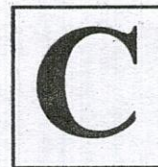


DO NOT OPEN THIS TEST BOOKLET TILL YOU ARE ASKED TO DO SO.

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

Test Booklet Series

**TEST BOOKLET
MECHANICAL ENGINEERING
PAPER – I**



(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 POINT PEN ONLY.**
3. This Test Booklet is divided into three **SECTIONS** i.e., **SECTION-A, SECTION-B and SECTION-C.**
 - (A) **SECTION-A (MCQ Pattern)** contains 40 items (questions). Each question, carrying 2 (two) 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 Text 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 and 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. $2 \times 40 = 80$

- Choose the correct answer from the four alternatives provided with each question and mark on the OMR Sheet.

Example : Poise is the unit of

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

Answer : ☒ Coefficient of viscosity.

- Which of the following air pollutant is most likely to trigger an asthma attack ?
 (A) Carbon monoxide (B) Nitrogen dioxide
 (C) Sulfur dioxide (D) Methane
- Which of the following is the most important benefit of analyzing air pollutants ?
 (A) Source and impact assessment
 (B) Polluting more for better accuracy
 (C) Increasing pollutant concentration to boost natural processes
 (D) Cost-driven reduction in advanced analytics
- The most effective way to reduce Volatile Organic Compound (VOC) emissions from industrial processes is
 (A) Catalytic converter (B) Wet scrubber
 (C) Electrostatic precipitator (D) Thermal oxidizer
- Which technology uses filters to remove particulate matter from industrial exhaust gases ?
 (A) Electrostatic precipitators (B) Scrubbers
 (C) Carbon capture and storage (D) Flue gas desulfurization

5. Which instrument measures air ozone concentration ?
 - (A) Spectrometer
 - (B) Gas chromatograph
 - (C) Photometer
 - (D) Mass spectrometer
6. What is the main way that water is added to aquifers ?
 - (A) Surface runoff
 - (B) Melting ice
 - (C) Sea water intrusion
 - (D) Atmospheric moisture
7. A fluid in equilibrium cannot sustain
 - (A) tensile stress
 - (B) shear stress
 - (C) bending stress
 - (D) compressive stress
8. What technology breaks down organic matter in waste water treatment plants ?
 - (A) Reverse osmosis
 - (B) Biological processes
 - (C) Chlorination
 - (D) Activated carbon filtration
9. What is a common point-source urban pollution control method ?
 - (A) Implementing buffer zones
 - (B) Building waste water treatment plants
 - (C) Using cover crops
 - (D) Releasing chemical dispersants
10. The biggest obstacle to preventing plastic pollution in oceans and waterways is
 - (A) Difficulty in recycling
 - (B) High biodegradability of plastics
 - (C) Lack of public awareness
 - (D) Natural degradation in sunlight

11. What value of sound intensity corresponds to the lower limit of audibility for human beings ?
- (A) 50 dB (B) 40 dB
(C) 30 dB (D) 20 dB
12. The Environmental Noise Directive (END) is
- (A) A United Nations Convention that sets noise limits for different types of noise
(B) A United States Environmental Protection Agency (EPA) regulation that sets noise limits for different types of noise
(C) An Indian Noise Convention that sets noise limits for different types of noise
(D) An European Union directive that sets noise limits for different types of noise
13. Which of these is not a penalty for not complying with environmental rules ?
- (A) Fines
(B) Closure of the business
(C) Imprisonment
(D) Compensation for environmental damage
14. Which of these is not an ISO 14001 requirement ?
- (A) Establish an environmental policy (B) Implement a management system
(C) Obtain third-party certification (D) Carry out regular audits
15. Which is a legally binding International treaty on climate change ?
- (A) The Montreal Protocol (B) The Kyoto Protocol
(C) The Stockholm Convention (D) The Paris Agreement

16. Which Indian statutory body implements water pollution control ?
- (A) The Central Pollution Control Board
 - (B) The State Pollution Control Boards
 - (C) The National Green Tribunal
 - (D) The Ministry of Environment, Forest and Climate Change
17. The strain-energy density of a material represents
- (A) The amount of deformation a material can endure
 - (B) The energy stored per unit area due to deformation
 - (C) The energy stored per unit volume due to deformation
 - (D) The energy change in temperature due to strain
18. What happens to Young's modulus when the length of a wire is halved and the radius is doubled ?
- (A) Becomes 2 times its initial value
 - (B) Becomes $\frac{1}{4}$ times its initial value
 - (C) Becomes $\frac{1}{2}$ times its initial value
 - (D) None of these
19. A simply supported beam subjected to lateral load deflects less than a specified limit. Which of the following actions will result in an increase in deflection ?
- (A) Increase the sectional area's moment of inertia.
 - (B) Use a material with a higher modulus of elasticity.
 - (C) Extend the span of the beam.
 - (D) Decrease the magnitude of the applied load.

20. An end-loaded cantilever beam with a square cross-section of side 'a' experiences a change in tip deflection when 'a' is increased by 50%. How does this alteration affect the tip deflection ?
- (A) The tip deflection increases by around 6.25%.
 - (B) The tip deflection decreases by around 6.25%.
 - (C) The tip deflection increases by around 20%.
 - (D) The tip deflection decreases by around 20%.
21. The ratio of thickness to diameter for thin cylinder is
- (A) $1/30$
 - (B) $1/20$
 - (C) $1/5$
 - (D) $1/2$
22. In a thin cylinder, radial stress is considered or assumed to be
- (A) negligible as compared to other stresses
 - (B) very high as compared to other stresses
 - (C) infinite
 - (D) equal to hoop stress
23. Against deflection of a beam, _____ is a measure of its resistance against deflection.
- (A) Strength
 - (B) Stiffness
 - (C) Slope
 - (D) Maximum bending
24. In simply supported beams, the slope is _____ at supports.
- (A) Minimum
 - (B) Zero
 - (C) Maximum
 - (D) Equal to uniformly distributed load

25. For two shafts connected in parallel
- (A) torque in each shaft is the same
 - (B) shear stress in shaft is the same
 - (C) angle of twist of each shaft is the same
 - (D) torsional stiffness of each shaft is the same
26. In a simply supported beam at a place, where the bending moment is maximum, the shear force will be ____.
- (A) Maximum
 - (B) Minimum
 - (C) Zero
 - (D) None of these
27. Lathe centers are provided with the following standard taper
- (A) Morse
 - (B) British
 - (C) Metric
 - (D) Sharpe
28. In which of the following operations on a lathe, the spindle speed will be minimum ?
- (A) Knurling
 - (B) Turning
 - (C) Taper turning
 - (D) Thread cutting
29. Drilling is an example of _____ type of cutting.
- (A) simple
 - (B) uniform
 - (C) orthogonal
 - (D) oblique
30. The helical grooves which extend to the full length of the drill body, that help to evacuate chips during cutting are called
- (A) lips
 - (B) flutes
 - (C) marginal holes
 - (D) chipping edges

31. Cylindrical parts are held on planer by
- (A) V-Blocks only (B) Angle plates only
- (C) V-Blocks, T-Bolts, and Clamps (D) Magnetic Vice
32. The load required to produce a unit deflection in a spring is called
- (A) stiffness of a spring (B) power of a spring
- (C) specific weight of a spring (D) ultimate load
33. Size of shaper is determined by
- (A) Length of stroke (B) Size of stroke
- (C) Size of tool (D) Horse power of Motor
34. Which of the following is mainly responsible for the causes of water pollution ?
- (A) Afforestation (B) Oil refineries
- (C) Paper factories (D) Both (B) and (C)
35. Which pollution causes hearing loss in organisms ?
- (A) Air pollution (B) Noise pollution
- (C) Water pollution (D) Soil pollution
36. Which of the following air pollutants cause acid rain ?
- (A) Nitric oxide (B) Sulphur Dioxide
- (C) Carbon Monoxide (D) Both among (A) and (B)

37. With the objective of providing protection and for improvement of the environment, when did the Government of India enact the "Environment Protection Act" ?
- (A) 1990 (B) 1986
(C) 1967 (D) 2023
38. In one of the methods of controlling air pollution, which is the most widely used technique for removing particulate matter ?
- (A) Loudspeakers (B) Growing trees
(C) Electrostatic precipitator (D) Magnets
39. As part of controlling air pollution, where are the "catalytic converters" fitted ?
- (A) Plants
(B) Internal Combustion Engine Automobiles
(C) Refrigerators
(D) Electric Trains
40. Which of the following was the main purpose behind setting up the Central Pollution Control Board (CPCB) ?
- (A) To regulate air and water pollution
(B) Not to regulate but only advise Government on social media related pollution
(C) To regulate noise pollution
(D) To regulate deforestation.

SECTION-B

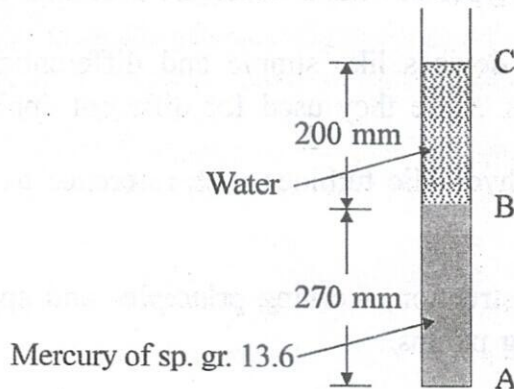
- Answer *all* questions. Each question carries 6 marks. 6×15=90

41. Explain in brief about the main factors responsible for air and water pollution.
42. Define air pollution, and explain about its causes, effects and methods to control it.
43. How does an industrial unit or a power plant degrade air quality around its periphery ?
What are the main after-effects of setting up such polluting unit in a location ?
44. How does noise pollution affect human comfort ? What are the methods to control noise pollution ?
45. What are the differences between thin and thick cylinders/shells.
46. Explain in brief about the main types of beams which are used in a variety of structures.
47. What are pressure measuring devices like simple and differential manometers, and Bourdon Tube Pressure gauges ? Are they used for different applications ?
48. Distinguish different types of hydraulic turbines with reference to their head, type of turbine, and application.
49. Explain in brief about the construction, working principles and applications of single and double acting reciprocating pumps.
50. How does temperature affect spring performance ?
51. Explain briefly stress-strain diagram's significance, features, and material behavior implications.
52. How are thin cylinders and spherical shells manufactured ?
53. What is pump cavitation, and how does it affect performance ?
54. How does a rotameter measure the volumetric flow rate of a fluid ?
55. How do impulse and reaction turbines suit different hydroelectric scenarios based on head and flow ?

SECTION-C

- Answer *all* questions. Each question carries 6 marks : $6 \times 5 = 30$

56. A simply supported beam of span length 6 m and 75 mm diameter carries a uniformly distributed load of 1.5 kN/m. What is the maximum value of Bending Stress ?
57. A solid circular shaft of diameter 100 mm is subjected to an axial stress of 50 MPa. It is further subjected to a torque of 10 kNm. Calculate the maximum principal stress experienced by the shaft.
58. A vertical tube (as shown in figure below) contains 200 mm of water on top of 270 mm of mercury of specific gravity of 13.6. What is the pressure at the bottom of the tube ?



59. Compute the head loss due to pipe friction and the power required to maintain flow in a circular pipe of 40 mm diameter and 750 m laid horizontal when water flows at a rate of 4 litres per minute. Take dynamic viscosity of water equal to $1.14 \times 10^{-3} \text{ N s/m}^2$.
60. If overall efficiency of a Peltan Turbine is 72%, and if Shaft Power = 680 kW and Runner Power = 800 kW, then, what is the hydraulic efficiency ?