

## **Factors Affecting Engine Performance**

1. What are the factors affecting the heat loss to the cylinder walls? Explain them.
2. Explain how increasing the number of cylinders for a given engine capacity will affect the heat transfer process between the gases and cylinder walls. Assist your answer with sketches.
3. How do you think that ignition or injection timing will affect the amount of power developed by the engine? Consider the amount of torque and the heat transferred.
4. Explain, how the residual gases affect the engine performance?
5. What is the effect of valve resistance on engine performance? Explain thoroughly and assist your answer with sketches.
6. What is the effect of combustion duration on engine performance? Explain thoroughly and assist your answer with sketches.
7. Do the atmospheric conditions have anything to do with engine performance? Explain thoroughly.
8. Explain the commercial methods by which automobile engine power is rated?
9. What is the dynamometer and what is its principle? Assist your answer with sketches and formulae.
10. Compare the thermal efficiency of the engine and the bsfc and state which one is more reliable from an engineering point of view?
11. Why the thermal efficiency increases as engine loading increases? Assist your answer with sketches.
12. What are the factors upon which thermal efficiency depends? Explain them.
13. Explain the engineering methods by which automobile engine power is rated.
14. Explain the mean effective pressure and state how it is used to compare the performance of different engines.
15. Explain the specific fuel consumption and state how it is used to compare the performance of different engines.
16. Why the volumetric efficiency is always less than unity? It drops dramatically under certain operational conditions, explain them.
17. What are the factors affecting the volumetric efficiency of the engine? Explain them.

### **SKYACTIV-G**

18. What are the main characteristics of the Skyactiv-G engine?
19. What is the correlation between the engine torque? and compression ratio and why the compression ratio was limited to 12:1 as the highest? Assist your answers with sketches.
20. What was the strategy of Skyactiv-G to increase the compression ratio? And how it was achieved practically? Assist your answers with sketches.
21. Explain how the residual gas concentration in the cylinder was reduced in Skyactiv-G technology? Assist your answers with sketches.
22. In a multi-cylinder engine, why the exhaust gases remain in the cylinder as residual gases? Assist your answer with sketches.
23. Are the residual gases in the cylinder good for the SI engine? Explain why?
24. What is the principle of the 4-2-1 exhaust system used in Skyactiv-G engine? Assist your answer with sketches.

25. How is the duration of combustion minimized in the Skyactiv-G engine and why? Assist your answers with sketches.

### **SKYACTIV-D**

26. What are the characteristics of Skyactiv-D engine?
27. Explain the trade-off between soot and NO<sub>x</sub> formation in conventional diesel engines. Assist your answer with sketches.
28. Explain the process of soot formation in conventional diesel engines. Assist your answer with sketches.
29. What are the advantages of the low-compression diesel strategy? Explain them and assist your answer with sketches.
30. In Skyactiv-D engines, how the output torque is affected by the lower compression ratio? Are there any environmental benefits? Explain and assist your answers with sketches.
31. In Skyactiv-D engines, how the mechanical friction is affected by the lower compression ratio? Are there any mechanical benefits? Explain and assist your answer with sketches.
32. What are the challenges facing the Skyactiv-D engines? And how they could be tackled? Give a brief explanation and assist your answers with sketches.
33. Why do Skyactiv-D engines need a high-performance fuel injection system? What are the characteristics of this system? Assist your answer with sketches.
34. Why do Skyactiv-D engines need a variable valve lift system? What are the characteristics of this system? Assist your answer with sketches.
35. Why do Skyactiv-D engines need a two-stage turbocharging? What are the characteristics of this system? Assist your answer with sketches.

### **Skyactiv-X**

36. Define the Skyactiv-X engine and what are its characteristics?
37. Explain the principle of the HCCI engine and what are the factors affecting the stability of combustion? Assist your answers with sketches.
38. Why the HCCI engine had not been used on a commercial scale? Explain and assist your answer with sketches.
39. Explain the principle of Spark-Controlled Compression Ignition SPCCI used in Skyactiv-X engines. Assist your answer with sketches.
40. In the SPCCI approach, how the mixture is stimulated throughout the entire operational range? Explain thoroughly and assist your answer with sketches.
41. Explain how abnormal combustion is avoided by mixture control in the SPCCI approach?
42. In the SPCCI approach, explain how the fuel injection system is organized?
43. What are the advantages of the SPCCI engine? Explain them and assist your answer with sketches.
44. Explain the performance of the Skyactiv-X engine in terms of power and response. Assist your answer with sketches.
45. How fuel efficient is the Skyactiv-X engine compared to other gasoline engines? Assist your answer with sketches.
46. Define the cetane number and explain how the variation of cetane value affects the combustion process?
47. Define the fuel ignitability (auto-ignition), explain its stages and how to control them?
48. Explain the physical delay period, its stages and how to control them?

49. Define the ignition delay period (ID) and how it could be identified? Assist your answer with sketches.
50. How can you identify the start of injection (SOI) in a running engine? Assist your answer with sketches.
51. How can you identify the start of combustion process (SOC)? Assist your answer with sketches.
52. What are the combustion scenarios of the smaller spherules and the larger ones when they are released from the injector nozzle into the combustion chamber?
53. Explain the chemical delay period when it starts and how to control it?
54. Explain how the kinematic viscosity of the fuel affect the spray characteristics in the combustion chamber? Assist your answer with sketches.
55. Explain how the density of the fuel affect the spray characteristics in the combustion chamber? Assist your answer with sketches.
56. Explain how the surface tension of the fuel affect the spray characteristics in the combustion chamber? Assist your answer with sketches.
57. Explain how the volatility of the fuel affect the spray characteristics in the combustion chamber? Assist your answer with sketches.
58. Is there any correlation between the injection pressure and fuel volatility to influence fuel ignitability? Explain it.
59. Define the flame lift-off length (FLL) assisting your answer with a sketch.
60. Explain the recent diesel combustion strategy assisting your answer with sketches.
61. What is the effect of the injector orifice size on the fuel spray characteristics? Assist your answer with sketches.
62. Explain the flame propagation and emissions formation, during the fuel injection process, in direct injection engines assisting your answer with sketches.
63. Explain the characteristics of fuel spray at the end of the injection process and how they affect the combustion process and emissions formation?
64. Explain the conditions in the cylinder at the end of the combustion process and how they affect the emissions formation.
65. Explain the phenomena of knocking in SI engines assisting your answer with sketches.
66. Explain the influence of compression ratio on engine knocking and engine octane requirement.
67. Explain the influence of ignition timing on engine knocking and engine octane requirement.
68. Explain the influence of engine speed on engine knocking and engine octane requirement.
69. Explain the influence of engine load on engine knocking and engine octane requirement.
70. Explain the influence of mixture strength on engine knocking and engine octane requirement.
71. Explain the influence of charge temperature on engine knocking and engine octane requirements.
72. Explain the influence of spark over-advancement on engine knocking and engine octane requirement.
73. Explain the influence of spark retardation on engine knocking and engine octane requirement.
74. Compare between the 2-stroke and 4-stroke cycle engines. How the disadvantages could be minimized. Assist your answers with sketches.
75. Explain the test procedure to measure the amount of air consumed by the engine. Write an expression to measure the actual air mass flowrate. Assist your answer with sketches.

76. Why the actual weight of air aspirated under maximum output conditions is always less than the theoretically possible weight?
77. Is thermal efficiency a reliable measure for engine performance? If not, what is the substitute?
78. During flame propagation in the SI engine, what are the factors which affect the autoignition of the mixture ahead the flame front and might lead to engine knocking?
79. What is the purpose of valve overlap? And what effects does it have on the combustion process?
80. Derive an expression for the bmep, explain it and how do you assess its reliability in comparison to the power and torque of the engine?
81. Describe the piston rings and state their function.
82. Define the engine firing-order. Why it is important to implement it in engines?
83. What is the principle of lubrication?
84. What is the lambda sensor? How it functions?
85. Explain the equivalence ratio of the fuel? Why it is important in environmental performance analysis of engines?