DRAG OF 3D BODIES

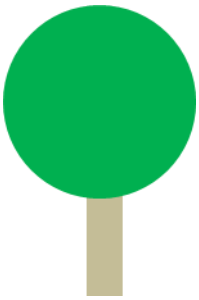
LIFT & DRAG SELF ASSESSMENT SHEET 2

1. a) A skydiver of total mass 80 kg jumps from a plane and free falls in still air until he achieves his terminal velocity of 55 m/s. His effective area is 0.45m^2. At this altitude air density is 1.01 kg/m^3. What is his drag coefficient at this point?

b) When he deploys his parachute he falls vertically; his frontal area is reduced to 0.2m^2 and his C_D is reduced to 0.9. The drag coefficient for the parachute is 1.2 and its diameter is 7.4m^2. Assuming the wake from the skydiver is separate to that of the parachute (is this a valid assumption?) calculate his new terminal velocity.

c) How long will it take the parachutist to fall 1000m after terminal velocity has been reached, assuming air density does not change? Factoring in the increase in density will the descent time increase or decrease?

Ans: 1.14, 5.5m/s, 182s



2. A highly idealized tree consists of a smooth sphere of diameter 9m on top of a pole of diameter 0.5m and height 2.5m. If this tree is in a crossflow of constant velocity 15 mph (1609 m in a mile), and assuming there is no atmospheric boundary layer, what is the bending moment at the base of the tree trunk? Take the density of air to be 1.2 kg/m^3 and the viscosity to be 1.8x10^{-5} kg/ms.

If the sphere was treated as rough, would the moment be lower or higher and why?

Ans: 3630 Nm, higher