Homework Problem 3.1 in Heywood

Isooctane is supplied to a four cylinder spark ignition engine at 2.0 g/s. Calculate the air flow rate for
stoichiometric combustion. If the engine is operating at 1500 rev/min estimate the mass of fuel and
air entering each cylinder per cycle. The engine displaced volume is 2.4 liters. What is the volumetric
efficiency?

Data

$a = 8$

$b = 18$

$y = \frac{b}{a}$

$mdot_{fuel} = 0.002$ [Kg/sec] mass flow rate of fuel

$Vd = 0.0024$ [m^3] engine displacement

$Vcyl = \frac{Vd}{4}$ [m^3] cylinder displacement

$W = 1500$ [rev/min]

$fac = 2$ [rev/cycle]

$tf = 60$ [sec/min]

Use Equation 3.6 on Page 69 to get stoichiometric AF

$$AF = \frac{34.56 \cdot [4 + y]}{12.01 + 1.008 \cdot y}$$

Air flow rate for stoichiometric combustion

$$\frac{mdot_{air}}{mdot_{fuel}} = AF$$

Air and mass flow per cycle per cylinder

$$mdot_{fuel,cycle} = \frac{mdot_{fuel}}{W} \cdot fac \cdot \frac{tf}{4} \text{ [Kg/cycle]}$$

$$mdot_{air,cycle} = \frac{mdot_{air}}{W} \cdot fac \cdot \frac{tf}{4} \text{ [Kg/cycle]}$$

Volumetric efficiency

$$v_{air} = \frac{mdot_{air,cycle}}{\rho['Air', T=298, P=101.3]} \text{ [m}^3\text{]}$$

$$\eta_{vol} = \frac{v_{air}}{Vcyl}$$

Unit Settings: [kJ]/[K]/[kPa]/[kg]/[radians]

a = 8	AF = 15.13	b = 18
η_{vol} = 0.8513	fac = 2 [rev/cycle]	$mdot_{air}$ = 0.03025
$mdot_{air,cycle}$ = 0.0006051 [Kg/cycle]	$mdot_{fuel}$ = 0.002 [Kg/sec]	$mdot_{fuel,cycle}$ = 0.00004 [Kg/cycle]
tf = 60 [sec/min]	Vcyl = 0.0006 [m^3]	Vd = 0.0024 [m^3]
v_{air} = 0.0005108 [m^3]	W = 1500 [rev/min]	y = 2.25