## Due Tuesday May 12

## Read: Chapter 10

Problem - The 2-D stream function for potential flow over an elliptically shaped body at zero angle of attack is produced by the superposition of a uniform flow plus a source and a sink of equal strength. The stream function and flow pattern are

$$
\Psi=U_{\infty} y+\frac{Q}{2 \pi} \operatorname{ArcTan}\left(\frac{y}{x+a}\right)-\frac{Q}{2 \pi} \operatorname{ArcTan}\left(\frac{y}{x-a}\right)
$$



Choose two aspect ratios for the ellipse (length/width $=2$, length $/$ width $=20$ ).

1) Use the potential flow solution to determine the pressure coefficient on the body.
2) Use Thwaites' method to calculate the properties of the laminar boundary layer up to separation. How does the separation point depend on the aspect ratio of the ellipse? Use the radius of curvature at the forward stagnation point to initiate the calculation.
3) Use Head's method to do the same for a turbulent boundary layer. For a given aspect ratio how does the separation point depend on the Reynolds number based on the length of the body?
