

28/AE/CME/M-2022-7

Booklet Series

Candidate's Roll Number

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**B**

Serial No.

203531

Question Booklet

Paper—V

**MECHANICAL ENGINEERING**

( Objective )

Time Allowed : 1 Hour

Maximum Marks : 100

Read the following instructions carefully before you begin to answer the questions.

**IMPORTANT INSTRUCTIONS**

1. This Question Booklet contains **50** questions in all.
2. **All** questions carry equal marks.
3. Attempt **all** questions.
4. **Immediately after commencement of the examination, you should check up your Question Booklet and ensure that the Question Booklet Series is printed on the top right-hand corner of the Booklet. The Booklet contains 12 printed pages and no page or question is missing or unprinted or torn or repeated. If you find any defect in this Booklet, get it replaced immediately by a complete Booklet of the same series.**
5. You must write your Roll Number in the space provided on the top of this page. Do not write anything else on the Question Booklet.
6. An Answer Sheet will be supplied to you separately by the Invigilator to mark the answers. **You must write your Name, Roll No. and other particulars on the first page of the Answer Sheet provided, failing which your Answer Sheet will not be evaluated.**
7. You will encode your **Roll Number** and the **Question Booklet Series A, B, C or D** as it is printed on the top right-hand corner of this Question Booklet with Black/Blue ballpoint pen in the space provided on **Page-2** of your Answer Sheet. **If you do not encode or fail to encode the correct series of your Question Booklet, your Answer Sheet will not be evaluated correctly.**
8. Questions and their responses are printed in English only in this Booklet. Each question comprises **four** responses—(A), (B), (C) and (D). You are to select **ONLY ONE** correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.
9. In the Answer Sheet, there are **four** brackets—(A), (B), (C) and (D) against each question. To answer the questions you are to **mark with Black/Blue ballpoint pen ONLY ONE** bracket of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. **Any erasure or change is not allowed.**
10. You should not remove or tear off any sheet from the Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. **After the examination has concluded, you must hand over your Answer Sheet to the Invigilator.** Thereafter, you are permitted to take away the Question Booklet with you.
11. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.

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- In a gas turbine cycle, the turbine output is 600 kJ/kg, the compressor work is 400 kJ/kg and the heat supplied is 1000 kJ/kg. The thermal efficiency of the cycle is
    - 80%
    - 20%
    - 40%
    - 60%
  - In a gas turbine cycle with regeneration
    - heat input increases
    - pressure ratio increases
    - work output decreases
    - thermal efficiency increases
  - For a steady incompressible flow, the  $u$ -component of velocity is given as  $u = Ae^x$ . The corresponding  $v$ -component of velocity is
    - $-Ae^x$
    - $Ae^y$
    - $Ae^{xy}$
    - $-Ae^{xy}$
  - In the boundary layer, the flow is
    - viscous and irrotational
    - viscous and rotational
    - inviscid and irrotational
    - inviscid and rotational
  - What is the commonly used boundary layer control method to prevent separation?
    - Suction of retarded fluid within the boundary
    - Use of smooth boundary
    - Using large divergence angle in the boundary
    - Suction of accelerating fluid within the boundary
  - Which one of the following dimensionless numbers identifies the compressibility effect of a fluid?
    - Weber number
    - Euler number
    - Froude number
    - Mach number

7. The movable wicket gates of a reaction turbine are used to

- (A) reduce the size of the turbine
- (B) control the flow of water passing through the turbine
- (C) control the pressure under which the turbine is working
- (D) strengthen the casing of the turbine

8. Consider the following energies associated with a Pelton turbine :

- 1. Mechanical
- 2. Kinetic
- 3. Potential

The correct sequence of energy conversion starting from the entry fluid is

- (A) 1-3-2
- (B) 1-2-3
- (C) 2-3-1
- (D) 3-2-1

9. Kaplan turbine is

- (A) an impulse inward flow turbine
- (B) a high head mixed flow turbine
- (C) a low head axial flow turbine
- (D) an outward flow reaction turbine

10. The specific speed  $N_s$  of a water turbine is expressed by which of the following expressions?

(A)  $N_s = \frac{N\sqrt{Q}}{H^{3/4}}$

(B)  $N_s = \frac{N\sqrt{P}}{H^{5/4}}$

(C)  $N_s = \frac{N\sqrt{P}}{H^{3/4}}$

(D)  $N_s = \frac{N\sqrt{Q}}{H^{5/4}}$

11. The specific speed of a centrifugal pump is given by

(A)  $\frac{N\sqrt{H}}{Q^{3/4}}$

(B)  $\frac{N\sqrt{Q}}{H^{3/4}}$

(C)  $\frac{N\sqrt{P}}{H^{5/4}}$

(D)  $\frac{N\sqrt{Q}}{H^{5/4}}$

12. Fluid flow machines are using the principle of either (i) supplying energy to the fluid or (ii) extracting energy from the fluid. Some fluid flow machines are combination of both (i) and (ii). They are classified as

- (A) windmills
- (B) compressors
- (C) hydraulic turbines
- (D) torque converters

13. A composite wall of a furnace has two layers of equal thickness having thermal conductivities in the ratio 3 : 2. What is the ratio of the temperature drop across the two layers?

- (A)  $\log_e 2 : \log_e 3$
- (B) 2 : 3
- (C) 3 : 2
- (D) 1 : 2

14. Which one of the following expresses the thermal diffusivity of a substance in terms of thermal conductivity  $k$ , mass density  $\rho$  and specific heat  $C$ ?

- (A)  $\frac{\rho C}{k^2}$
- (B)  $\rho^2 k C$
- (C)  $\frac{1}{\rho k C}$
- (D)  $\frac{k}{\rho C}$

15. Fins are made as thin as possible to

- (A) improve the flow of coolant around the fin
- (B) reduce the total weight
- (C) accommodate more number of fins
- (D) increase the width for the same profile area

16. A refrigerator working on a reversed Carnot cycle has a COP of 4. If it works as a heat pump and consumes 1 kW, the heating effect will be

- (A) 6 kW
- (B) 1 kW
- (C) 4 kW
- (D) 5 kW

17. In vapour compression refrigeration system, at entrance to which component the working fluid is superheated vapour?

- (A) Expansion valve
- (B) Evaporator
- (C) Condenser
- (D) Compressor

18. In a vapour absorption refrigerator, heat is rejected in

- (A) condenser and absorber
- (B) condenser only
- (C) generator only
- (D) absorber only

19. What is an azeotrope?

- (A) An eco-friendly refrigerant
- (B) A non-halogenic refrigerant
- (C) A refrigerant dissolved in alcohol
- (D) A mixture of refrigerants without phase separation

20. Global warming is caused by

- (A) carbon monoxide
- (B) ozone
- (C) carbon dioxide
- (D) nitrogen

21. The most common type of absorption system in use in industrial applications is based on the refrigerant absorbent combination of

- (A) ammonia-water
- (B) air-water
- (C) lithium bromide-air
- (D) carbon dioxide-water

22. In aqua-ammonia and Li-Br-water absorption systems, the refrigerants are respectively

- (A) ammonia and water
- (B) water and water
- (C) water and Li-Br
- (D) ammonia and Li-Br

23. Which one of the following is the extensive property of a thermodynamic system?

- (A) Density
- (B) Volume
- (C) Pressure
- (D) Temperature

24. Zeroth law of thermodynamics forms the basis of \_\_\_\_\_ measurement.

- (A) work
- (B) pressure
- (C) temperature
- (D) heat exchange

25. Which one of the following is the fluid whose properties in all its three phases are made use of in thermodynamics?

- (A) Water
- (B) Ammonia
- (C) Freon
- (D) Helium

26. The cyclic integral of  $(\delta Q - \delta W)$  for a process is

- (A) unpredictable
- (B) positive
- (C) negative
- (D) zero

27. Change in enthalpy in a closed system is equal to heat transferred, if the reversible process takes place at constant

- (A) entropy
- (B) temperature
- (C) internal energy
- (D) pressure

28. Which one of the following thermodynamic processes approximates the steaming of food in a pressure cooker?

- (A) Isothermal
- (B) Isenthalpic
- (C) Isobaric
- (D) Isochoric

29. "Heat cannot be transported from a system at low temperature to another system at high temperature without the aid of external agency." This statement of second law is attributed to

- (A) Joule-Thomson
- (B) Gay-Lussac
- (C) Clausius
- (D) Max Planck

30. Second law of thermodynamics defines

- (A) internal energy
- (B) entropy
- (C) enthalpy
- (D) efficiency

31. When a real gas undergoes Joule-Thomson expansion, the temperature

- (A) always decreases
- (B) may remain constant
- (C) always increases
- (D) may increase or decrease

32. Use of pulverized coal in boiler furnace provides

- (A) high calorific value
- (B) smokeless burning
- (C) better combustion
- (D) less corrosion on furnace walls

33. Blowing down of boiler water is the process to

- (A) control the drum level
- (B) reduce the boiler pressure
- (C) increase the steam temperature
- (D) control the solid concentration in the boiler water

34. A device which is used to drain off water from steam pipes without escape of steam is called

- (A) injector
- (B) steam separator
- (C) steam trap
- (D) pressure reducing valve

35. The amount of water evaporated from and at 100 °C into dry saturated steam at atmospheric pressure is called

- (A) boiler horsepower
- (B) evaporative capacity
- (C) equivalent evaporation
- (D) generation factor

36. A correctly designed convergent-divergent nozzle working at designed load is

- (A) never isentropic
- (B) always isentropic
- (C) always choked
- (D) never choked

37. What is the critical pressure ratio for isentropic nozzle flow with ratio of specific heats as 1.5?

- (A)  $(1.25)^3$
- (B)  $(0.8)^3$
- (C)  $(0.8)^{0.6}$
- (D)  $(1.25)^{0.33}$

38. Which of the following statements is/are true in relation to choked flow through a nozzle?

1. Discharge is maximum.
2. Discharge is zero.
3. Velocity at throat is supersonic.
4. Nozzle exit pressure is less than or equal to critical pressure.

Select the correct answer using the codes given below.

- (A) Both 1 and 4
- (B) 1 only
- (C) Both 1 and 3
- (D) Both 2 and 3

39. Shock waves involving an abrupt rise of pressure and increase of entropy generally occur

- (A) in the divergent section of the nozzle
- (B) at entry to the nozzle
- (C) in the convergent section of the nozzle
- (D) at the nozzle throat

40. Which of the following is a pressure compounded turbine?

- (A) Rateau
- (B) Parsons
- (C) Curtis
- (D) All of the above

41. In Parsons' reaction turbine, the velocity diagram triangles at the inlet and outlet are

- (A) congruent
- (B) asymmetrical
- (C) isosceles
- (D) right angled

42. The isentropic enthalpy drop in moving blade is two-third of the isentropic enthalpy in fixed blades of a turbine. The degree of reaction will be

- (A) 1.66
- (B) 0.4
- (C) 0.6
- (D) 0.66

43. The breeder ratio for a breeder type reactor

- (A) tends to infinity
- (B) is less than unity
- (C) is unity
- (D) is more than unity

44. Identify the type of nuclear reactor that does not require a heat exchanger.

- (A) Pressurized water
- (B) Gas-cooled
- (C) Sodium-cooled
- (D) Boiling water

45. For the same compression ratio and heat input, the cycle in decreasing order of thermal efficiency is

- (A) Otto, Diesel, Dual
- (B) Otto, Dual, Diesel
- (C) Diesel, Otto, Dual
- (D) Dual, Diesel, Otto

46. Morse test is conducted only on

- (A) water-cooled engines
- (B) variable speed engines
- (C) low-power engines
- (D) multi-cylinder engines

47. Which of the following identifies the anti-knock quality of diesel fuel?

- (A) Cetane number
- (B) SAE number
- (C) API gravity
- (D) Octane number

48. In a reciprocating compressor, one should aim at compressing the air

- (A) polytropically
- (B) adiabatically
- (C) isentropically
- (D) isothermally

49. The suction pressure is 1 bar and the delivery pressure is 125 bar. What is the ideal intermediate pressure at the end of first stage for a 3-stage air compressor?

- (A) 20 bar
- (B) 25 bar
- (C) 5 bar
- (D) 10 bar

50. Which one of the following types of impeller vanes is most commonly used in centrifugal type impellers?

- (A) Tangential
- (B) Forward curved
- (C) Radial
- (D) Backward curved

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