_0*K/((T/W)^2))))/(3*rho_curr*cd_0));
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```
    cr_max(j) = v_cr_max(j)*((T/W) -
((0.5*rho_curr*cd_0*v_cr_max(j)^2)/(W/S)) -
((2*K*W)/(S*rho_curr*v_cr_max(j)^2)));
    j = j+1;
end

plot(alt_b,cr_max);

%alt_b(length(alt_b))



%% Generating the Standard Atmosphere conditions till 15 Km
function rho = atm(h)    % h taken in Km

rho_s = 1.2250;
temp_s = 288.16;

temp = temp_s + -0.0065*h;

    if h <= 11000
        rho = rho_s*(temp/temp_s)^-(9.8/(-0.0065*287 + 1));
    else
        rho_1 = rho_s*(temp/temp_s)^-(9.8/(-0.0065*287 + 1));
        rho = rho_1*(2.718)^-(9.8*(h-11)/(287*temp));
    end
end
```