



POSTAL BOOK PACKAGE 2026

CONTENTS

MECHANICAL ENGINEERING

Objective Practice Sets

Internal Combustion Engines

1. Basics and Air Standard Cycles..... 2 - 23
2. Combustion in SI and CI engines 24 - 33
3. Fuels 34 - 41
4. Ignition, Engine friction, Lubrication and cooling 42 - 49
5. Supercharging, Engine Emission and their Control 50 - 65

Basic and Air Standard Cycles

MCQ and NAT Questions

- Q.1** The function of piston rings in internal combustion engines is to
 (a) dissipate heat to cylinder walls
 (b) seal the cylinder
 (c) prevent piston from wear
 (d) all of the above
- Q.2** Advantage of two stroke engine over a four stroke engine is
 (a) more uniform turning moment on crankshaft
 (b) reduced friction loss
 (c) more power for same cylinder dimensions
 (d) all of the above
- Q.3** The power to weight ratio of diesel engine compared to petrol engine is
 (a) high
 (b) low
 (c) same
 (d) high in some cases and low in other cases
- Q.4** An engine has four cylinders of 68 mm bore and 75 mm stroke. The cubic capacity of the engine is
 (a) 1089.5 cm³ (b) 1289.5 cm³
 (c) 1489.5 cm³ (d) 1689.5 cm³
- Q.5** A certain engine produces 10 kW indicated power & mechanical efficiency is 80%. The friction power is
 (a) 12 kW (b) 8 kW
 (c) 4 kW (d) 2 kW
- Q.6** Fuel consumption of a engine is 0.35 kg/kW-hr and heating value of fuel is 43000 kJ/kg. The brake thermal efficiency is
 (a) 20.1% (b) 23.9%
 (c) 28.29% (d) 32.21%
- Q.7** The relative efficiency of a engine will be equal to if air standard efficiency & brake thermal efficiency of engine are 53.4% & 24.4%, respectively.
 (a) 40.7% (b) 45.7%
 (c) 13.1% (d) 53.4%
- Q.8** In a SI engine very high compression ratio cannot be used because
 (a) the engine efficiency would be unmanageable high
 (b) the power required for compression would be high
 (c) cylinders will required very thick walls
 (d) self-ignition may takes place before the spark occurs
- Q.9** In a four stroke IC engine cam shaft rotates at
 (a) same speed as crankshaft
 (b) twice the speed of crankshaft
 (c) half the speed of crankshaft
 (d) none of the above
- Q.10** Thermal efficiency of CI engine is higher than that of SI engine due to
 (a) fuel used
 (b) higher compression ratio
 (c) constant pressure heat addition
 (d) none of the above
- Q.11** If clearance volume is 10% of swept volume, the compression ratio will be equal to
 (a) 9 (b) 10
 (c) 11 (d) 12
- Q.12** In an engine working on Otto cycle, the compression ratio is 5.5. The work output per cycle is $23.625 \times 10^5 V_c$ joule where V_c is the clearance volume in m³, the mean effective pressure (in bar) is
 (a) 3.25 bar (b) 5.25 bar
 (c) 7.25 bar (d) 9.25 bar
- Q.13** The order of values of thermal efficiency of Otto, diesel and Dual cycle, when they have equal compression ratio and heat rejection, is given by
 (a) $\eta_{\text{Otto}} > \eta_{\text{diesel}} > \eta_{\text{dual}}$

- (b) $\eta_{\text{diesel}} > \eta_{\text{dual}} > \eta_{\text{Otto}}$
(c) $\eta_{\text{dual}} > \eta_{\text{diesel}} > \eta_{\text{Otto}}$
(d) $\eta_{\text{Otto}} > \eta_{\text{dual}} > \eta_{\text{diesel}}$

Q.14 Which of the following process is not a part of the dual cycle ?

- (a) Adiabatic compression
(b) Constant volume expansion
(c) Isothermal expansion
(d) Constant pressure expansion

Q.15 Match **List-I** (details of the processes of the cycle) with **List-II** (name of the cycle) and select the correct answer using the codes given below the lists:

List-I

- A.** Two isothermals and two adiabatics
B. Two isothermals and two constant volumes
C. Two adiabatics and two constant volumes
D. Two adiabatics and two constant pressure

List-II

1. Otto
2. Joule
3. Carnot
4. Stirling

Codes:

	A	B	C	D
(a)	4	3	1	2
(b)	4	3	2	1
(c)	3	4	1	2
(d)	3	4	2	1

Q.16 For an engine working on air standard Otto cycle has a clearance volume of 10 percent of swept volume. The efficiency of engine will be

- (a) 56.4% (b) 61.6%
(c) 67.8% (d) data insufficient

Q.17 The stroke and bore of a four stroke spark ignition engine are 250 mm and 200 mm respectively. The clearance volume is 0.001 m^3 . If the specific heat ratio $\gamma = 1.4$, the air-standard cycle efficiency of the engine is

- (a) 46.40% (b) 56.10%
(c) 58.20% (d) 62.80%

Q.18 A diesel engine is usually more efficient than a spark ignition engine because

- (a) diesel being a heavier hydrocarbon, releases more heat per kg than gasoline

- (b) the air standard efficiency of diesel cycle is higher than the Otto cycle, at a fixed compression ratio
(c) the compression ratio of a diesel engine is higher than that of an SI engine
(d) self ignition temperature of diesel is higher than that of gasoline

Q.19 In combustion process, the effect of dissociation is to

- (a) reduce the flame temperature
(b) separate the products of combustion
(c) reduce the proportion of carbon monoxide in gases
(d) reduce the use of excess air

Q.20 The most perfect method of scavenging is

- (a) cross scavenging
(b) uniflow scavenging
(c) loop scavenging
(d) reverse flow scavenging

Q.21 As compared to air standard cycle, in actual working the effect of variation in specific heats is to

- (a) increase maximum pressure and maximum temperature
(b) reduce maximum pressure and maximum temperature
(c) increase maximum pressure and decrease maximum temperature
(d) decrease maximum pressure and increase maximum temperature

Q.22 For same power output and same compression ratio, as compared to two-stroke engines, four-stroke S.I. engines have

- (a) higher fuel consumption
(b) lower thermal efficiency
(c) higher exhaust temperatures
(d) higher thermal efficiency

Q.23 Two stroke SI engines suffer from

- (a) fuel loss
(b) idling difficulty
(c) both (a) and (b)
(d) none of the above

Q.24 With dissociation the exhaust gas temperature

- (a) decreases
(b) increases
(c) no effect
(d) increases upto certain air-fuel ratio and then decreases

- Q.25** For a given compression ratio, as the mixture is made progressively rich from lean, the mean effective pressure
- increases
 - decreases
 - initially increases and then decreases
 - remains more or less same
- Q.26** Which one of the following events would reduce the volumetric efficiency of a vertical compression ignition engine?
- The inlet valve closing after bottom dead centre
 - Inlet valve closing before bottom dead centre
 - Inlet valve opening before top dead centre
 - Exhaust valve closing after top dead centre
- Q.27** Keeping other parameters constant brake power of a diesel engine can be increased by
- decreasing the density of intake air
 - increasing the temperature of intake air
 - increasing the pressure of intake air
 - decreasing the pressure of intake air
- Q.28** Consider the following parts of IC Engine:
- | | |
|---------------|-------------|
| 1. Rocker arm | 2. Follower |
| 3. Cams | 4. Camshaft |
| 5. Crankshaft | |
- Which among the above constitutes the part of valve train system?
- 1, 2 and 3
 - 1, 2, 3 and 4
 - 2, 3 and 4
 - All of the above
- Q.29** Consider the following statements pertaining to volumetric efficiency:
- The normal range of volumetric efficiency at full throttle for SI engines is more than that of CI engines.
 - Volumetric efficiency is maximum at inlet mach number of 0.5.
 - Inlet valve mach index is related volumetric efficiency.
- Which of these statements are correct?
- 2 only
 - 2 and 3
 - 1, 2 and 3
 - 1 and 3
- Q.30** Consider the following statements:
- Mean piston speed is given by $\bar{V}_p = LN$.
 - Automobile engines operate at higher end of mean piston speed near to 15 m/s.
 - Large marine diesel operate at lower end of mean piston speed near to 8 m/s.
- Which of these are correct?
- 1, 2 and 3
 - 1 and 2
 - 2 and 3
 - 1 only
- Q.31** All of followings are correct except:
Inlet-valve mach index is dependent on
- mean piston speed
 - bore
 - inlet sonic velocity
 - fuel consumption
- Q.32** The minimum number of rings in a piston are
- two
 - three
 - four
 - six
- Q.33** The slotted grooves on oil rings for pistons help to
- seal the cylinder
 - minimize friction
 - prevent the piston from wear
 - provide an escape for the oil that the slots edge out from the cylinder walls.
- Q.34** Mean effective pressure at a given compression ratio is maximum when the air-fuel ratio is
- higher than stoichiometric
 - lower than stoichiometric
 - equal to stoichiometric
 - none of the above
- Q.35** The mean effective pressure of Otto cycle may be expressed in the form
- $\frac{\eta_{th} \Delta P}{2(\gamma - 1)(r - 1)}$
 - $\frac{\eta_{th} \Delta P}{(\gamma - 1)(r - 1)}$
 - $\frac{\eta_{th} \Delta P}{3(\gamma - 1)(r - 1)}$
 - $\frac{2\eta_{th} \Delta P}{(\gamma - 1)(r - 1)}$
- (All notations have standard meaning)
- Q.36** Mean effective pressure of Otto cycle is
- inversely proportional to pressure ratio
 - directly proportional to pressure ratio
 - does not depend on pressure ratio
 - proportional to square root of pressure ratio
- Q.37** In diesel engines, the accumulation of carbon in cylinder increases
- volumetric efficiency
 - mechanical efficiency

- (a) The pressure at the beginning of the compression stroke is 0.1 MPa.
 (b) The compression ratio of the cycle is 15.15.
 (c) The specific volume at the end of compression stroke is $0.23 \text{ m}^3/\text{kg}$.
 (d) The specific net work output of the cycle is 663.7 kJ/kg .

- Q.93** In a compression ignition engine, the inlet air pressure is 1 bar and the pressure at the end of isentropic compression is 32.42 bar. The expansion ratio is 8. The temperature at the end of compression stroke is 810 K. Which of the following statements is(are) correct?
 (For air $\gamma = 1.4$, $R = 0.287 \text{ kJ/kgK}$)
 (a) The compression ratio of the cycle is 12.
 (b) Maximum temperature in the cycle is 942°C .
 (c) Cut-off ratio of the cycle is 1.5.
 (d) Air standard efficiency of the above diesel cycle is 43.44%.

- Q.94** A diesel engine has a compression ratio of 17 and cut-off takes place at 10% of the stroke. The pressure and temperature at the beginning of the compression stroke are 1 bar and 300 K respectively. (Take $\gamma = 1.4$ for air)
 (a) Maximum pressure in the cycle is 52.8 bar.
 (b) Maximum temperature in the cycle is 1490.8 K.

- (c) Cut-off ratio for the cycle is 2.6.
 (d) Air standard efficiency of diesel cycle is 43.44%.

- Q.95** The minimum and maximum temperature in air standard Otto cycle are 300 K and 1875 K respectively. Which of the following statements is(are) correct when net work output is maximum?
 (For air take, $c_p = 1.005 \text{ kJ/kgK}$, $c_v = 0.718 \text{ kJ/kgK}$, $\gamma = 1.4$)
 (a) Temperature after the compression process in 750 K.
 (b) Compression ratio of the cycle is 6.72.
 (c) Heat added in the cycle is 807.75 kJ/kg
 (d) Net work output from the cycle is 430.76 kJ/kg

- Q.96** Which of the following statements is(are) true for Dual cycle?
 (a) The heat addition at constant pressure is 2-3 times more than the heat addition at constant volume.
 (b) The dual cycle engine is more compact in size with respect to diesel cycle.
 (c) The sound pollution for dual cycle engine is higher than that of the diesel cycle engine.
 (d) The maintenance is easier and maintenance cost is less for dual cycle engine than that of the diesel cycle engine.

■■■■

Answers Basic and Air Standard Cycles						
1. (d)	2. (d)	3. (b)	4. (a)	5. (d)	6. (b)	7. (b)
8. (d)	9. (c)	10. (b)	11. (c)	12. (b)	13. (d)	14. (c)
15. (c)	16. (b)	17. (c)	18. (c)	19. (a)	20. (b)	21. (b)
22. (d)	23. (c)	24. (a)	25. (c)	26. (b)	27. (c)	28. (b)
29. (b)	30. (c)	31. (d)	32. (b)	33. (d)	34. (a)	35. (b)
36. (b)	37. (c)	38. (c)	39. (c)	40. (a)	41. (b)	42. (d)
43. (a)	44. (a)	45. (d)	46. (c)	47. (c)	48. (a)	49. (d)
50. (d)	51. (d)	52. (c)	53. (d)	54. (a)	55. (d)	56. (d)
57. (d)	58. (b)	59. (a)	60. (c)	61. (c)	62. (a)	63. (b)
64. (b)	65. (6.075)	66. (75)	67. (168)	68. (0.34)	69. (25)	70. (264)
71. (5.328)	72. (2)	73. (1.78)	74. (53.9)	75. (45.45)	76. (5.34)	77. (535.96)
78. (1554.97)		79. (8.92)	80. (154.6)	81. (83.9)	82. (6.94)	83. (c)
84. (c)	85. (b)	86. (a)	87. (a, c)	88. (a, d)	89. (b, d)	90. (a, d)
91. (a, b, c)		92. (a, d)	93. (a, b, c)	94. (a, c)	95. (a, c)	96. (a, b, d)

Explanations Basic and Air Standard Cycles

1. (d)

Function of piston rings:

- (i) Improves heat transfer from the piston to the cylinder wall.
- (ii) Seals the combustion chamber so that there will be minimal loss of gases to the crank cases.
- (iii) Prevent piston from wear.
- (iv) Regulating oil consumption by scraping oil from the cylinder walls back to the sump.
- (v) Maintain proper oil quantity between piston and cylinder wall.

2. (d)

Advantages of 2-stroke over 4-stroke.

- For same power developed, 2-stroke engine is lighter, less bulky and occupy less floor area.
- More uniform turning moment so lighter weight of flywheel is required.
- More power for same cylinder dimension.
- The work required to overcome the friction and the exhaust strokes is saved.
- Little maintenance because of fewer parts.

3. (b)

The power of weight ratio of diesel is lower than petrol engine because of bulky and robust construction required for its higher compression ratio.

4. (a)

$$\begin{aligned}\text{Capacity of engine} &= 4 \times V_s \\ &= 4 \times \frac{\pi}{4} (6.8)^2 \times 7.5 = 1089.5 \text{ cm}^3\end{aligned}$$

5. (d)

b.p.(brake power)

$$= \eta_m \times ip = 0.80 \times 10 = 8 \text{ kw}$$

$$\therefore f.p = ip - bp = 10 - 8 = 2 \text{ kw}$$

6. (b)

$$\begin{aligned}\eta_{bt} &= \frac{1kW - hr}{m_f/hr \times CV} \\ &= \frac{3600}{0.35 \times 43000} = 23.9\%\end{aligned}$$

7. (b)

Relative efficiency

$$= \frac{\text{Brake thermal efficiency}}{\text{Air thermal efficiency}} = \frac{24.4}{53.4} = 45.7\%$$

8. (d)

A very high compression ratio is SI engines is avoided because self ignition may occur before spark occurs.

9. (c)

In a four stroke IC engine cam shaft rotates at half the speed of crank shaft.

10. (b)

Thermal efficiency of CI is higher than SI engines because of its higher compression ratio (16 - 24).

11. (c)

$$r = \frac{V_1}{V_2} = \frac{V_s + V_c}{V_c} = \frac{V_s + 0.1V_s}{(0.1V_s)} = 11$$

12. (b)

Compression ratio

$$r = \frac{V_c + V_s}{V_c}$$

$$5.5 = 1 + \frac{V_c}{V_c} \Rightarrow \frac{V_s}{V_c} = 4.5 \text{ or,}$$

$$V_s = 4.5 V_c$$

$$\begin{aligned}\therefore P_m &= \frac{W_{net}}{V_s} = \frac{23.625 \times 10^5}{4.5 V_c} V_c \\ &= 5.25 \times 10^5 \text{ N/m}^2 = 5.25 \text{ bar}\end{aligned}$$

13. (d)

For same compression and heat rejection.

Process 1-2 same compression ratio for all three cycles.

