ME 417: Internal Combustion Engines

PART–01: Find practical/brief reasoning for the following statements.

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1. In the context of the energy scenario, the future of FUELs is not gloomy.
2. Desirable engine fuels are often blends.
3. Engines fails to achieve 100% combustion efficiency.
4. The use of LHV usually favours fuels with a low C/H ratio.
5. Fuel combustion is frequently in gaseous form.
6. Laminar burning velocity of fuel-air mixture is an intrinsic property.
7. A fuel-air mixture's flame speed can be zero, but not its laminar burning velocity.
8. The laminar burning velocities of air-fuel mixtures increase with temperature.
9. The laminar burning velocities of air-fuel mixtures decrease with pressure.
10. The maximum value of the laminar burning velocities of air-fuel mixtures is frequently attained at slightly rich conditions.
11. Turbulence speeds up combustion of fuel, but excess of it is undesirable.
12. Cycle-by-cycle variations in engine combustion are unavoidable.
13. Initial flame-speeds in SI engines are slow.
14. Spark timing is advanced more for lean mixtures in SI engines.
15. Spark timing is advanced more at higher engine speeds in SI engines.
16. Higher values of volumetric efficiency are at low engine speeds.
17. Knocking more likely to occur with lean mixtures in SI engines.
18. A good SIE fuel is a bad CIE fuel, and vice versa.
19. SI engines are high speed engines.
20. SI engines knock less at high engine speeds.
21. Knock increases with engine speed in CI engines.
22. SI engine exhaust temperatures are high.
23. Intake and exhaust valves are opened earlier and closed later.
24. Part load efficiencies of CI engines are better.
25. Slightly higher brake power is available with slightly rich mixtures.
26. Specific fuel consumptions of SI engines are high.
27. For a given displacement volume of engine, CI engines develop less power.
28. Indicated efficiency of SI engine is high for lean mixtures.
29. Indicated mean effective pressure in SI engine is high for stoichiometric mixture.
30. From knocking point of view, natural gas is a bad CI fuel, but a good SI fuel.

31. Exhaust valves are smaller is size.
32. Knock is always present in case of CI engines.
33. In SI engines, a rich/lean mixture is effective in reducing knock.
34. Adiabatic flame temperature is highest at slightly rich condition.
35. Gas-turbines require excess air to cool the combustor.
36. Actual engine efficiencies are lower than air-standard cycle efficiencies.
37. GT exhaust are at very high temperatures.
38. Big engines are slow speed engines.
39. Laminar burning velocities does not change, but fuel burning is increased at higher engine speeds.
40. CI engines are large.
41. Increase in ambient temperature lowers engine power with slight improvement in fuel economy.
42. Increase in ambient moisture lowers output power with slight improvement in fuel economy.
43. Increase in ambient pressure increases output power with slight reduction in fuel economy.
44. Turbo-charging & super-charging are often employed in CI engines.
45. Turbo-charging & super-charging are not employed in normal SI engines.

PART–02: Make practical comparisons.

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1. SI engines vs. CI engines.
2. Large engines vs. small engines.
3. High-speed engines vs. low-speed engines.
4. Part-load efficiency vs. full-load efficiency.
5. Reciprocating engines vs. rotary engines.
6. Regular car-engines vs. sports-car engines.
7. Regular engines vs. hydrogen-fuelled engines.
8. Regular engines vs. marine engines.
9. New-engines vs. old-engines.
10. Motor-cycle engines vs. truck engines.

PART–03: Make elaborate and engineering analysis.

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1. Design a car-engine to operate at 10,000 rpm to produce 100 kW of brake power. The engine should use octane at stoichiometric condition. Estimate engine dimensions and valve sizes with proper reasoning for all the assumptions.
2. Redesign the engine, if lean methane ($\phi = 0.8$) is used to produce same power at same speed.
3. Redesign the engine, if hydrogen is to be used to produce same power. Report some of the characteristics of the design (e.g. spark-timing, fuel-system, volumetric-efficiency concerns).
4. If you just change the fuel of engine 1 to hydrogen, what sort of output power and performance you should expect.