Given: Journal bearing with $C_r = 0.0017$, $r = 0.75$ in, $\varepsilon = 0.6$, $\mu = 2.2\ \mu$reyn, $n = 20$ rev/sec, and $p_o = 0$.

Find: (a) Plot of Sommerfeld equation for $\theta = 0 \rightarrow \pi$.

(b) Plot of Sommerfeld equation for $\theta = 0 \rightarrow 2\pi$.

Is solution from $\pi \rightarrow 2\pi$ possible?

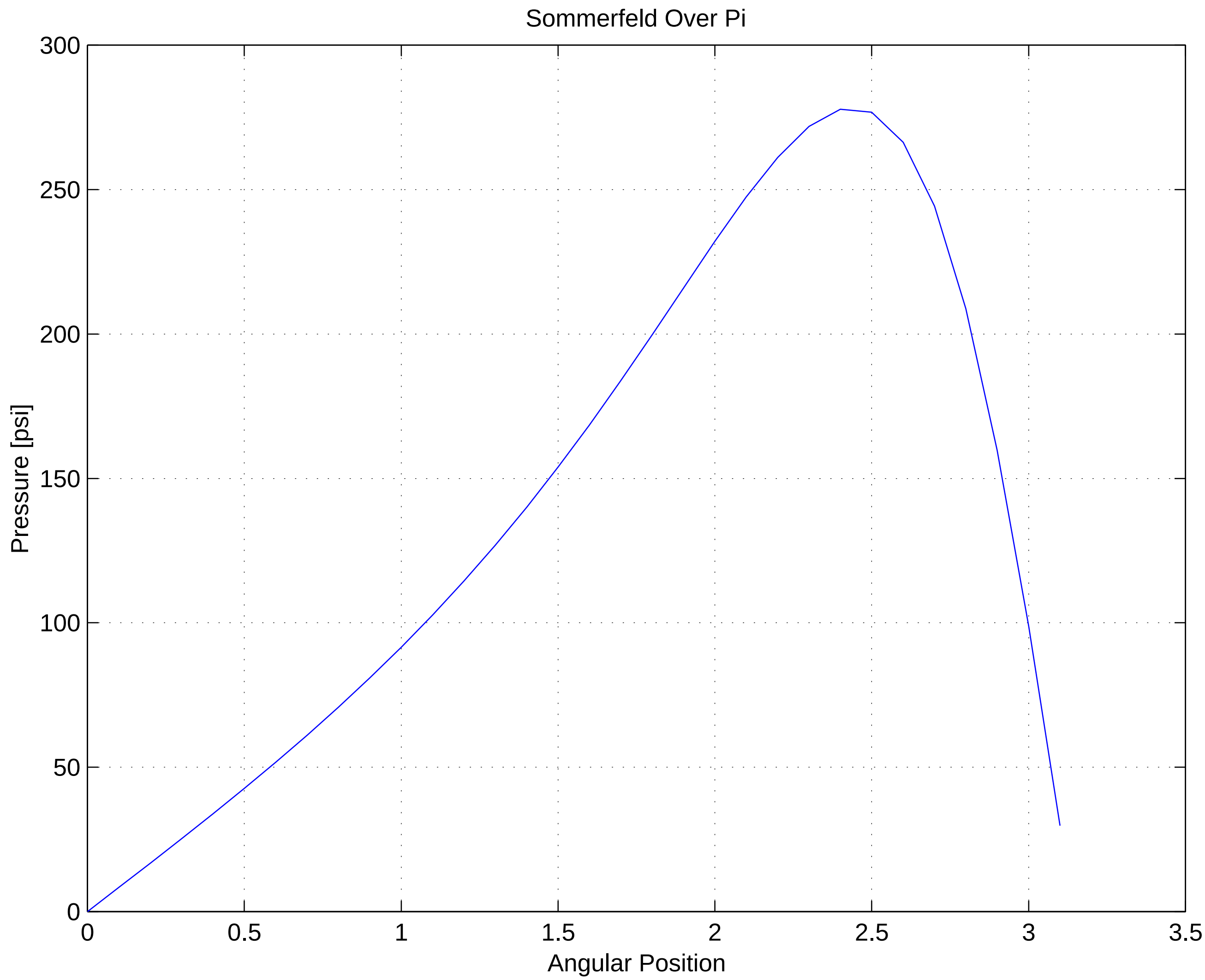
Solution: The Sommerfeld equation is

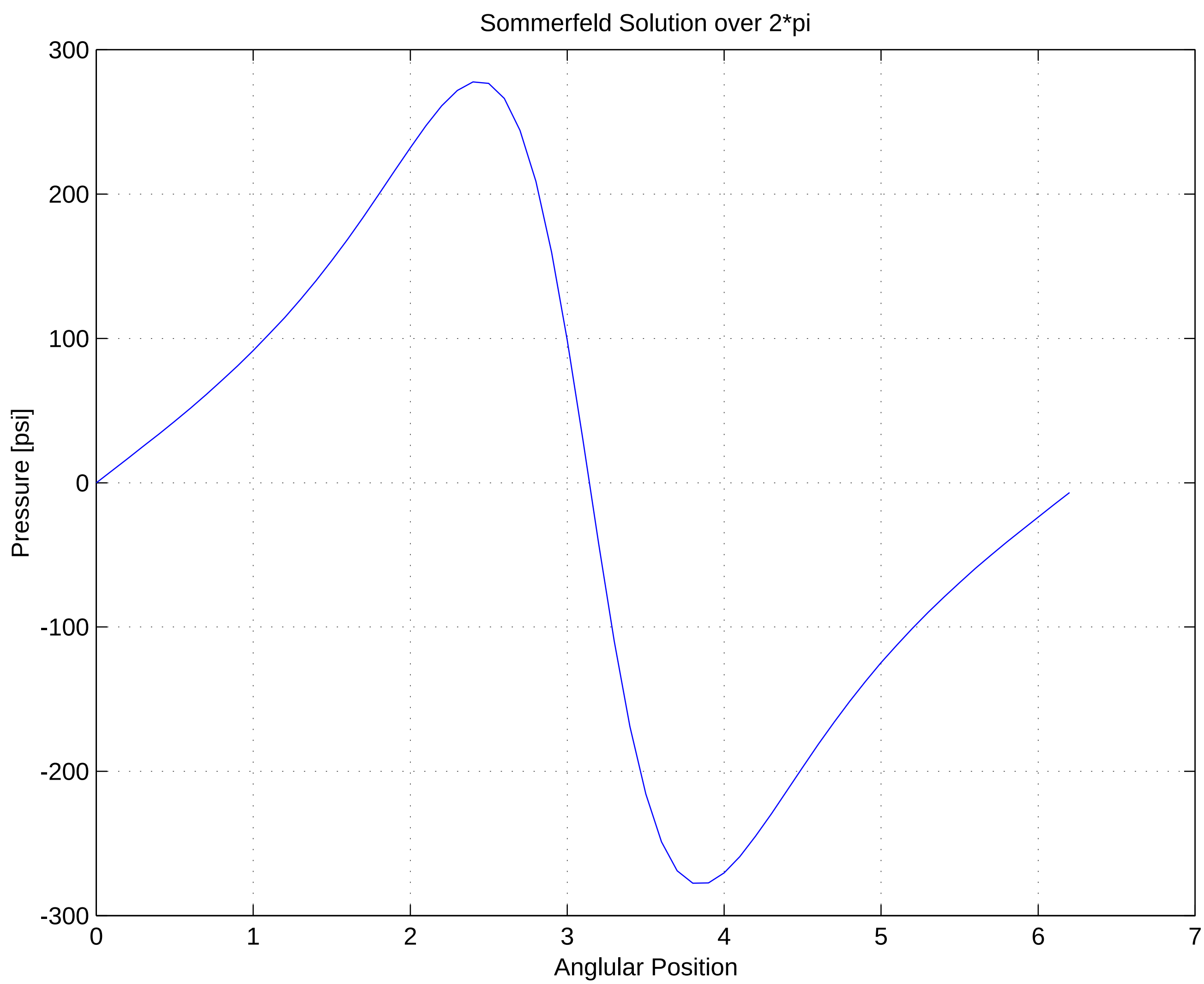
$$p = \frac{\mu U r}{C_r^2}\left[\frac{6\varepsilon \sin\theta\,(2+\varepsilon\cos\theta)}{(2+\varepsilon)^2(1+\varepsilon\cos\theta)^2}\right] + p_o$$

The MATLAB program used to generate the plots and the plots for part a and b are attached.

The Sommerfeld equation predicts a negative absolute pressure for $\pi \leq \theta \leq 2\pi$. This is physically impossible. The oil will boil when the pressure drops below its vapor pressure.

```
% Machine Design Lecture 25
% Sommerfeld Pressure Solution
% for Hydrodynamic Bearing

e=0.6;
cr=0.0017;
r=0.75;
mu=2.2e-6;
p0=0;
n=20;
U=r*2*pi*n;

ang=0:0.1:pi;

sinang=sin(ang);
cosang=cos(ang);
numer=6*e*sinang.*(2+e*cosang);
denom=(2+e^2)*(1+e*cosang).^2;
p=(mu*U*r/cr^2)*numer./denom;

plot(ang,p)
```


Sommerfeld Over Pi
Pressure [psi]
Angular Position
300
250
200
150
100
50
0
0
0.5
1
1.5
2
2.5
3
3.5


Sommerfeld Solution over 2*pi
Pressure [psi]
Anglular Position
300
200
100
0
-100
-200
-300
0
1
2
3
4
5
6
7