IC Engines and Gas Turbines

Week -4

Ignition and Lubricating systems

Practise questions

21\textsuperscript{st} February 2022
Question-1

Match the following according to the significance

a. First phase of spray
   i. Combustion of droplets
b. Second phase of spray
   ii. Atomization of droplets
   iii. Equal distribution of fuel droplets

(A) a - i, b - ii
(B) a - iii, b - i
(C) a - i, b - ii
(D) a - ii, b - iii
Question-2

For better distribution of fuel droplets, we should have

(A) Lower injection pressure and high density of air
(B) Higher injection pressure and higher density of fuel
(C) Higher injection pressure and higher density of air
(D) Higher injection pressure and lower density of fuel

\[ V \propto \sqrt{AP} \]

Higher injection pressure \( \implies \) fuel droplet should be able to penetrate.

High density of air \( \implies \)
Question-3

Which type of nozzle is less susceptible to clogging?

(A) Single orifice nozzle
(B) Multi orifice nozzle
(C) Pintle type nozzle
(D) None of above
Propane ($C_3H_8$) is burned in an oxygen atmosphere with 10% deficient oxygen with respect to the stoichiometric requirement. Assuming no hydrocarbons in the products, the volume percentage of CO in the products is

(A) 14.28%  
(B) 10%  
(C) 17.5%  
(D) 5%

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

$0.9 \times 5 = 4.5O_2$

$C_3H_8 + 4.5O_2 \rightarrow aCO + bCO_2 + cH_2O$

\[
\begin{align*}
a + b &= 3 \\
8 &= 2c \\
a + 2b + c &= 9
\end{align*}
\]

\[
\begin{align*}
a + 2b &= 5 \\
8 &= 2c \\
a &= 1
\end{align*}
\]

Volume of CO = \(\frac{1}{1+2+4}\) = 14.28%
Question-5

Air contains 79% $N_2$ and 21% $O_2$ on a molar basis. Methane($CH_4$) is burned with 50% excess air then required stoichiometrically. Assuming complete combustion of methane, the molar percentage of $N_2$ in the products is

(A) 50%
(B) 73.83%
(C) 20%
(D) 60%

\[
CH_4 + 2\left(O_2 + \frac{79}{21}N_2\right) \rightarrow CO_2 + 2H_2O + 2\times\frac{79}{21}N_2
\]

50% of excess air
1.5x 2 = 3

\[
CH_4 + 3\left(O_2 + \frac{79}{21}N_2\right) \rightarrow CO_2 + 2H_2O + \left(3\times\frac{79}{21}N_2\right)
\]

\[
\% N_2 = \frac{8\times\frac{79}{21}}{1+2\times\left(8\times\frac{79}{21}\right)+1} = 3.83研究中心

+ O_2

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Question-6

Given the required characteristics of the lubricating oil, state which of those are correct and which are wrong

a. Lubricating oil must have adhesion with the solid surface.
b. This lubricating oil must resist being squeezed from the mating surfaces even under extreme forces experienced by the engine between some components.

(A) a is correct, b is wrong
(B) both a and b are correct
(C) both a and b are wrong
(D) a is wrong, b is correct
If P is the pressure on top surface of piston, B is the bore diameter, \( F_t \) is the frictional force, \( F_r \) is the force on the connecting rod, \( \theta \) is the angle between the connecting rod and centre line of the cylinder and \( \phi \) is the crank angle. The expression for the force on the connecting rod in the vertical direction is given by

(A) \( P(\pi B^2/4) \)
(B) \( \pm F_t \)
(C) \( -F_r \cos(\theta) \)
(D) \( P(\pi B^2/4) - F_r \cos(\theta) \)
\[ \frac{ma}{\text{Fr.}} = \text{Fr.} \]

\[ \frac{m \cdot \Delta \omega_p}{dt} = P \left( \frac{\pi}{2} \beta^2 \right) - F_{\text{rcosO}} \pm F_{\text{f}} \]

\[ \frac{F_{\text{osinO}}}{F_{\text{r}}} = \frac{F_{\text{rcosO}}}{F_{\text{f}}} \]

Varying according to the cam self-angle.
The statement “Lubricating oil should have very high viscosity such that the mating surfaces will require very high shearing force to move the adjacent layers of the fluid”

(A) True

(B) False

(C) Insufficient data

(D) Can’t say
A six cylinder, four-stroke diesel engine develops 125 kW at 3000 rpm. Its brake specific fuel consumption is 200 gm/kW h. Calculate the quantity of fuel to be injected per cycle per cylinder. Specific gravity of the fuel may be taken as 0.85.

(A) 0.0545 cc/cycle  
(B) 0.0123 cc/cycle  
(C) 0.1 cc/cycle  
(D) 0.0253 cc/cycle
Fuel Consumed in one cycle:

\[
\frac{4166.6 \text{ gm/h}}{60} = 69.44 \text{ gm/min}
\]

\[
\frac{69.44}{N/2} = \frac{69.44}{300/2} = 0.04629 \text{ gm/cycle}
\]

\[
f = 0.85 \text{ gm/cc}
\]

Volume of fuel per cycle per cylinder:

\[
0.0544 \text{ cc/cycle}
\]
Question-10

Which component in battery ignition system distributes a high voltage to different cylinders in battery ignition system?

(A) Ignition coil
(B) Distributor
(C) Break Point
(D) Battery
According to the working principle of battery ignition system, find the correct order from the following

(A) Charging the condenser, discharging the condenser, breaker points are closed

(B) Charging the condenser, breaker points are closed, discharging the condenser

(C) Breaker points are closed, charging the condenser, discharging the condenser

(D) Discharging the condenser, charging the condenser, breaker points are closed
For a four cylinder, four stroke engine operating at \( N \) rpm, the breaker point must make and break the circuit

(A) \( N \) times  
(B) \( 2N \) times  
(C) \( N/2 \) times  
(D) None

\( \frac{N}{2} \times 4 = 2N \)