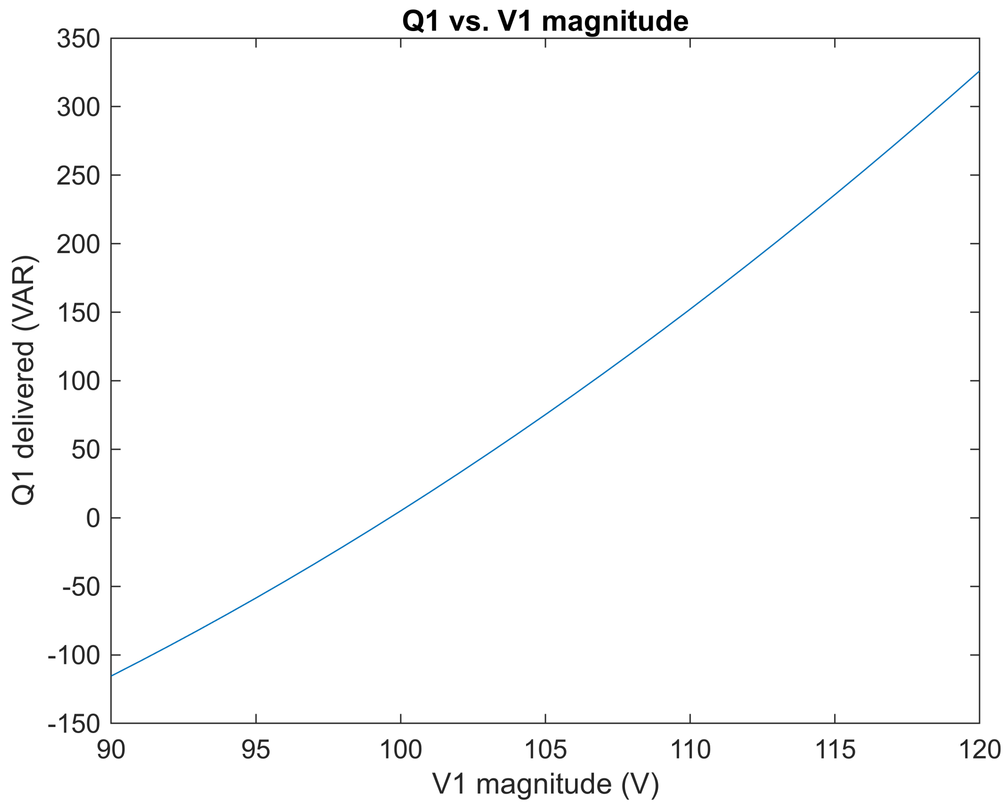
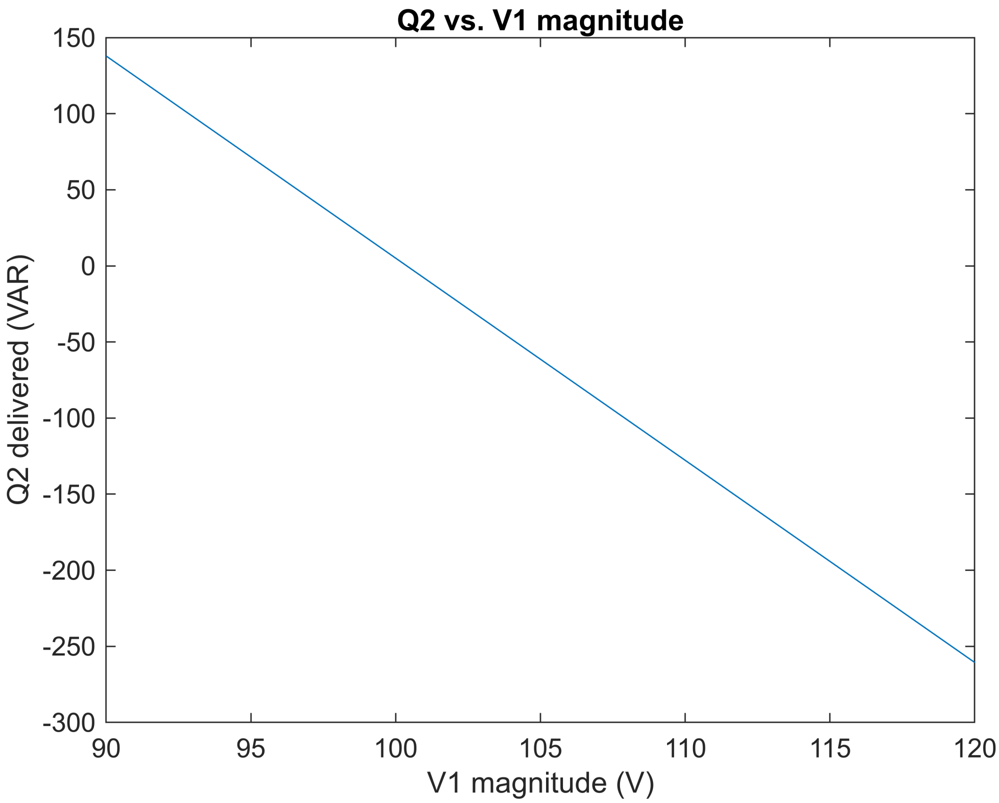
```
% a) Compute the complex power at point 1 and 2 and power losses of the line
V2 = 100;                                 % source V2 (V)
ZL = 0.0 + 7.5i;                          % line impedance (ohms)
magnitude = [90:120];                     % V1 magnitude from 75% (90) to 100% (120)
V1 = magnitude*(cosd(-5) + sind(-5)*i);   % source V1 (V)
VL = V1 - V2;                             % voltage across line impedance, ZL (V)
I12 = VL/ZL;                              % line current, I12 (A)
I21 = -I12;                               % line current, I21 (A)

P1 = real(V1.*conj(I12));         % real power delivered at point 1, Q1 (W)
Q1 = imag(V1.*conj(I12));         % reactive power delivered at point 1, Q1 (VAR)
P2 = real(V2.*conj(I21));         % real power delivered at point 2, Q2 (W)
Q2 = imag(V2.*conj(I21));         % reactive power delivered at point 2, Q2 (VAR)
PL = real(VL.*conj(I12));         % real power absorbed at line impedance (W)
QL = imag(VL.*conj(I12));         % reactive power absorbed at line impedance (VAR)


% b) Tabulate the reactive powers and plot Q1 Q2, QL, versus voltage magnitude V1.
T = table(rot90(magnitude, 3), rot90(Q1, 3), rot90(Q2, 3), rot90(QL, 3),
'VariableNames', {'V1 magnitude (V)', 'Q1 delivered (VAR)', 'Q2 delivered (VAR)',
'QL absorbed (VAR)'});
disp(T)
```

V1 magnitude (V)	Q1 delivered (VAR)	Q2 delivered (VAR)	QL absorbed (VAR)
90	-115.43	137.9	22.466
91	-104.58	124.62	20.034
92	-93.465	111.33	17.869
93	-82.081	98.052	15.97
94	-70.431	84.769	14.339
95	-58.513	71.487	12.973
96	-46.329	58.204	11.875
97	-33.878	44.922	11.043
98	-21.161	31.639	10.478
99	-8.177	18.356	10.179
100	5.0737	5.0737	10.147
101	18.591	-8.2089	10.382
102	32.375	-21.491	10.884
103	46.426	-34.774	11.652
104	60.743	-48.057	12.687
105	75.327	-61.339	13.988
106	90.178	-74.622	15.556
107	105.3	-87.904	17.391
108	120.68	-101.19	19.493
109	136.33	-114.47	21.861
110	152.25	-127.75	24.496
111	168.43	-141.03	27.397
112	184.88	-154.32	30.565
113	201.6	-167.6	34
114	218.58	-180.88	37.701
115	235.83	-194.17	41.67
116	253.35	-207.45	45.904
117	271.14	-220.73	50.406
118	289.19	-234.01	55.174
119	307.5	-247.3	60.209
120	326.09	-260.58	65.51

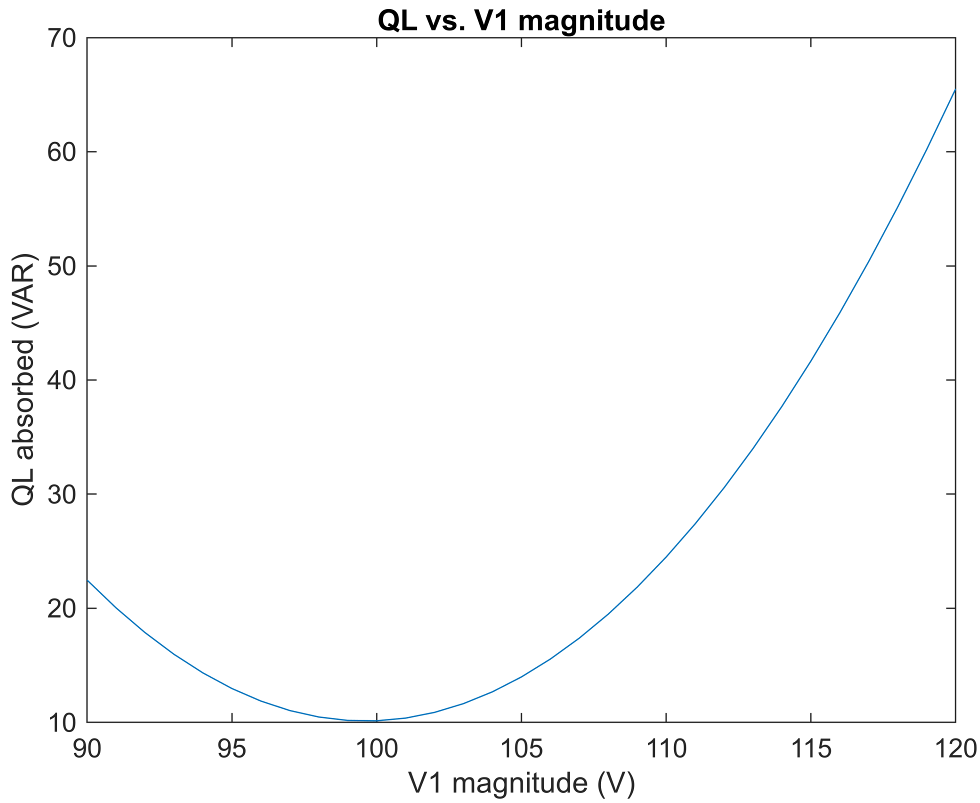
```
% Q1 vs. V1 plot
plot(magnitude, Q1)
title('Q1 vs. V1 magnitude')
xlabel('V1 magnitude (V)')
ylabel('Q1 delivered (VAR)')
```




```
% Q2 vs. V1 plot
plot(magnitude, Q2)
title('Q2 vs. V1 magnitude')
xlabel('V1 magnitude (V)')
ylabel('Q2 delivered (VAR)')
```




```
% QL vs. V1 plot
plot(magnitude, QL)
title('QL vs. V1 magnitude')
xlabel('V1 magnitude (V)')
ylabel('QL absorbed (VAR)')
```




```
% c) Compare and discuss about the results

% The first plot (almost linear) shows that reactive power is first
% absorbed (negative) by point 1 before the magnitude of V1 reaches
% about 100V (similar to question 2). Point 1 then delivers reactive
% power (positive) to the rest of the circuit as in question 2.

% The second plot (linear) shows that reactive power is first delivered
% (positive) by point 2 till the magnitude of V1 reaches about 100V
% (as in question 2). Point 2 then absorbs reactive power (absorbs)
% from the rest of the circuit like in question 2.

% The third plot is also similar to that in question 2. It shows that
% the line impedance only absorbs reactive power (always positive).
% This curve is also parabolic where its lowest point is at 10 VAR and
% at exactly 100V. Similar to question 2, when points 1 and 2 deliver
% the same amount of reactive power (at 100V), the line impedance aborbs
% all of the reactive power and counters the small phase difference of 5
% degrees between the two points. However, in this case there is no
% resistive load in the line impedance meaning that points 1 and 2 deliver
% exactly the same reactive power at 100V (when both points have identical
% magnitudes). On the other hand, question 2 showed similar results
% because the resistive load in the line was very small. In conclusion,
% having a resistive load shifts the voltage magnitude at point 1 away
% from 100V (also voltage magnitude of V2) when both points 1 and 2 deliver
% the same reactive power.
```