1. A furnace is fired by a gas having the composition H2 = 48%, CO = 12%, CnHm = 3.6%, CO2 = 2%, O2 = 0.4% and the rest N2. Using a certain quantity of air excess over stoichiometry, complete combustion of the gas is achieved, giving a dry waste gas of 5m3/m3 of fuel burned. Estimate
   a. Composition by volume of dry waste gas formed.
   b. Percent excess air used.
   c. Weight of water formed per m3 of gas burned, neglecting water percent in the air used.
   Assume the hydrocarbon used is CH4..

2. 100 kg per hour of coke are fed to a furnace having grate efficiency such as 95% carbon present in the coke is burnt. The coke composition is 90% carbon and 10% ash (by weight). 30% excess air is supplied for ensuring complete combustion. If 98% of carbon burnt is oxidized to dioxide and rest to monoxide,
   a. Report the composition by volume of the flue gases.
   b. If the flue gases are at a temperature of 300 °C and a pressure of 750 mm Hg, calculate their flow rate in m^3/min.

3. Estimate the stoichiometric air requirement for 80% Octane (C8H18), 10% Ethanol (C2H5OH), and 10% Methanol (CH3OH) blend.