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

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)^(1.052);
i_b = i_m*k_e;

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

end

t_e_f = t


%% Q2 - Part G
values = 0:0.5:20;

thrust_all = zeros(2,1);
p_induced_all = zeros(2,1);
p_tot_all = zeros(2,1);
syms v

for j = 1:length(values)
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```
    V = values(j);
    D = 0.5*rho*V*V*S*cd;
    alpha_d = atan(D/W);
    eqn = v^4 +  (2*V*sin(alpha_d))*v^3 + V^2*v^2 - (W^2 + D^2)/(2*rho*A)^2 == 0;
    thrust = sqrt(W^2 + D^2);
    v_val = double(max(solve(eqn,v, 'Real',true)));
    P_ind = thrust*(v_val);
    P_tot = thrust*(v_val+ V*sin(alpha_d));

    thrust_all(j) = thrust;
    p_induced_all(j) = P_ind;
    p_tot_all(j) = P_tot;
end

specific_power = p_tot_all./values';

plot(values,thrust_all);
hold on;
plot(values,p_induced_all);
plot(values,p_tot_all);
plot(values,specific_power);

legend({'Thrust','Induced Power','Total Power','Specific Total Power'})


Answers:

All powers in Watts
All time in seconds

part a =

   40.1378 W

part b =

   1.2942e+03 s

part c =

   62.6388 W

part d =

  829.3264 s

part e =

  669.6810 s

part f =

   262 s

part g = Plot added

part h =

  t_max =

   1.7846e+03 s


  V =

   11.5000 m/s
```