

1. Laminar and turbulent boundary layers

- (a) Sketch the velocity boundary layer for flow past a plate with overall Reynolds number $Re_L = 10^8$. Your sketch need not be to scale, but should clearly indicate the transition from laminar to turbulent flow in the boundary layer.
- (b) Give expressions of proportionality between the boundary layer thickness and distance from the plate leading edge (*e.g.* $\delta_u \propto x^2$). Why does the turbulent boundary layer grow faster than the laminar boundary layer.
- (c) If the flow conditions can be controlled to produce laminar flow, will the drag force on the plate be higher or lower than if there is turbulence? Explain your answer (a few words will do).