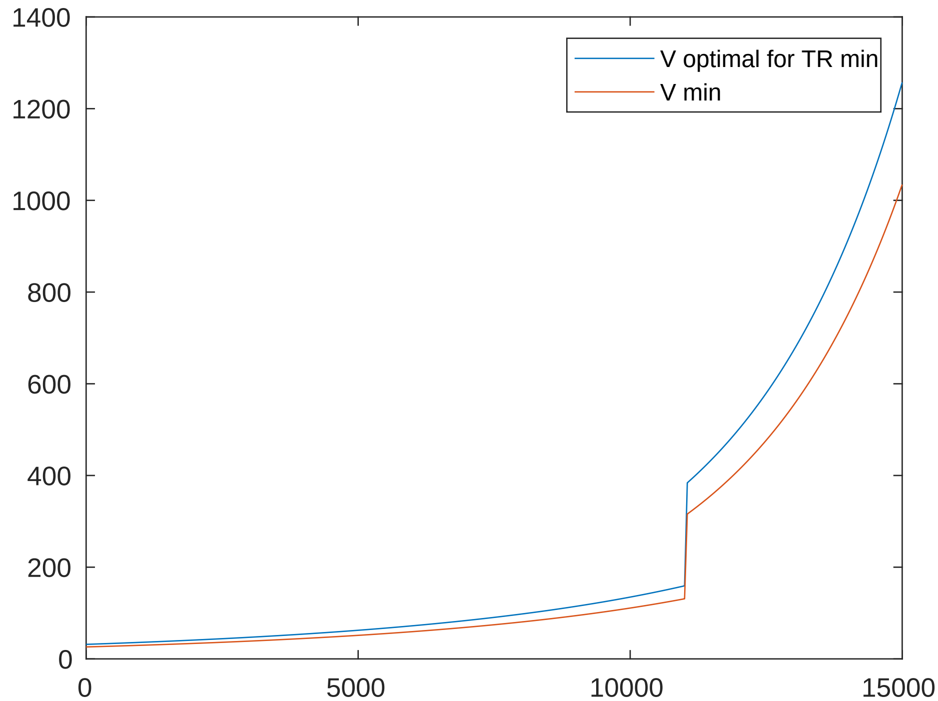
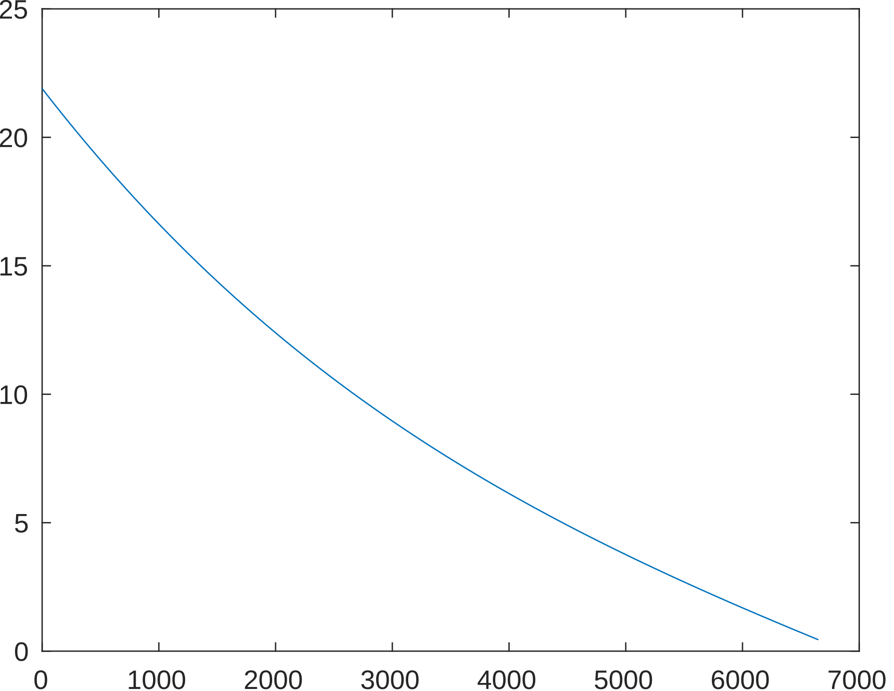
```
%AER1216_Assignment3_q1
clear

%% 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));
```

```
    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
```



1400
1200
1000
800
600
400
200
0
0
5000
10000
15000
V optimal for TR min
V min


25
20
15
10
5
0
0
1000
2000
3000
4000
5000
6000
7000

Code :

```
clear
% AER1216 Assignment3 Q2

W = 8; % in N
cd = 0.7;
S = 0.01; % in m2
k_v = 1050*(2*pi/60); % in rpm/V
i_0 = 0.4; % in A
r_m = 0.12; % in Ohms
k_t = 1/k_v;
r_e = 0.05; % in Ohms

rad = 4*0.0254; % in m
A = 4*pi*(rad)^2; % in m2
rho = 1.225; % in Kg/m3

%% Q2 - Part A
p_ind_momentum = sqrt((W^3)/(2*rho*A))

%% Q2 - Part B
cells = 3;
power = (1300/1000)*3600; % in A-s
e_b = cells*3.7*power;
t_e_momentum = e_b/(p_ind_momentum)

%% Q2 - Part C
% Hover -> V = 0
% We need Thrust  = 2N, Which we recieve for 5000 RPM
% Thus, Power Required = 15.6596973 W * 4

p_actual = 15.6596973 * 4

%% Q2 - Part D
t_e_actual_ideal = e_b/p_actual

%% Q2 - Part E
t_e_actual_actual = t_e_actual_ideal*0.85*0.95

%% Q2 - Part F
c =  12.3063;

d =  -0.000328;

b =  -0.008112;

e =  -4.7809e-7;

a =  -7.7835e-7;

f = 1.4086e-10;

T = W/4; % in N
```

```
ct = 0.1415;
n = sqrt(T/(ct*rho*(2*rad)^4));
Q = 0.030166949343; % in N-m
i_m = Q/k_t + i_0; % in A
omg = 5000;
v_mi = omg/k_v + i_m*r_m;
v_et = v_mi + i_m*r_e;

dt = 0.1; % in s
D = 1; % in mA-hr
t = 0;

while D <= power || k_e < 1

g = (a*D^2 + b*D + c)/(1 + d*D + e*D^2 + f*D^3);
k_e = (v_et*(i_m^0.05)/g)^(1/0.95);
i_b = i_m*k_e;

D = D + i_b*dt;
t = t + dt;

end

t_e_f = t
```

Answers:

All powers in Watts
All time in seconds

part a =

40.1378

part b =

1. 2942e+03

part c =

62.6388

part d =

829.3264

part e =

669.6810