

DO NOT OPEN THIS TEST BOOKLET TILL YOU ARE ASKED TO DO SO.

TR/TES/Mech-II/M/Diploma-V(B)/24

Test Booklet Series

TEST BOOKLET

MECHANICAL ENGINEERING PAPER – II



(Signature of the Candidate)

(Invigilator's Signature)

Time Allowed – 3 hours (Three hours)

Maximum Marks – 200

INSTRUCTIONS

1. IMMEDIATELY BEFORE THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY TEST BOOKLET OF SAME SERIES.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES IN THE OMR ANSWER SHEET ONLY IN THE APPROPRIATE PLACE IN THE ANSWER SHEET BY BLACK BALL POINT PEN ONLY.
3. This Test Booklet is divided into three SECTION i.e., SECTION-A, SECTION-B and SECTION-C.
 - (A) SECTION-A (MCQ Pattern) contains 40 items (questions). Each question, carrying two (2) marks only, has four responses (answers). You will select the response which you want to mark on the OMR Sheet. In case you feel that there is more than one correct response, mark the response which you consider the most appropriate. In any case choose ONLY ONE response for each item.
 - (B) Questions under SECTION-B (Conventional Method) and SECTION-C (Conventional Method) are to be answered in separate Answer Book.
4. You have to mark all your responses of SECTION-A by Black Ball Point pen only on the separate OMR Answer Sheet provided. See directions in the Answer Sheet.
5. Before you proceed to mark in the Answer Sheet the responses to various items of SECTION-A in the Test Booklet, you have to fill in some particulars in the Answer Sheet.
6. On completion of the Examination, you should handover the OMR Answer Sheet for SECTION-A and Answer Book for SECTION-B & C to the Invigilator only. You are permitted to take the Test Booklet with you.
7. Sheets for rough work are appended on the Test Booklet at the end.
8. Instructions for wrong and multiple answer(s) SECTION-A :
 - (a) There will be four alternatives for the answer to every question. However, there will be no negative marking for wrong answer.
 - (b) If a candidate gives more than one answer, it will be treated as a Wrong Answer even if one of the given answers happens to be correct.

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SECTION – A

Answer *all* questions. Each question carries 2 marks.

All Symbols have their usual meanings.

Example : Poise is the unit of

- (A) Surface tension (B) Buoyant force
☒ (C) Coefficient of viscosity (D) Gravitational force

Answer : ☒ (C) Coefficient of viscosity.

- Choose the correct answer from the four alternatives provided with each question and mark on the OMR Sheet. 2×40=80

1. In vapour compression cycle, the condition of refrigerant is dry saturated vapour

- (A) after passing through the condenser
 (B) before passing through the condenser
 (C) after passing through the expansion or throttle valve
 (D) before entering the compressor

2. The cooled air is expanded in an expander. The temperature of the air coming out from the expander is _____ due to isentropic expansion.

- (A) below the atmospheric temperature (B) above the atmospheric temperature
 (C) above the melting point of aluminium (D) below the absolute zero temperature

3. In refrigeration system, heat absorbed in comparison to heat rejected is
- (A) more
 - (B) less
 - (C) more for small capacity and less for high capacity
 - (D) less for small capacity and more for high capacity
4. Which of the following is a component of the transmission system ?
- (A) Differential
 - (B) Brakes
 - (C) Accelerator
 - (D) Shock absorbers
5. During braking the brake shoe is moved outward to press against the
- (A) Wheel piston or cylinder
 - (B) Brake lining
 - (C) Brake drum or disc
 - (D) Wheel rim or axle
6. Gudgeon pins or piston pins are made by
- (A) Piston material itself
 - (B) Cork
 - (C) Cast iron
 - (D) Hardened and ground steel
7. The maximum oil pressure in the lubrication system of an automobile is primarily controlled by the
- (A) Oil pressure relief valve
 - (B) Oil Filter
 - (C) Pump Motor
 - (D) Hand Brake
8. Which of the following is used for checking the level of lubricant in an automobile engine ?
- (A) Autocollimator
 - (B) Dipstick
 - (C) Hydrometer
 - (D) Multimeter

9. Which component releases excess pressure from the cooling system to prevent damage ?

(A) Water pump

(B) Oil filter

(C) Thermostat

(D) Radiator cap

10. What does the thermostat do in the cooling system ?

(A) Measures coolant temperature

(B) Filters impurities from the coolant

(C) Regulates the flow of coolant based on engine temperature

(D) Provides a barrier between oil and coolant

11. The primary function of the chassis in an automobile is

(A) to provide storage space for passengers and cargo

(B) to improve fuel efficiency

(C) to house the engine and transmission

(D) to support and provide structural integrity to the vehicle

12. The purpose of the anti-roll bar (stabilizer bar) in an automobile's chassis is

(A) to provide storage space for tools and equipments

(B) to reduce air resistance and improve aerodynamics

(C) to improve fuel efficiency

(D) to minimize body roll during cornering

13. What is the purpose of the crumple zones in the design of an automobile's body ?
- (A) to increase the vehicle's overall weight
 - (B) to absorb energy and reduce impact forces during collisions
 - (C) to protect passengers from rain and wind
 - (D) to enhance the aesthetic appeal of the vehicle
14. The differential is a component in the drivetrain of an automobile that allows the wheels on the
- (A) same axle to rotate at different speeds, especially during turns
 - (B) different axles to rotate at same speeds
 - (C) movement to avoid lock on slippery surfaces
 - (D) vehicle to have high air conditioning cooling inside the vehicle
15. In which stage of the clutch operation is power transmitted from the engine to the transmission ?
- (A) Engagement
 - (B) Disengagement
 - (C) Neutral
 - (D) Floating
16. What type of clutch is commonly used in manual transmission automobiles ?
- (A) Centrifugal clutch
 - (B) Hydraulic clutch
 - (C) Friction clutch
 - (D) Torque converter clutch
17. What is "gear ratio" in a gearbox ?
- (A) The number of gears in the gearbox
 - (B) The speed of the vehicle in a particular gear
 - (C) The difference in size between two gears
 - (D) The ratio of the speed of the driving gear to the speed of the driven gear

18. The type of steering system which uses a pinion gear and a rack to convert rotational motion into linear motion is
- (A) Recirculating ball steering (B) Rack and pinion steering
- (C) Worm and sector steering (D) Variable-assist steering
19. The purpose of the steering column in the steering system is
- (A) to support the vehicle's weight
- (B) to connect the steering wheel to the wheels
- (C) to control the vehicle's speed
- (D) to regulate the engine's temperature
20. The braking system which uses compressed air to transmit force from the brake pedal to the brake components is
- (A) Mechanical braking system (B) Pneumatic braking system
- (C) Hydraulic braking system (D) Electronic braking system
21. Identify the the type of windmill in Figure-5.



Figure-5

- (A) Three blade type windmill (B) Propeller type windmill
- (C) Darrieus type windmill (D) Savonius type windmill

22. What does the Yaw system do in a wind turbine ?

(A) Blade pitch control

(B) Wind direction alignment

(C) Power generation

(D) Turbine shutdown

23. What converts wind energy to mechanical energy in turbines ?

(A) Generator

(B) Rotor blades

(C) Gearbox

(D) Nacelle

24. The function of step-up transformer in wind power plant

(A) increases voltage for grid connection

(B) converts wind energy to electrical energy

(C) adjusts blade pitch angle

(D) controls turbine rotation speed

25. What results from aerobic sewage decomposition ?

(A) Biomass

(B) Synthetic fuels

(C) Bio fuels

(D) Metal articles

26. Mixture of ice and water form a

(A) closed system

(B) open system

(C) isolated system

(D) heterogeneous system

27. Which of the following is false statement ?

Excess quantities of sulphur in fuel are objectionable because it may cause the following

(A) piston ring and cylinder wear

(B) formation of hard coating on piston skirts

(C) oil sludge in the engine crank case

(D) detonation

28. Which of the following best indicates the process of gasification ?

- (A) Biomass $\rightarrow$ carbon dioxide and water $\rightarrow$ producer gas and charcoal $\rightarrow$ carbon monoxide and hydrogen
- (B) Biomass $\rightarrow$ carbon monoxide and hydrogen $\rightarrow$ carbon dioxide and water $\rightarrow$ producer gas and charcoal
- (C) Producer gas and charcoal $\rightarrow$ carbon dioxide and water $\rightarrow$ carbon monoxide and hydrogen $\rightarrow$ biomass
- (D) Biomass $\rightarrow$ producer gas and charcoal $\rightarrow$ carbon dioxide and water $\rightarrow$ carbon monoxide and hydrogen

29. The process of addition of moisture to air at the constant dry bulb temperature is known as

- (A) humidification
- (B) dehumidification
- (C) sensible cooling
- (D) air conditioning

30. For a refrigerator using a reversed Carnot cycle with COP of 4, what is the ratio of the highest to lowest absolute temperatures ?

- (A) 1.0
- (B) 1.25
- (C) 1.45
- (D) 1.65

31. What is the optimal absorbent -refrigerant pair for solar refrigeration ?

- (A) Ammonia-Water
- (B) Water-Lithium bromide
- (C) Water-Ammonia
- (D) Lithium bromide-Water

32. When replacing a burnt-out hermetic compressor with a new one, is it recommended to integrate a sizable combined drier and strainer within the system ? This should be positioned in

- (A) the designated refrigerant lines
- (B) the allocated liquid lines
- (C) the designated discharged lines
- (D) the specified suction lines

33. Where is the air refrigeration cycle commonly used ?

- (A) Home fridges
- (B) Commercial fridges
- (C) Gas liquefaction
- (D) Air-conditioning

34. Which cycle exhibits the lowest COP and optimal waste heat utilization in refrigeration ?

- (A) Vapor compression cycle
- (B) Air refrigeration cycle
- (C) Vapor absorption cycle
- (D) Vortex refrigeration system

35. In milk chilling plants, the common secondary refrigerant is

- (A) Ammonia solution
- (B) Sodium silicate
- (C) Glycol
- (D) Brine

36. Use the provided codes to choose the correct answer :

- | | |
|--------------------------------------|-----------------------|
| (a) Bell-Coleman refrigeration | 1. Generator |
| (b) Vapour compression refrigeration | 2. Flash chamber |
| (c) Absorption refrigeration | 3. Compressor |
| (d) Jet refrigeration | 4. Expansion cylinder |

Codes:

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

37. Calculate the hourly water flow rate for a 4 Ton water cooler, with inlet at 40°C and outlet at 15°C .
- (A) 382 kg (B) 482 kg
(C) 582 kg (D) 282 kg
38. What pressure is maintained at the cooling turbine outlet in an aircraft refrigeration system ?
- (A) Compressor inlet pressure (B) Evaporator pressure
(C) Cabin pressure (D) Ambient pressure
39. What is the combined COP of a series arrangement of two reversible refrigerators with COPs of 3.5 and 4.5 ?
- (A) 1.5 (B) 1.75
(C) 2.0 (D) 2.25
40. What property remains consistent in the expansion valve of a refrigerator ?
- (A) Pressure (B) Temperature
(C) Entropy (D) Enthalpy.

SECTION – B

- Answer *all* questions. Each question carries 6 marks. 6×15=90
 - All Symbols have their usual meanings.
41. What is the purpose of the transmission system in an automobile ?
 42. Explain briefly about any two types of suspension systems commonly used in vehicles. Which one is better suited for off-roads ?
 43. What are the functions of Brake pads (in brake discs), brake shoes (in brake drums) and brake fluid, and how these are among the most important components within all components of an automobile braking system ?
 44. What is the primary purpose of a fuel pump in an automobile ? Explain about problems which may arise if the fuel pump is not working properly.
 45. What is the significance of emission standards, such as Bharat and Euro norms ? Explain in brief about their impacts on pollution ?
 46. Explain in brief about the main sections of a Solar Power Plant.
 47. What are the important parameters which may be focussed for achieving higher efficiency in solar power production ?
 48. Elucidate the advantages and disadvantages of wind power plants over hydro power plants ?
 49. What challenges does biomass energy face ?
 50. What differentiates synthetic refrigerants from natural refrigerants in terms of molecular composition and environmental impact ?
 51. List the merits, demerits and applications of an air refrigeration system.
 52. Where are low- and high-pressure switches located and what are their roles ?
 53. What are regenerative fuel cells ? Briefly describe its working with a properly labelled diagram.
 54. What are the advantages of lubricants in IC engines used for automobiles ?
 55. What are the desirable properties of refrigerants ?

SECTION – C

- Answer *all* questions. Each question carries 6 marks.
- All Symbols have their usual meanings.

6×5=30

56. The enthalpies at the beginning of compression, at the end of compression, and at the end of condensation are 180 kJ/kg, 220 kJ/kg and 80 kJ/kg, respectively. Determine the COP of the vapor compression refrigeration system.
57. A cold storage is to be maintained at -5°C while the surroundings are at 35°C . The heat leakage from the surroundings into the cold storage is estimated to be 29 kW. The actual C.O.P. of the refrigeration plant is one-third of an ideal plant working between the same temperatures. Find the power or work required to drive the plant.
58. Calculate the tons of refrigeration required to cool 50 cubic meter of air per minute from 35°C Dry Bulb Temperature and 60% relative humidity (Enthalpy is say, $h_1 = 90$ kJ/kg) to 21°C Dry Bulb Temperature and 70% relative humidity (Enthalpy is say, $h_2 = 49$ kJ/kg). Assume Specific volume of air at $35^{\circ}\text{C} = 0.886$ m³/kg.
59. Given the weight-based ultimate analysis of petrol as 85% carbon and 15% hydrogen, determine the weight ratio of air to petrol consumption. If the volumetric analysis of dry exhaust gas shows CO₂ at 11.5%, CO at 1.2%, O₂ at 0.9%, and N₂ at 86%, calculate the percentage of excess air as well.
60. The following results refer to a test on a petrol engine :
- Indicated power = 30 kW; brake power = 26 W; engine speed = 1000 rpm; fuel per break-power hour = 0.35 kg; calorific value of the fuel used = 43900 kJ/kg. Calculate :
- (a) The indicated thermal efficiency
 - (b) The break thermal efficiency
 - (c) The mechanical efficiency.