`Vehicular Electronics HW3

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All code is written in matlab.

**P1.(****a).**

**Source with comment**

|  |
| --- |
| % steady-state discharge rate = C/2  % then, the current at steady-state = 80 / 2 = 40 A  % Now we can find that R = 40 / 12 = 10/3 Ω  L = 90 / 1000;  R = 10 / 3;  V = 12;    syms I(t) t;  dI(t) = diff(I(t), t);  % L \* di/dt + R \* i(t) = V(t) = 12  eqn = L \* dI(t) + R \* I(t) == 12;  % Initial condition (The current is zero at start)  cond = I(0) == 0;  % Solve differential equation  I = dsolve(eqn, cond)    % Plot  fig1 = figure;  ezplot(I, [0, 2, 0, 4], fig1); |

**Answer**

|  |
| --- |
| I =    40 - 40\*exp(-(10\*t)/3) |

****

**P1.(b).**

**Source with comment**

|  |
| --- |
| % SOD(t) = Integral 0 to t {I(t) dt}  SOD(t) = int(I, t);    % Plot  fig2 = figure;  ezplot(SOD, [0, 2], fig2); |

**Answer**

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| --- |
| SOD(t) =    40\*t + 12\*exp(-(10\*t)/3) |



**P1.(c).**

**Source with comment**

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| --- |
| % SOC(t) = Q\_T - SOD(t) = 80 - SOD(t);  SOC(t) = 80 - SOD(t)    % Plot  fig2 = figure;  ezplot(SOC, [0, 2], fig2); |

**Answer**

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| --- |
| SOC(t) =    80 - 12\*exp(-(10\*t)/3) - 40\*t |



**P1.(d).**

**Source with comment**

|  |
| --- |
| % DoD = (Q\_T - SOC(t)) / Q\_T \* 100 = (80-SOC(t)) / 80 \* 100  DoD(t) = (80 - SOD(t)) / 80 \* 100  eqn = DoD(t) == 80;  ans = vpa(solve(eqn, t)) |

**Answer**

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| --- |
| ans =    0.2833300564187140480479809058996 |

**P2.(a).**

**Source with comment**

|  |
| --- |
| syms n l  % Solve the equation  eqns = [10^n \* 67.5 == l, 110^n \* 8 == l];  [soln, soll] = solve(eqns, [n, l])  % Show the approximate value of each variable  valuen = vpa(soln)  valuel = vpa(soll) |

**Answer**

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| --- |
| soln =    -log(16/135)/log(11)    soll =    2^(3 - log(16/135)/log(11))/55^(log(16/135)/log(11))    valuen =    0.8893991661736668685217113081962    valuel =    523.24241204321224213646929369093 |

**P2.(b).**

**Source with comment**

|  |
| --- |
| % SE = E/M = E / 15  % E = Q \* V so SE = Q \* 12 / 15  Q = 67.5 \* 15 / 12 |

**Answer**

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| --- |
| Q =  84.3750 |

**P3.(a).**

**Source with comment**

|  |
| --- |
| % At each cycles, Q = integral 0 to 0.001ms {i(t)} = 100 \* 0.5 / 1000 / 3600 (Ah)  % Q\_T = 400 Ah (4 parallel set of 100 Ah battery)  % DoD(t) = SOD(t) / Q\_T = 0.8  % then SOD(t) = 0.8 Q\_T  % SOD(t) = n \* 100 \* 0.5 / 1000 / 3600 at n = (number of cycle)  c = 100 \* 0.5 / 1000 / 3600;  n = 400 \* 0.8 / c  % take 1ms per every cycle  t = n \* 0.001 % Second  th = t / 3600 % Hour |

**Answer**

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| --- |
| n =  23040000  t =  23040  th =  6.4000 |

**P3.(b).**

**Source with comment**

|  |
| --- |
| % Approximately, In this situation, Every 51 cycles battery discharges  % 50 \* {100 \* 0.5 / 1000 / 3600} (Ah) and regenarates  % 80 \* 0.5 / 1000 / 3600 (Ah)  % So can assume that each cycle, battery discharges  % { 50 \* {100 \* 0.5 / 1000 / 3600} - 80 \* 0.5 / 1000 / 3600 } / 51 (Ah)  c = ( 50 \* (100 \* 0.5 / 1000 / 3600) - 80 \* 0.5 / 1000 / 3600 ) / 51;  n = 400 \* 0.8 / c  % take 1ms per every cycle  t = n \* 0.001 % Second  th = t / 3600 % Hour |

**Answer**

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| --- |
| n =  2.3883e+07  t =  2.3883e+04  th =  6.6341 |

**P4.(a).**

**Source with comment**

|  |
| --- |
| % Before Solving the problem, There is unknown number (only shows  % its ten's digit is 4) following 42 in both figures.  % I assume that it is 45.  % Also, The velocity at t=42 is missing, too  % I assume that it is 20    % Constants  m = 700;  Mb = 150;  C\_D = 0.2;  A\_F = 2;  rho = 1.16;  g = 9.81;  C\_0 = 0.009;    % F\_TR(t) + F\_AD(t) + F\_roll = m \* d v(t) / dt % (F = ma)  % F\_AD(t) = 0.5 \* rho \* C\_D \* A\_F \* v(t)^2  % F\_roll(t) = m \* g \* C\_0 (C\_1 = 0)    syms t V dV  F\_AD(t) = 0.5 \* rho \* C\_D \* A\_F \* V ^ 2;  F\_TR(t) = m \* dV + F\_AD(t) + m \* g \* C\_0  % Plot  fig1 = figure;  hold on  % 0 <= t < 19  v(t) = 32/19 \* t \* (1000/3600);  F\_TR\_1(t) = subs(F\_TR, {V, dV}, {v, diff(v, t)});  ezplot(F\_TR\_1, [0, 19], fig1);  % 19 <= t < 38  v(t) = 32 \* (1000/3600);  F\_TR\_2(t) = subs(F\_TR, {V, dV}, {v, diff(v, t)});  ezplot(F\_TR\_2, [19, 38], fig1);  % 38 <= t < 42  v(t) = ((32 + 3 \* 38) - 3 \* t) \* (1000/3600);  F\_TR\_3(t) = subs(F\_TR, {V, dV}, {v, diff(v, t)});  ezplot(F\_TR\_3, [38, 42], fig1);  % 42 <= t < 45  v(t) = ((20 + (20 / 3) \* 42) - (20 / 3) \* t) \* (1000/3600);  F\_TR\_4(t) = subs(F\_TR, {V, dV}, {v, diff(v, t)});  ezplot(F\_TR\_4, [42, 45], fig1);  title('F\_{TR}(t)')  axis auto |

**Answer**



**P4.(b).**

**Source with comment**

|  |
| --- |
| %P\_TR = F\_TR \* v  P\_TR(t) = F\_TR(t) \* V;  % Plot  fig2 = figure;  hold on  % 0 <= t < 19  v(t) = 32/19 \* t \* (1000/3600);  P\_TR\_1(t) = subs(P\_TR, {V, dV}, {v, diff(v, t)});  ezplot(P\_TR\_1, [0, 19], fig2);  % 19 <= t < 38  v(t) = 32 \* (1000/3600);  P\_TR\_2(t) = subs(P\_TR, {V, dV}, {v, diff(v, t)});  ezplot(P\_TR\_2, [19, 38], fig2);  % 38 <= t < 42  v(t) = ((32 + 3 \* 38) - 3 \* t) \* (1000/3600);  P\_TR\_3(t) = subs(P\_TR, {V, dV}, {v, diff(v, t)});  ezplot(P\_TR\_3, [38, 42], fig2);  % 42 <= t < 45  v(t) = ((20 + (20 / 3) \* 42) - (20 / 3) \* t) \* (1000/3600);  P\_TR\_4(t) = subs(P\_TR, {V, dV}, {v, diff(v, t)});  ezplot(P\_TR\_4, [42, 45], fig2);  title('P\_{TR}(t)')  axis auto |

**Answer**



**P4.(c).**

**Source with comment**

|  |
| --- |
| %f\_cycle = integral of I^n / lambda  syms I  I1 = (100 / 19 \* I) ^ 0.9 / 216E4;  I2 = (35 + 0 \* I) ^ 0.9 / 216E4; % dummy zero for assume this as symbolic function  f\_cycle = vpa(int(I1, [0, 19]) + int(I2, [19, 38]));  % # of cycle required for 100% DoD  N = 1 / f\_cycle    % How much EV goes at 1 cycle : integral of v(t)  lengthsum = 0;  % 0 <= t < 19  v(t) = 32/19 \* t \* (1000/3600);  lengthsum = lengthsum + vpa(int(v, [0, 19]));  % 19 <= t < 38  v(t) = 32 \* (1000/3600) + 0 \* t; % dummy zero for assume this as symbolic function  lengthsum = lengthsum + vpa(int(v, [19, 38]));  % 38 <= t < 42  v(t) = ((32 + 3 \* 38) - 3 \* t) \* (1000/3600);  lengthsum = lengthsum + vpa(int(v, [38, 42]));  % 42 <= t < 45  v(t) = ((20 + (20 / 3) \* 42) - (20 / 3) \* t) \* (1000/3600);  lengthsum = lengthsum + vpa(int(v, [42, 45]));  lengthsum    % EV range = N \* (length at 1 cycle)  lm = N \* lengthsum % Meter  lmi = lm / 1609.344 % Mile |

**Answer**

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| --- |
| N =    1969.0272356916214259231747347698    lengthsum =    290.55555555555555555555555555556    lm =    572111.80237039889208767799238033    lmi =    355.49379273194473896306421512105 |