

HW#2 Internal Combustion Engines

1) A special “oxygenated fuel” is being promoted to reduce CO emissions from ICEs. Its formula is $C_3H_6(OH)_2$. Keep in mind that the fuel contains some oxygen, and use ($O_2 + 3.76 N_2$) for air.

- A) What is the molecular weight of the fuel [gm/mole]?
- B) What is the Air/Fuel mass ratio for Stoichiometric combustion?

2) In accordance with Malaysia’s drive to convert vehicles to Natural Gas (ie. NG Vehicles) you have converted your motorbike to run on Methane (CH_4). To demo your new NGV you plan to drive it 250km (total distance) from the Natural Gas filling station in Perai to Taiping, up Bukit Larut and back. Use the following data for your vehicle:

Engine:	4-Stroke
Fuel:	CH_4
Equivalence Ratio:	1.05 (Slightly Rich)
Operating speed:	2500 rpm (Average)
Vehicle Speed:	65 km/h (Average)
Displacement:	125 cc
Throttle:	40% (ie. the pressure in the combustion chamber is $\frac{1}{2}$ bar at IVC)

Also remember that the engine is intaking **Air** and **Fuel** on each intake stroke (not just **Air**).

- A) What is the Air/Fuel Ratio (mass)?
- B) What % of the intake gas is fuel (in terms of % volume)?
- C) How much CH_4 will be consumed [kilos]?
- D) The max. pressure of the fuel tank is 200 bar, how big will the tank have to be [liters]?
- E) What are the vehicles emissions of CO_2 in [gm/km]?

3) A typical automotive SI engine will have about 400cc displacement per cylinder, and a CR of 10. Assume $B=S$, the pressure in the cylinder is 0.90 bar at BDC, and isentropic compression.

- A) What is the dead volume per cylinder [cc]?
- B) What is the pressure at TDC?
- C) What is the temperature at TDC [$^{\circ}C$]?