California State Polytechnic University, Pomona
Aerospace Engineering Department

ARO 3011-02   **Quiz 6**
Open book, open notes. 15 minutes.

BLT = Boundary Layer Theory; **NLLT** = Numerical Lifting Line Theory; **PMT**: Propeller Momentum Theory (also called Actuator Disk Theory); **P**: Piston Engine; **T**: Turboprop Engine

1. Which BL flow has more energy and momentum, laminar or (turbulent?) _____

2. During takeoff and landing, in the presence of large adverse pressure gradients, we prefer to have ___turbulent___ BLs on flaps.

3. One of the key findings of BLT is that within the BL normal to the wall $\frac{\partial p}{\partial y} =$ ⓞ

4. At a given point, as Reynolds number increases, the boundary layer thickness ___decreases___

5. For BL on a flat plate, define Cf using the usual symbols: $C_f \equiv T_w / (\frac{1}{2}\rho V^2)$

6. Is shear stress at the wall larger near the (LE) or farther downstream? _____

7. At the point of BL separation, wall shear stress is exactly ___ⓞ___ .

8. Sketch the velocity profiles in a laminar and a turbulent BL on top of each other to show the major differences, including BL thicknesses.
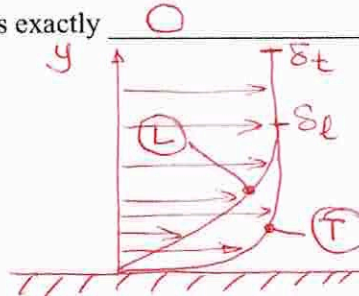
9. Fundamentally speaking, there are two types of drag: pressure drag and ___skin friction drag___.

10. In the "fully rough" region of Fig. 7.6 of White, CD is ___independent___ of Reynolds number.

11. A NLLT model of a wing, using n horseshoe vortices, leads to a system of ___n___ X ___n___ linear simultaneous equations.

12. For fixed L, the wing of minimum total induced drag is the one that is ___elliptically___ loaded.

13. Can NLLT be used to find total wing lift coefficient? ___Yes___

14. Can NLLT be used to find spanwise distribution of section $C_l(y)$? *Yes*

15. Can NLLT be used for a low aspect ratio wing? *No*

16. In PMT, the *induced* velocity at the propeller is denoted by w.

17. In PMT, the *induced* power for a propeller is just wT.

18. In PMT, can you use actuator-disk theory to design a propeller? *No*

19. For the same power output, which engine is lighter and more compact, P or T? *(T)*

20. Are all propellers twisted for improved performance, just as all wings are? *Yes*