1. **Tough to visualize the \( \theta \) coordinate?** (1 student)
   It’s similar to the physical \( x \) coordinate, except that the \( \theta \) coordinate is more “bunched up” at the leading edge and trailing edge. Imagine sliding along the half-circle (3rd figure in F2 notes) at a uniform speed in \( \theta \). Your horizontal velocity in \( x \) will be very slow near the leading edge, normal in the middle, and then slow again near the trailing edge.

2. **What’s the origin that \( \theta \) is measured from? The quarter-chord?** (1 student)
   No, from the leading edge. As \( x \) runs from 0 to \( c \) along the chord, \( \theta \) runs from 0 to \( \pi \). See the 3rd figure in F2 notes.

3. **What exactly is the Fourier series representing?** (1 student)
   The function \( f(\theta) \equiv \alpha - dZ/dx \). This is the angle between the freestream direction and the camberline surface.

4. **What does \( c_{m,c/4} = \frac{\pi}{4}(A_2 - A_1) \) physically mean?** (1 student)
   The moment about the quarter-chord point can be written as the net moment of all the lift forces \( dL' \) distributed on the airfoil, each with moment arm \((c/4 - x)\). Therefore:

\[
M'_{c/4} = \int (c/4 - x) \, dL' = \int \rho V_\infty \gamma (c/4 - x) \, dx
\]

When you plug in the \( A_n \) series for \( \gamma \) and do the integral, only the \( A_1 \) and \( A_2 \) terms end up nonzero. Nondimensionalizing then gives \( c_{m,c/4} \), still only involving \( A_1 \) and \( A_2 \).

5. **You wrote two expressions for \( A_0 \) and two for \( A_n \). Which ones do we use?** (1 student)
   The first expressions were for any general \( f(\theta) \). The second expressions had our particular \( f(\theta) \), and hence are specific to TAT. So we’ll be using the second forms.

6. **How do you know \( \frac{1}{\pi} \int_0^\pi f(\theta) \, d\theta \) is the average?** (1 student)
   The **definition** of a function over an interval \( a \ldots b \) is

\[
\frac{1}{b-a} \int_a^b F(t) \, dt
\]

7. **Why was \( \alpha \) taken out of the \( A_0 \) integral, and why did it disappeared from \( A_n \)?** (1 student)
   Since \( \alpha \) is a constant, I just integrated it trivially.

\[
\frac{1}{\pi} \int_0^\pi \alpha \, d\theta = \alpha
\]

It disappeared from the \( A_n \) integrals because

\[
\frac{2}{\pi} \int_0^\pi \alpha \cos n \theta \, d\theta = 0
\]

for any integer \( n > 0 \).
8. Why does $M_{LE}'$ have an $A_0$ term, but $M_{c/4}'$ doesn’t? (1 student)
That’s just how it comes out. Intuitively, if you look at $A_0$’s function $(1 + \cos \theta)/\sin \theta$
plotted in $x$, you can sorta see it has zero moment about the quarter-chord point. So $M_{c/4}'$ cannot be affected by $A_0$, and hence cannot be affected by $\alpha$.

9. How else are Fourier series used? (1 student)
We will use them again when we look at 3-D wings.

10. Isn’t the moment about the quarter chord always zero? (1 student)
It is not zero for a general cambered airfoil. It is zero only for a symmetrical (zero-camber) airfoil, and also for some special reflexed airfoils which have S-shaped camber lines.

11. Still don’t understand what $\theta_o$ is. (1 student)
To evaluate $w(x)$ from the vortex sheet, we need two $x$-locations:
1) the $x$ where $w$ is being calculated, simply called “$x$”.
2) the $x$ location where the piece of the vortex sheet is being considered, called “$\xi$”.
The $\theta$-value corresponding to $x$ is called “$\theta_o$”.
The $\theta$-value corresponding to $\xi$ is called “$\theta$”.

12. Are we supposed to be able to reproduce all this math? (1 student)
You are expected to understand the concepts involved. The “math” really just boils down to a few integrals in the end. I don’t expect you to memorize all the formulas. A practicing aerodynamicist can always look them up.

13. Explain how you got the PRS result again. (1 student)
Difficult without a board. I’ll go over it in F4.

14. Completely lost in the math. (5 students)
I’ll work out an application example in the F4 lecture. Hopefully that will help.

15. No mud (9 students)