



**POSTAL  
BOOK PACKAGE**

**2025**

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**MECHANICAL  
ENGINEERING**

**Objective Practice Sets**

## **Power Plant Engineering**

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# Steam Generators

**Q.1** Which of the following statements are true in the context of Lancashire boiler?

1. It is a fire tube boiler.
  2. It employs two flue tubes and three passes.
  3. It is a water tube boiler.
  4. It makes use of external pump for circulation
- (a) 1, 2                      (b) 2, 3  
(c) 1, 4                      (d) 3, 4

**Q.2** The major shortcoming of fire tube boiler is:

- (a) size and pressure limitation inherent in design
- (b) high cost
- (c) requirement of high draught
- (d) need of highly skilled labour for operation

**Q.3** Which of the following are functions of a steam drum?

- (a) to ensure moisture free steam going to the superheater
- (b) to secure bubble-free water going to the downcomer
- (c) to aid in steam formation at the desired rate
- (d) Both (a) and (b)

**Q.4** Match **List-I (Method for separation of steam-water mixture)** with **List-II (Mechanism of separation of mixture)** and select the correct answer:

List-I	List-II
A. Baffles	1. Centrifugal force
B. Cyclone separators	2. Gravity
C. Steam Washing	3. Fabric Filters
D. Screens	4. Pure Feedwater

**Codes:**

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

**Q.5** Match **List-I (Name of Boiler)** with **List-II (Type)** and select the correct answer using the codes given below the lists:

List-I	List-II
A. Stirling	1. Bent water tube
B. Cochran	2. Once through flow
C. Lancashire	3. Vertical fire tube
D. Benson	4. Inclined water tube
	5. Horizontal fire tube

**Codes:**

	A	B	C	D
(a)	2	5	4	1
(b)	1	3	5	2
(c)	2	3	5	1
(d)	1	5	4	2

**Q.6** Performance of mechanical draft cooling tower is superior to natural draft with

- (a) increase in air wet bulb temperature
- (b) decrease in air wet bulb temperature
- (c) increase in air dry bulb temperature
- (d) increase in recirculation of air

**Q.7** Consider the boiler accessories:

1. Superheater                      2. Air preheater
3. Economizer                      4. I D fan

What is the correct sequence of the flow of flue gases through the above accessories of a natural circulation high pressure boiler?

- (a) 1-3-2-4                      (b) 1-3-4-2
- (c) 3-1-2-4                      (d) 3-1-4-2

**Q.8** In a boiler, the subcooled liquid enters at enthalpy 200 kJ/kg and exits at 10 bar pressure with quality of steam as 0.9. Enthalpy of saturated liquid and saturated vapour at 10 bar is 700 kJ/kg and 1700 kJ/kg respectively. What will be the efficiency of boiler ?

Take steam generation rate = 6.3 tonne/hr

Coal consumption = 0.7 tonne/hr

Calorific value of coal = 30 MJ/kg

- (a) 250 N/m<sup>2</sup>                      (b) 300 N/m<sup>2</sup>  
(c) 305 N/m<sup>2</sup>                      (d) 310 N/m<sup>2</sup>

**Q.52** A chimney of height 40 m has mean flue gas temperature of 327°C. The temperature of outside air is 30°C. The air fuel ratio is 14.3. Draught produced in mm of water column is

- (a) 2026 mm H<sub>2</sub>O                      (b) 21.42 mm H<sub>2</sub>O  
(c) 23.26 mm H<sub>2</sub>O                      (d) 24.61 mm H<sub>2</sub>O

**Q.53** Consider the following statements:

1. The amount of volatile matter indicates whether the coal will burn with a short or long flame and whether it will tend to produce smoke.
2. Proximate Analysis gives the percentage of moisture, ash and volatile matter.
3. Ultimate Analysis gives the chemical elements that comprise the coal substance.
4. Higher rank coals are characterised by a greater oxygen content that aids ignition.

Which of these statements are correct?

- (a) 1, 2, 3, 4                      (b) 1, 2, 3  
(c) 1, 2, 4                      (d) 2, 3, 4

**Q.54** Consider the following statements with respect to draught system in a thermal power plant:

1. It is used to supply to the furnace the required quantity of air for complete combustion of fuel.
2. The term 'draught' is used to define the static pressure in the furnace.
3. Natural draught is provided by the use of induced draught fans
4. Forced draught fans are normally located at the foot of the stack and handle hot combustion gases.
5. Forced draught fans maintain the entire system up to stack entrance under positive gauge pressure.

Which of these statements are correct?

- (a) 1, 2, 3, 4                      (b) 1, 2, 5  
(c) 3, 4, 5                      (d) 1, 3, 4



**Answers      Steam Generators**

- |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a)  | 2. (a)  | 3. (d)  | 4. (b)  | 5. (b)  | 6. (d)  | 7. (a)  | 8. (d)  | 9. (c)  |
| 10. (b) | 11. (b) | 12. (c) | 13. (c) | 14. (c) | 15. (d) | 16. (c) | 17. (c) | 18. (c) |
| 19. (a) | 20. (c) | 21. (a) | 22. (c) | 23. (b) | 24. (a) | 25. (c) | 26. (b) | 27. (a) |
| 28. (d) | 29. (a) | 30. (c) | 31. (a) | 32. (c) | 33. (b) | 34. (c) | 35. (d) | 36. (a) |
| 37. (b) | 38. (c) | 39. (b) | 40. (d) | 41. (b) | 42. (a) | 43. (a) | 44. (a) | 45. (a) |
| 46. (b) | 47. (a) | 48. (a) | 49. (c) | 50. (c) | 51. (d) | 52. (b) | 53. (b) | 54. (b) |

**Explanations      Steam Generators**

- |  |   |
|--|---|
| <p><b>1. (a)</b><br/>Lancashire boiler is a stationary, horizontal, natural circulation fire tube boiler having two flue tubes and three passes.</p>   | <p><b>4. (b)</b><br/>Mechanical separators like baffles, screens and cyclones are housed inside drum for separation of steam-water mixture.</p> |
| <p><b>2. (a)</b><br/>The major shortcoming of a fire-tube boiler is that definite size and pressure limitations are inherent in its basic design i.e. the maximum size of the unit and the maximum operating pressure are limited.</p> | <p><b>6. (d)</b><br/>Performance of mechanical draft cooling tower is superior to natural draft with increase in recirculation of air.</p>      |
| <p><b>3. (d)</b><br/>Steam formation takes place inside the boiler.</p>  | <p><b>7. (a)</b><br/>Flow of flue gases is :<br/>Superheater-Economizer-Air preheater-ID fan</p>  |

## Gas Turbine

## MCQ and NAT Questions

- Q.1** Which of the following cycles are employed in ships and submarines?  
 (a) Open Brayton cycle  
 (b) Closed Brayton cycle  
 (c) Rankine cycle  
 (d) Diesel cycle
- Q.2** Arrange Otto cycle, Brayton cycle and Rankine cycle in increasing order of maximum temperature reached:  
 (a) Otto > Brayton > Rankine  
 (b) Brayton > Rankine > Otto  
 (c) Rankine > Otto > Brayton  
 (d) Otto > Rankine > Brayton
- Q.3** Arrange the following in increasing order of pressure ratio:  
 (a) Otto > Brayton > Rankine  
 (b) Brayton > Rankine > Otto  
 (c) Rankine > Otto > Brayton  
 (d) Otto > Rankine > Brayton
- Q.4** Which of the following are the effects of regeneration in a gas cycle?  
 1. Net work output increases  
 2. Both heat supplied and heat rejected decreases  
 3. There is an increase in mean temperature of heat addition  
 4. There is a decrease in cycle efficiency  
 (a) 1, 3 (b) 2, 3  
 (c) 2, 4 (d) 1, 4
- Q.5** In a gas turbine cycle, the turbine output is 800 kJ/kg, the compressor work is 500 kJ/kg and the heat supplied is 1200 kJ/kg. The thermal efficiency of the cycle is  
 (a) 15% (b) 25%  
 (c) 30% (d) 35%
- Q.6** An open cycle constant pressure gas turbine uses a fuel of calorific value 45000 kJ/kg with A/F ratio 60 : 1 and develops a net output of 100 kJ/kg of air. The thermal efficiency of the cycle is  
 (a) 10.33% (b) 12%  
 (c) 13.33% (d) 16.67%
- Q.7** A gas turbine operates between 5°C and 839°. What is the pressure ratio at which maximum work is obtained?  
 (a) 10.2 (b) 11.3  
 (c) 14 (d) 14.7
- Q.8** The use of gas turbines in electric power stations serves  
 (a) to meet the base load  
 (b) to meet the peak loads  
 (c) to start the thermal power plants  
 (d) to generate power when other power sources fail
- Q.9** A gas turbine cycle with infinitely large number of stages during compression and expansion leads to  
 (a) Stirling cycle (b) Atkinson cycle  
 (c) Ericsson (d) Brayton cycle
- Q.10** The temperature at exit of compressor of a gas turbine operating on Brayton cycle is 127°C and the maximum temperature reached is 1027°C. The back work ratio is:  
 (a) 0.308 (b) 0.410  
 (c) 0.631 (d) 0.841
- Q.11** For a simple Brayton cycle, compressor inlet temperature is 27°C and the temperature at inlet of turbine is 927°C. The maximum possible work output taking  $C_p = 1$  kJ/kg K is:  
 (a) 900 kJ/kg (b) 300 kJ/kg  
 (c) 600 kJ/kg (d) 1000 kJ/kg
- Q.12** A gas turbine cycle with heat exchange and reheating improves  
 (a) Only the thermal efficiency  
 (b) Only the specific power output  
 (c) Both thermal efficiency and specific power output  
 (d) Neither thermal efficiency nor specific power output

Answers		Gas Turbine						
1. (b)	2. (a)	3. (c)	4. (b)	5. (b)	6. (c)	7. (b)	8. (b)	9. (c)
10. (a)	11. (b)	12. (c)	13. (c)	14. (c)	15. (a)	16. (b)	17. (b)	18. (d)
19. (b)	20. (a)	21. (a)	22. (a)	23. (c)	24. (b)	25. (b)	26. (c)	27. (a)
28. (d)	29. (c)	30. (b)	31. (a)	32. (a)	33. (80)	34. (47.47)	35. (208.71)	36. (582.79)
37. (3.44)	38. (318.63)	39. (733.31)	40. (2.96)	41. (19.9)	42. (a, d)	43. (b, d)		
44. (a, b, c)	45. (a, b, c)	46. (a, b, c, d)						

**Explanations Gas Turbine**

**3. (c)**

**Cycle Pressure ratio**

- Rankine cycle – 180 to 300
- Brayton cycle – 10 to 15
- Otto cycle – 15 to 25

⇒ In increasing order of pressure ratio,  
Rankine > Otto > Brayton

**4. (b)**

Regeneration is a process in which high temperature gases at the turbine exit are utilised for heating the cooled air coming out of the compressor.

Regeneration increases the efficiency of the cycle.

There is no change in compressor and turbine work.

**5. (b)**

Net work =  $W_T - W_C$   
 $= 800 - 500 = 300 \text{ kJ/kg}$

Heat supplied = 1200 kJ/kg

Thermal efficiency =  $\frac{\text{Net work}}{\text{Heat applied}}$   
 $= \frac{300}{1200} \times 100 = 25\%$

**6. (c)**

$\eta = \frac{\text{Net output}}{\dot{m}_f \times \text{CV}} = \frac{100 \times 60}{45000} = 13.33\%$

**7. (b)**

$T_3 = 1112 \text{ K}, T_1 = 278 \text{ K}$   
 For maximum work output,

$$r_{p, \text{opt}} = \left( \frac{T_3}{T_1} \right)^{\frac{\gamma}{2(\gamma-1)}} = \left( \frac{1112}{278} \right)^{\frac{1.4}{0.8}}$$

$$r_{p, \text{opt}} = 11.3$$

**8. (b)**

Gas turbine in power stations mainly serves for peak loads.

**9. (c)**

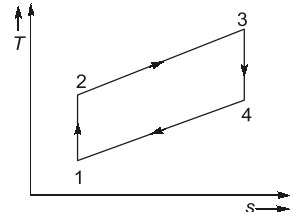
A gas turbine cycle with infinitely large number of stages during compression and expansion leads to constant temperature and constant pressure cycle i.e. Ericsson cycle.

**10. (a)**

Back work ratio,  $r_{bw} = \frac{W_C}{W_T}$

$$= \frac{T_2 - T_1}{T_3 - T_4}$$

for a Brayton cycle;



$$\frac{T_2}{T_1} = \frac{T_3}{T_4} \Rightarrow T_4 = \frac{T_3 \cdot T_1}{T_2}$$

$$\Rightarrow r_{bw} = \frac{(T_2 - T_1)}{T_3 \left( \frac{T_2 - T_1}{T_2} \right)} = \frac{T_2}{T_3}$$

$$\Rightarrow r_{bw} = \frac{(127 + 273)}{(1027 + 273)} = 0.308$$

**11. (b)**

$$W_{\text{max}} = C_p \left[ \sqrt{T_3} - \sqrt{T_1} \right]^2$$