```
clc
clear all
syms R xtheta rtheta r0 b wtheta
format default
wh = 12
```

```
wh = 12
```

```
wtheta = 30
```

```
wtheta = 30
```

```
b = 40
```

```
b = 40
```

```
R = wh./wtheta
```

```
R = 0.4000
```

```
rtheta = 0.45.*b.^2
```

```
rtheta = 720
```

```
xbar = 0.09
```

```
xbar = 0.0900
```

```
xtheta = 0.09.*b
```

```
xtheta = 3.6000
```

```
bxtheta = b.*xtheta
```

```
bxtheta = 144
```

```
Bxtheta = linspace(-1,1,100).*b
```

```
Bxtheta = 1×100
  -40.0000  -39.1919  -38.3838  -37.5758  -36.7677  -35.9596  -35.1515  -34.3434 ···
```

```
r0 = (rtheta.^2- bxtheta.^2).^0.5
```

```
r0 = 705.4530
```

```
Ro = (rtheta.^2- Bxtheta.^2).^0.5
```

```
Ro = 1×100
  718.8880  718.9325  718.9761  719.0188  719.0606  719.1015  719.1414  719.1805 ···
```

```
omegasq1 = (1 + R^2 + sqrt((1-R^2)^2+4*R^2*(bxtheta/rtheta)^2)) /(2*(r0/rtheta)^2)
```

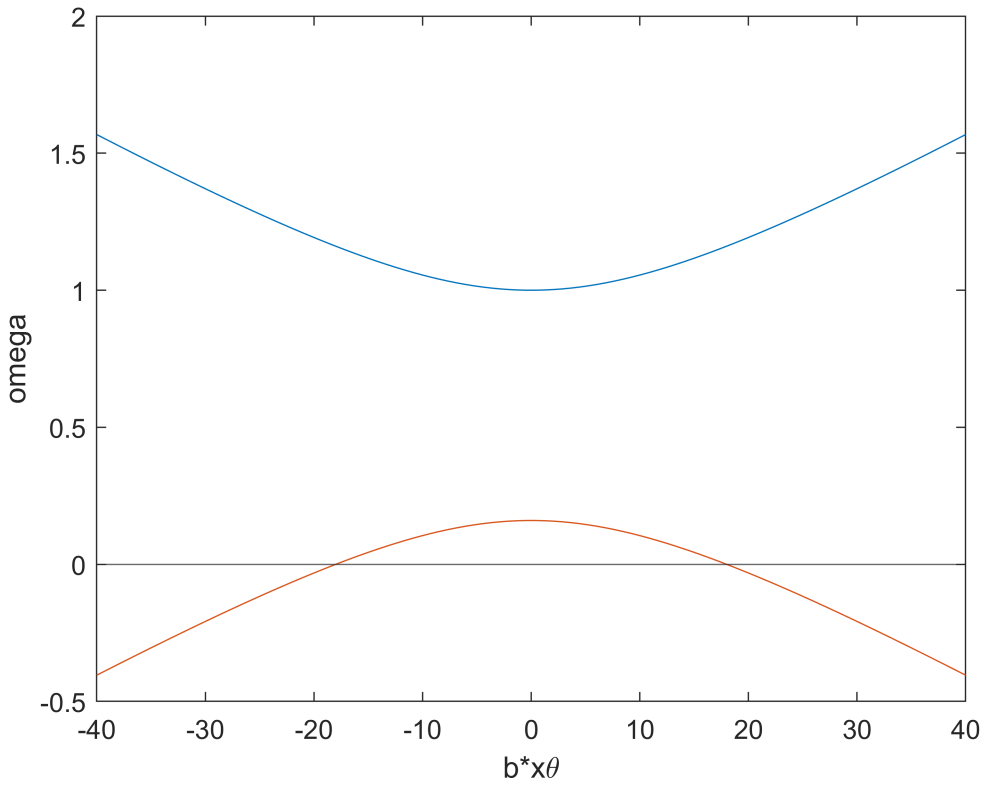
```
omegasq1 = 1.0495
```

```
omegasq2 = (1 + R^2 - sqrt((1-R^2)^2+4*R^2*(bxtheta/rtheta)^2)) /(2*(r0/rtheta)^2)
```

```
omegasq2 = 0.1588
```

```
for i= 1:length(Bxtheta)
Omega1(i) = ((1 + R.^2) - (sqrt((1 - (R.^2)).^2 + 4.*(R^2).*(Bxtheta(i).*b ./rtheta).^2))./(2
```

```
Omega2(i) = ((1 + R.^2) + (sqrt((1 - (R.^2)).^2 + 4.*(R^2).*(Bxtheta(i).*b ./rtheta).^2))).//(2
end
plot(Bxtheta,Omega2)
hold on
plot(Bxtheta,Omega1)
yline(0)
xlabel('b*x\theta')
ylabel('omega')
hold off
```




```
omega1 = sqrt(omegasq1)
```

```
omega1 = 1.0245
```

```
omega2 = sqrt(omegasq2)
```

```
omega2 = 0.3985
```

```
A = [omega1.^2 + R.^2, -omega1.^2 .*xtheta; -omega1.^2 .*xtheta, (-omega1.^2 + 1).*rtheta.^2]
```

```
A = 2×2
10^4 ×
    0.0001   -0.0004
   -0.0004   -2.5678
```

```
B = [omega2.^2 + R.^2, -omega2.^2 .*xtheta; -omega2.^2 .*xtheta, (-omega2.^2 + 1).*rtheta.^2]
```

```
B = 2×2
10^5 ×
    0.0000   -0.0000
```

```
   -0.0000    4.3608
```

```
phi1 = (omega1^2+R^2-omega1^2*bxtheta)/ (omega1^2*bxtheta - ((-omega1^2+1)*rtheta^2))
```

```
phi1 = -0.0058
```

```
phi_ratio1 = omega1^2*xbar/(R^2-omega1^2)
```

```
phi_ratio1 = -0.1062
```

```
phi_ratio2 = omega2^2*xbar/(R^2-omega2^2)
```

```
phi_ratio2 = 11.9187
```

```
ubar_12 = 1/phi_ratio2
```

```
ubar_12 = 0.0839
```

```
Phi1 = [1;ubar_12]
```

```
Phi1 = 2×1
    1.0000
    0.0839
```

```
Phi2 = [phi_ratio1;1]
```

```
Phi2 = 2×1
   -0.1062
    1.0000
```

```
rtheta_b = 0.45
```

```
rtheta_b = 0.4500
```

```
Cl = 6.5
```

```
Cl = 6.5000
```

```
mu = 15
```

```
mu = 15
```

```
a = 0.2
```

```
a = 0.2000
```

```
bxa = (b - 0.25.*(2*b))
```

```
bxa = 20
```

```
eb = (bxa + b*(a))./(b)
```

```
eb = 0.7000
```

```
db = eb + xbar
```

```
db = 0.7900
```

```
Vb = linspace(0,2.5,100)
```

```
Vb = 1×100
         0    0.0253    0.0505    0.0758    0.1010    0.1263    0.1515    0.1768 ···
```

```
A = rtheta_b.^2 - xbar.^2
```

```
A = 0.1944
```

```
B = rtheta_b.^2.*(1+R.^2) - ((db.*Cl)./(pi.*mu)).*Vb.^2
```

```
B = 1×100
    0.2349    0.2348    0.2346    0.2343    0.2338    0.2332    0.2324    0.2315 ···
```

```
C = rtheta_b.^2.*R.^2 - ((R.^2.*Cl.*eb)./(mu.*pi))*Vb.^2
```

```
C = 1×100
    0.0324    0.0324    0.0324    0.0323    0.0322    0.0322    0.0320    0.0319 ···
```

```
O1 = (B + sqrt((B.^2) - (4.*A.*C)))./(2.*A)
```

```
O1 = 1×100 complex
   1.0495 + 0.0000i   1.0492 + 0.0000i   1.0481 + 0.0000i   1.0463 + 0.0000i ···
```

```
O2 = (B - sqrt((B.^2) - (4.*A.*C)))./(2.*A)
```

```
O2 = 1×100 complex
   0.1588 + 0.0000i   0.1588 + 0.0000i   0.1588 + 0.0000i   0.1589 + 0.0000i ···
```

```
B1 = rtheta_b.^2.*(1+R.^2) - ((db.*Cl)./(pi.*mu)).*Vb.^2
```

```
B1 = 1×100
    0.2349    0.2348    0.2346    0.2343    0.2338    0.2332    0.2324    0.2315 ···
```

```
C1 = rtheta_b.^2.*R.^2 - ((R.^2.*Cl.*eb)./(mu.*pi)).*Vb.^2
```

```
C1 = 1×100
    0.0324    0.0324    0.0324    0.0323    0.0322    0.0322    0.0320    0.0319 ···
```

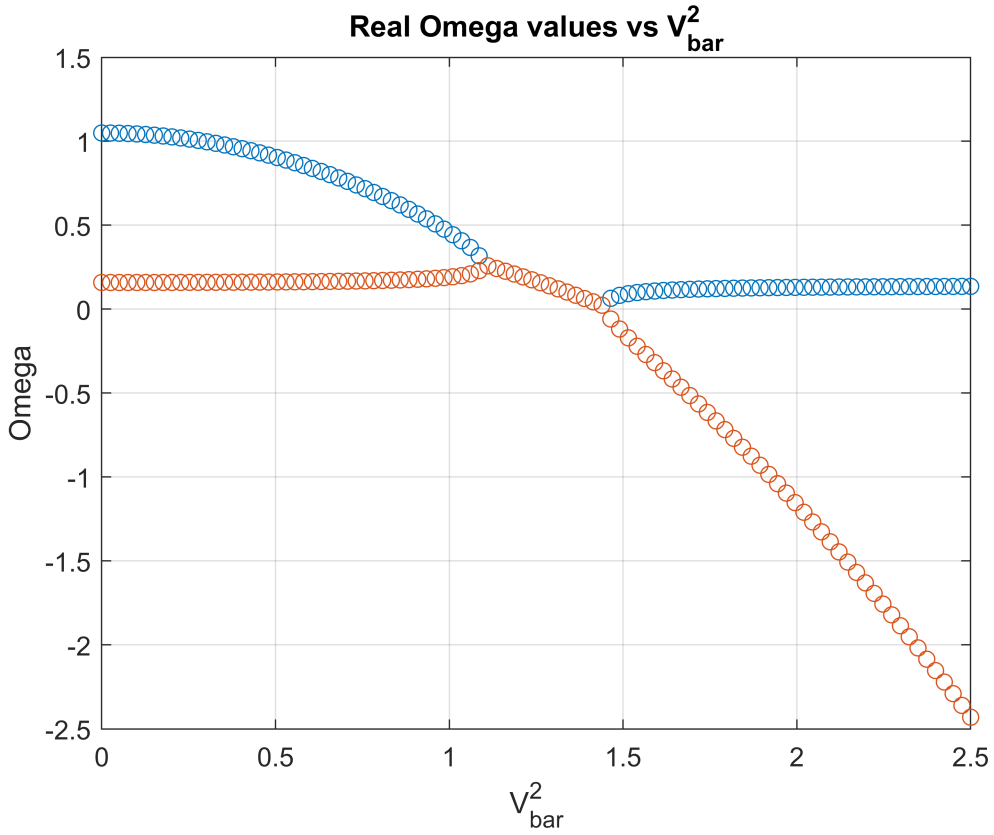
```
O11 = (B1 + sqrt((B1.^2) - (4.*A.*C1)))./(2.*A)
```

```
O11 = 1×100 complex
   1.0495 + 0.0000i   1.0492 + 0.0000i   1.0481 + 0.0000i   1.0463 + 0.0000i ···
```

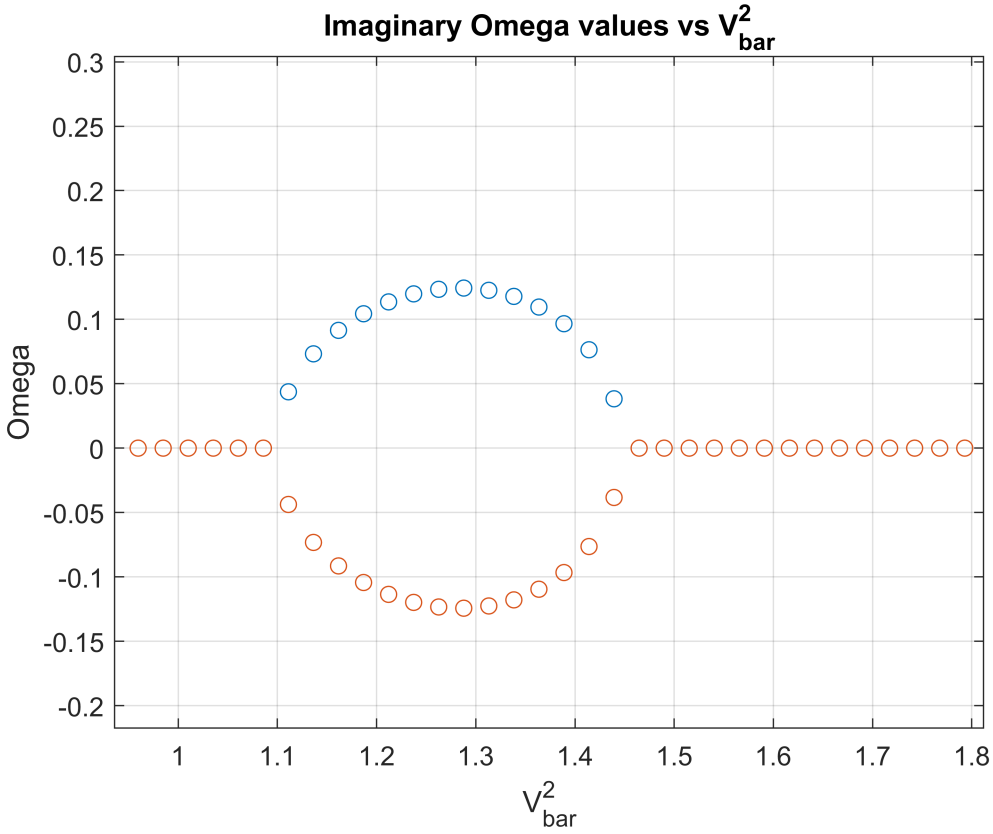
```
O22 = (B1 - sqrt((B1.^2) - (4.*A.*C1)))./(2.*A)
```

```
O22 = 1×100 complex
   0.1588 + 0.0000i   0.1588 + 0.0000i   0.1588 + 0.0000i   0.1589 + 0.0000i ···
```

```
plot(Vb, real(O1), 'o')
hold on
plot (Vb,real(O2), 'o')
grid on
hold off
ylabel ("Omega")
xlabel ("V_{bar}^2")
title ('Real Omega values vs V_{bar}^2')
```



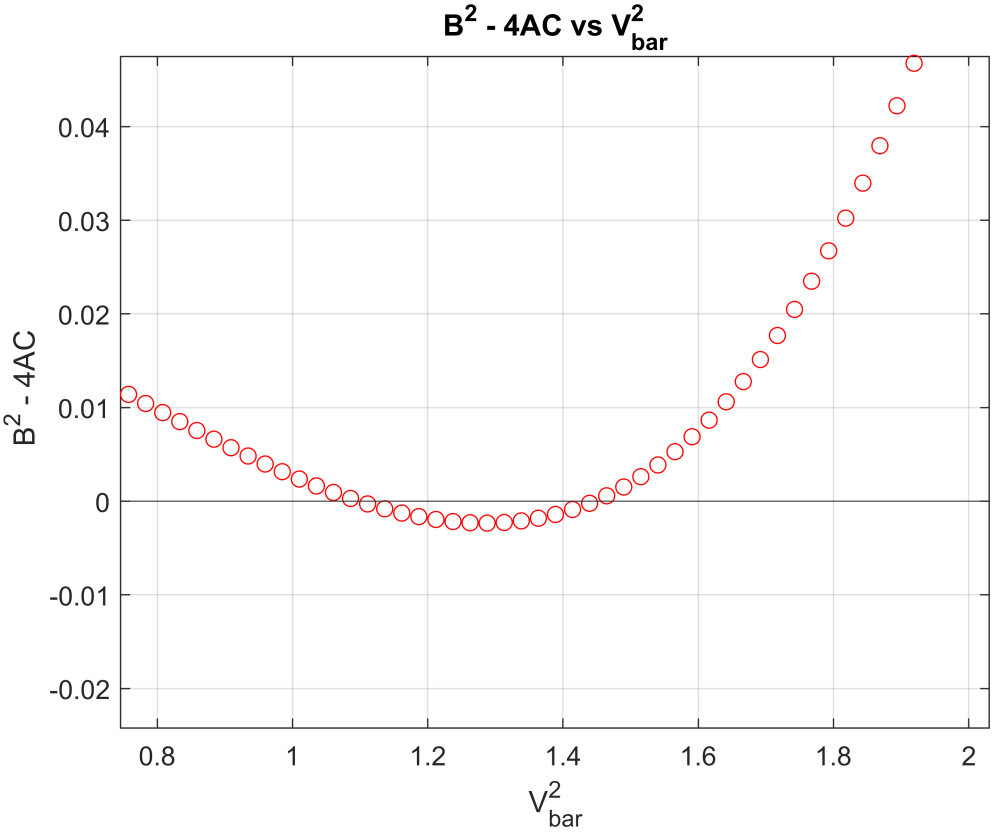

```
plot(Vb, imag(O11),'o')
hold on
plot (Vb,imag(O22), 'o')
grid on
hold off
xlim([0.936 1.812])
ylim([-0.242 0.389])
ylabel ("Omega")
xlabel ("V_{bar}^2")
title ('Imaginary Omega values vs V_{bar}^2')
```




```
D2 = B1.^2 - 4.*A.*C1
```

```
D2 = 1×100
    0.0300    0.0300    0.0299    0.0298    0.0296    0.0294    0.0291    0.0288 ···
```

```
plot(Vb,real(D2), 'ro')
grid on
yline(0)
xlim([0.746 2.031])
ylim([-0.0242 0.0475])
ylabel (" B^2 - 4AC")
xlabel ("V_{bar}^2")
title ('B^2 - 4AC vs V_{bar}^2')
```


B2 - 4AC vs V2bar
0.04
0.03
0.02
0.01
0
-0.01
-0.02
B2 - 4AC
0.8
1
1.2
1.4
1.6
1.8
2
V2bar