Homework No 4 (Laminar premixed and diffusion flame)

1. A 50 litre bottle of methane (CH4) stored at 300 K, 5MPa leaks into a 4m x 5m x 3m sealed room at 300 K and 1 bar. The bottle is completely empty and the gases are well mixed in the room after a long time. Is the mixture in the room flammable?

2. Consider a premixed flame stabilised above a circular tube. For the flame to be conical (constant angle α), what is the shape of the velocity profile at the tube exit? Why?

3. Using the definition of the volumetric flowrate ($Q = v_e \pi R^2$), show that the centreline mass fraction $Y_{F,0}$ for a laminar jet depends only on Q and ν.