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2018

TEST BOOKLET SERIES

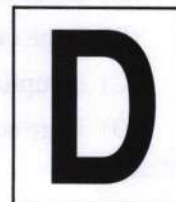
**TEST BOOKLET
MECHANICAL ENGINEERING**

Time allowed : 2 hours

Full marks : 200

Answer *all* the questions.

Questions are of equal value.



Serial No.

010292

Roll No.

Signature of the Candidate:

INSTRUCTIONS

Candidates should read the following instructions carefully before answering the questions:

1. This booklet consists of 16 pages including this front page, containing 100 questions. Verify the Page Nos. and Test Booklet Series on each page and bring at once to the Invigilator's notice any discrepancy.
2. Answers will have to be given in the Special Answer-Sheet supplied for the purpose.
3. Before you proceed to mark in the Answer-Sheet in response to various items in the Test Booklet, you have to fill in some particulars in the Answer-Sheet as per instructions sent to you in the Admit Card. **Do not fold the Answer-Sheet as this will result in error in your marks.**
4. All questions are of multiple-choice answer-type. You will find **four** probable answers (A), (B), (C) and (D) against each question. Find out which of the four answers appears to you to be correct or the best. Now darken the circle corresponding to the letter of the selected answer in the Answer-Sheet with **Black Ball Point Pen** as per instructions printed on the reverse of the Admit Card and in the Answer-Sheet.
5. One and only one circle is to be fully blackened for answer. Any spot in any other circle (multiple circle) or in wrong circle will be considered as wrong answer.
6. **There will be negative marking for wrong answers; $\frac{2}{3}$ mark will be deducted for each wrong answer.**
7. There are blank pages at the end of this Test Booklet for Rough Work.
8. **The Special Answer-Sheet should be handed over to the Invigilator before leaving the Examination Hall. You are permitted to take away the used Test Booklet after completion of the examination.**

Please Turn Over

1. Metal patterns are used for
 - (A) small castings
 - (B) large castings
 - (C) complicated castings
 - (D) large scale production of castings
2. Aluminium is the best material for making patterns because it is
 - (A) light in weight
 - (B) easy to work
 - (C) corrosion resistant
 - (D) All of the above
3. When a mould is made in three parts, the top part, is known as a
 - (A) drag
 - (B) cheek
 - (C) cope
 - (D) None of the above
4. Chills are used in casting moulds to
 - (A) achieve directional solidification.
 - (B) reduce blow holes.
 - (C) reduce the freezing time.
 - (D) increase the smoothness of the casting surface.
5. Swab is used for
 - (A) smoothing and cleaning out depressions in the mould.
 - (B) cleaning the moulding sand.
 - (C) moistening the sand around the edge before removing pattern.
 - (D) reinforcement of sand in the top part of the moulding box.
6. A jolt machine is used to
 - (A) ram the sand harder at the pattern face with decreasing hardness towards the back of the mould.
 - (B) ram the sand harder at the back of the mould and softer on the pattern face.
 - (C) produce uniform sand hardness throughout the mould.
 - (D) produce uniform packing of sand in the mould.
7. In die casting, machining allowance is
 - (A) small
 - (B) large
 - (C) very large
 - (D) not provided
8. The casting method adopted for ornaments and toys of non-ferrous alloys, is
 - (A) permanent mould casting
 - (B) slush casting
 - (C) die casting
 - (D) centrifugal casting
9. In a hot chamber die casting machine
 - (A) melting pot is separate from the machine.
 - (B) melting pot is an integral part of the machine.
 - (C) melting pot may have any location.
 - (D) high temperature and pressure is used.
10. In a cold chamber die casting machine
 - (A) melting pot is separate from the machine.
 - (B) melting pot is an integral part of the machine.
 - (C) melting pot may have any location.
 - (D) low temperature and pressure is used.

11. In ultrasonic machining tool is made of
 (A) Tungsten carbide
 (B) Brass or Copper
 (C) Diamond
 (D) Stainless steel
12. In Electro-chemical machining the gap between tool and work piece is kept as
 (A) 0.1 mm
 (B) 0.25 mm
 (C) 0.4 mm
 (D) 0.75 mm
13. Which of the following processes is used for preparing parts having large curved surfaces and thin sections?
 (A) Hot machining
 (B) Ultrasonic machining
 (C) ECM process
 (D) Chemical milling
14. Jigs are used
 (A) for holding and guiding the tool in drilling, reaming or tapping operations.
 (B) for holding the work in milling, grinding, planning or turning operations.
 (C) to check the accuracy of the work piece.
 (D) None of the above
15. A diamond locating pin is used in jigs and fixtures because
 (A) diamond is very hard and wear resistance.
 (B) it occupies very little space.
 (C) it helps in assemble with tolerance on center distance.
 (D) it has long life.
16. Gear burnishing is a process for
 (A) surface finishing.
 (B) under cut gears.
 (C) producing cycloidal gears.
 (D) removing residual stress from teeth roots.
17. Thermit welding is often used
 (A) replacing broken gear tooth.
 (B) repairing broken shears.
 (C) joining rails, trucks and locomotives frames.
 (D) All of the above
18. When a bar of length l and diameter d is rigidly fixed at the upper end and hanging freely, then the total elongation produced in the bar due to its own weight is
 (A) $\frac{wl}{2E}$
 (B) $\frac{wl^2}{2E}$
 (C) $\frac{wl^3}{2E}$
 (D) $\frac{wl^4}{2E}$
- where w = weight per unit volume of the bar.
19. The ratio of the lateral strain to the linear strain is called
 (A) Modulus of elasticity
 (B) Modulus of rigidity
 (C) Bulk modulus
 (D) Poisson's ratio
20. The Poisson's ratio for cast iron varies from
 (A) 0.23 to 0.27
 (B) 0.25 to 0.33
 (C) 0.31 to 0.34
 (D) 0.32 to 0.42

21. The strain energy stored in a body, when the load is gradually applied, is

- (A) $\frac{\sigma E}{V}$
 (B) $\frac{\sigma V}{E}$
 (C) $\frac{\sigma^2 E}{2V}$
 (D) $\frac{\sigma^2 V}{2E}$

where σ = Stress in the material of the body
 V = Volume of the body and
 E = Modulus of elasticity of the material.

22. The bending moment of a cantilever beam of length L and carrying a gradually varying load from zero at free end and w per unit length towards the fixed end is _____ at the fixed end.

- (A) $\frac{wL}{2}$
 (B) wL
 (C) $\frac{wL^2}{2}$
 (D) $\frac{wL^2}{6}$

23. If the tearing efficiency of a riveted joint is 70%, then the ratio of diameter to the pitch is

- (A) 0.20
 (B) 0.30
 (C) 0.5
 (D) 0.70

24. The neutral axis of the cross-section of a beam is that axis at which the bending stress is

- (A) zero
 (B) minimum
 (C) maximum
 (D) infinity

25. According to I.B.R., the thickness of the boiler shell should not be less than

- (A) 4mm
 (B) 5mm
 (C) 6mm
 (D) 7mm

26. The optimum effective temperature for human comfort is

- (A) higher in winter than in summer.
 (B) lower in winter than in summer.
 (C) same in winter and summer.
 (D) not dependent on season.

27. According to Indian standards, the total number of tolerance grades are

- (A) 8
 (B) 12
 (C) 18
 (D) 20

28. A material is said to be allotropic, if it has

- (A) fixed structure at all temperatures.
 (B) atoms distributed in random pattern.
 (C) different crystal structures at different temperatures.
 (D) atoms distributed in crystalline pattern.

29. The quantity of heat radiation is dependent on

- (A) area of the body only.
 (B) shape of the body only.
 (C) temperature of the body only.
 (D) All of the above

30. Stefan-Boltzmann law is expressed as

- (A) $Q = \sigma AT^4$
 (B) $Q = \sigma A^2 T^4$
 (C) $Q = \sigma AT^2$
 (D) $Q = AT^4$

31. The thermal conductivity is expressed as
- (A) $\frac{W}{mK}$
 - (B) $\frac{W}{m^2 K}$
 - (C) $\frac{W}{hmK}$
 - (D) $\frac{W}{h^2 m^2 K}$
32. The difference between the tooth space and the tooth thickness as measured on the pitch circle is called
- (A) working depth
 - (B) clearance
 - (C) face width
 - (D) backlash
33. The helix angle for double helical gears may be made up to
- (A) 45°
 - (B) 60°
 - (C) 75°
 - (D) 90°
34. If the centre distance of a mating gear having involute teeth is varied within limits, the velocity ratio
- (A) increases
 - (B) decreases
 - (C) remain unchanged
 - (D) None of the above
35. The sleeve and muff coupling is designed as a
- (A) thin cylinder
 - (B) thick cylinder
 - (C) solid shaft
 - (D) hollow shaft
36. In a steam engine, the valve rod is connected by an eccentric rod by means of
- (A) cotter joint
 - (B) knuckle joint
 - (C) universal joint
 - (D) flange coupling
37. The eye bolts are used for
- (A) transmission of power.
 - (B) locking devices.
 - (C) lifting and transporting heavy machines.
 - (D) absorbing shocks and vibrations.
38. The railway carriage couplings have
- (A) square thread
 - (B) acme threads
 - (C) knuckle threads
 - (D) buttress threads
39. In compression test, the fracture in cast iron specimen would occur along
- (A) the axis of load.
 - (B) an oblique plane.
 - (C) at right angles to the axis of specimen.
 - (D) would not occur.
40. The compressive strength of brittle materials is _____ its tensile strength.
- (A) equal to
 - (B) less than
 - (C) greater than
 - (D) double

41. The tensile test is carried on _____ materials.

- (A) ductile
- (B) brittle
- (C) malleable
- (D) plastic

42. The Rankine's formula holds good for

- (A) short columns
- (B) long columns
- (C) both short and long columns
- (D) weak columns

43. According to Euler's column theory, the crippling load for a column of length l with one end fixed and the other end hinged, is

- (A) $\frac{\pi^2 EI}{l^2}$
- (B) $\frac{\pi^2 EI}{4l^2}$
- (C) $\frac{2\pi^2 EI}{l^2}$
- (D) $\frac{4\pi^2 EI}{l^2}$

44. A thin cylindrical shell of diameter d , length l , and thickness t is subjected to an internal pressure p . The hoop stress in the shell is

- (A) $\frac{pd}{t}$
- (B) $\frac{pd}{2t}$
- (C) $\frac{pd}{4t}$
- (D) $\frac{pd}{6t}$

45. The tensile strength of the welded joint for double fillet is

- (A) $0.5s.l.\sigma_t$
- (B) $s.l.\sigma_t$
- (C) $\sqrt{2}s.l.\sigma_t$
- (D) $2s.l.\sigma_t$

where s = leg or size of the weld,
 l = length of the weld and

σ_t = allowable tensile stress for weld metal.

46. In order to avoid tearing off the plate at an edge, the distance from the centre of the rivet hole to the nearest edge of the plate (i.e. margin) should be

- (A) d
- (B) $1.5d$
- (C) $2d$
- (D) $2.5d$

where d = diameter of rivet hole in mm.

47. According to Unwin's formula, the relation between diameter of rivet hole d and thickness of plate t is given by

- (A) $d = t$
- (B) $d = 1.6\sqrt{t}$
- (C) $d = 2t$
- (D) $d = 6\sqrt{t}$

where d and t are in mm.

48. Two closely-coiled helical springs 'A' and 'B' of the same material, same number of turns and made from same wire are subjected to an axial load W . The mean diameter of spring 'A' is double the mean diameter of spring 'B'. The ratio of deflections in spring 'B' to spring 'A' will be

- (A) $1/8$
- (B) $1/4$
- (C) 2
- (D) 4

49. When a shaft of diameter D is subjected to a twisting moment T and a bending moment M , then the maximum normal stress is given by

- (A) $16 / \pi D^3 \left[\sqrt{M^2 + T^2} \right]$
 (B) $16 / \pi D^3 \left[\sqrt{M^2 - T^2} \right]$
 (C) $16 / \pi D^3 \left[M + \sqrt{M^2 + T^2} \right]$
 (D) $16 / \pi D^3 \left[M - \sqrt{M^2 + T^2} \right]$

50. The polar modulus for a solid shaft of diameter D is

- (A) $\frac{\pi D^2}{4}$
 (B) $\frac{\pi D^3}{16}$
 (C) $\frac{\pi D^3}{32}$
 (D) $\frac{\pi D^4}{64}$

51. The condition for a reversible cyclic process is

- (A) $\oint \frac{\delta Q}{T} = 0$
 (B) $\oint \frac{\delta Q}{T} < 0$
 (C) $\oint \frac{\delta Q}{T} > 0$
 (D) None of the above

52. The efficiency of Diesel cycle approaches to Otto cycle efficiency when

- (A) cut-off is increased.
 (B) cut off is decreased.
 (C) cut -off is zero.
 (D) cut-off is constant.

53. The compression ratio for petrol engines is

- (A) 3 to 6
 (B) 5 to 8
 (C) 15 to 20
 (D) 20 to 30

54. The air standard efficiency of an Otto cycle is given by

- (A) $1 - r^{\gamma-1}$
 (B) $1 + r^{\gamma-1}$
 (C) $1 - \frac{1}{r^{\gamma-1}}$
 (D) $1 + \frac{1}{r^{\gamma-1}}$

where r = Compression ratio and
 γ = Ratio of specific heats.

55. The amount of heat generated per kg of fuel is known as

- (A) Calorific value
 (B) Heat energy
 (C) Lower calorific value
 (D) Higher calorific value

56. A safety valve mainly used with locomotive and marine boilers is

- (A) lever safety valve
 (B) dead weight safety valve
 (C) high steam and low water safety valve
 (D) spring loaded safety valve

57. A device used to heat feed water by utilising the heat in the exhaust flue gases before leaving through the chimney, is known as

- (A) Economiser
 (B) Fusible plug
 (C) Superheater
 (D) Stop valve

58. Blast furnace is used to produce

- (A) Pig iron
- (B) Cast iron
- (C) Wrought iron
- (D) Steel

59. Match the correct answer from Group B for the heat treatment processes given in Group A.

Group A (Heat treatment process)	Group B (Effect on the properties)
(a) Annealing	(A) Refines grain structure
(b) Nitriding	(B) Improves the hardness of the whole mass
(c) Martempering	(C) Increases surface hardness
(d) Normalising	(D) Improves ductility
(A) DCBA	
(B) BCDA	
(C) ADCB	
(D) ACBD	

60. Duralumin contains

- (A) 3.5% to 4.5% copper, 0.4% to 0.7% magnesium, 0.4% to 0.7% manganese and rest aluminium.
- (B) 3.5% to 4.5% copper, 1.2% to 1.7% manganese, 1.8% to 2.3% Nickel, 0.6% each of silicon, magnesium and iron and rest aluminium.
- (C) 4% to 4.5% magnesium, 3% to 4% copper and rest aluminium.
- (D) 5% to 6% tin, 2% to 3% copper and rest aluminium.

61. Normalising of steel is done to

- (A) refine the grain structure.
- (B) remove strain caused by cold working.
- (C) remove dislocations caused in the internal structure due to hot working.
- (D) All of the above

62. If the body falls freely under gravity, then the gravitational acceleration is taken as

- (A) $+ 8.9 \text{ m/s}^2$
- (B) $- 8.9 \text{ m/s}^2$
- (C) $+ 9.8 \text{ m/s}^2$
- (D) $- 9.8 \text{ m/s}^2$

63. In American Standard Association (ASA) system, if the tool nomenclature is 8-6-5-5-10-15-2 mm, then the side rake will be

- (A) 5°
- (B) 6°
- (C) 8°
- (D) 10°

64. The negative rake is usually provided on

- (A) high carbon steel tools
- (B) high speed steel tools
- (C) cemented carbide tools
- (D) All of the above

65. With the same tool life, the maximum material per minute is removed by

- (A) increasing the cutting speed.
- (B) decreasing the cutting speed.
- (C) increasing the depth of cut.
- (D) increasing the feed rate.

66. High speed steel cutting tools operate at cutting speeds _____ than carbon steel tools.

- (A) 2 to 3 times lower
- (B) 2 to 3 times higher
- (C) 5 to 8 times higher
- (D) 8 to 20 times higher

67. For machining a mild steel workpiece by a high speed steel tool, the average cutting speed is

- (A) 5 m/min
- (B) 10 m/min
- (C) 15 m/min
- (D) 30 m/min

68. For machining a cast iron workpiece by a high speed steel tool, the average cutting speed is

- (A) 10 m/min
- (B) 15 m/min
- (C) 22 m/min
- (D) 30 m/min

69. The machining of titanium is difficult due to

- (A) high thermal conductivity of titanium.
- (B) chemical reaction between tool and work.
- (C) low tool-chip contact area.
- (D) None of the above

70. The recrystallization temperature of steel is

- (A) 400°C
- (B) 600°C
- (C) 800°C
- (D) None of the above

71. Which of the following methods can be used for manufacturing 2 metre long seamless metallic tubes?

- (A) Drawing
- (B) Extrusion
- (C) Rolling
- (D) Extrusion and Rolling

72. In a four high rolling mill, there are four rolls out of which

- (A) one is working roll and three are backing up rolls.
- (B) two are working rolls and two are backing up rolls.
- (C) three are working rolls and one is backing up roll.
- (D) all of the four are working rolls.

73. Rotary swaging

- (A) is extensively used for making bolts and rivets.
- (B) is used for reducing the diameters of round bars and tubes by rotating dies which open and close rapidly on the work.
- (C) is used to improve fatigue resistance of the metal by setting up compressive stresses in its surface.
- (D) consists of pressing the metal inside a chamber to force it out by high pressure through an orifice which is shaped to provide the desired form of the finished part.

74. In order to get uniform thickness of the plate by rolling process, one provides

- (A) camber on the rolls
- (B) offset on the rolls
- (C) hardening of the rolls
- (D) antifriction bearings

75. A mortise gauge is a

- (A) striking tool
- (B) planning tool
- (C) boring tool
- (D) marking tool

76. Kinematic viscosity is equal to

- (A) $\frac{\text{Dynamic viscosity}}{\text{Density}}$
 (B) Dynamic viscosity \times Density
 (C) $\frac{\text{Density}}{\text{Dynamic viscosity}}$
 (D) $\frac{1}{(\text{Dynamic viscosity} \times \text{Density})}$

77. Head loss due to a sudden enlargement in a pipe is

- (A) $\frac{v_1^2 - v_2^2}{2g}$
 (B) $\frac{(v_1 - v_2)^2}{2g}$
 (C) $\frac{(v_1 - v_2)^2}{g}$
 (D) $\frac{v_1^2 - v_2^2}{g}$

78. The point in the immersed body through which the resultant pressure of the liquid be taken to act is known as

- (A) Metacentre
 (B) Centre of pressure
 (C) Centre of buoyancy
 (D) Centre of gravity

79. Rain drops are spherical because of

- (A) Viscosity
 (B) Air resistance
 (C) Surface tension
 (D) Atmospheric pressure

80. In steady flow of a fluid, the acceleration of any fluid particle is

- (A) Constant
 (B) Variable
 (C) Zero
 (D) Never zero

81. For measuring flow by a venturimeter, it should be installed in

- (A) Vertical line
 (B) Horizontal line
 (C) Inclined line with upward flow
 (D) In any direction and in any location

82. The electron beam welding can be carried out in _____.

- (A) open air
 (B) a shielded gas environment
 (C) vacuum
 (D) a pressurised inert gas chamber

83. Capillarity is due to

- (A) Cohesion
 (B) Adhesion
 (C) Adhesion and Cohesion
 (D) Molecular structure

84. A Piezometer cannot be used for pressure measurement in pipes when

- (A) pressure difference is low.
 (B) velocity is high.
 (C) fluid in the pipe is a gas.
 (D) fluid is highly viscous.

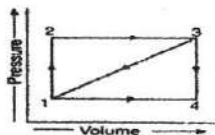
85. Units of Kinematic viscosity are
(A) M^2/sec
(B) $kg/sec/m^2$
(C) $Newton-sec/m^2$
(D) $Newton-sec^2/m$
86. The function of piston rings in an internal combustion engine is
(A) to prevent lubricating oil from entering the combustion space.
(B) to prevent leakage of combustion chamber products.
(C) to transfer heat from piston to cylinder walls.
(D) All of the above
87. The top ring nearest to the piston crown is known as
(A) Oil ring
(B) Scraper ring
(C) Compression ring
(D) Groove ring
88. Morse test is conducted on
(A) Single cylinder engines
(B) Multi-cylinder engines
(C) Vee engines
(D) Horizontal engines
89. In a diesel engine the duration between the time of injection and time of ignition is called
(A) Period of ignition
(B) Explosion period
(C) Pre-ignition period
(D) Delay period
90. Which of the following is the extensive property of a thermodynamic system?
(A) Pressure
(B) Volume
(C) Temperature
(D) Density
91. Which of the following is correct?
(A) Absolute pressure = Gauge pressure + Atmospheric pressure
(B) Gauge pressure = Absolute pressure + Atmospheric pressure
(C) Atmospheric pressure = Absolute pressure + Gauge pressure
(D) Absolute pressure = Gauge pressure – Atmospheric pressure
92. The value of pressure represented by 1mm of Hg is equal to
(A) $1.333 N/m^2$
(B) $13.33 N/m^2$
(C) $133.3 N/m^2$
(D) $1333 N/m^2$
93. First law of thermodynamics deals with
(A) Conservation of heat
(B) Conservation of momentum
(C) Conservation of mass
(D) Conservation of energy
94. Kelvin–Planck's statement deals with
(A) Conservation of work
(B) Conservation of heat
(C) Conservation of heat into work
(D) Conservation of work into heat

95. According to Kelvin–Plank’s statement of second law of thermodynamics

- (A) it is impossible to construct an engine working on a cyclic process, whose sole purpose is to convert heat energy into work.
- (B) it is possible to construct an engine working on a cyclic process, whose sole purpose is to convert heat energy into work.
- (C) it is impossible to construct a device which operates in a cyclic process and produces no effect other than transfer of heat from a cold body to a hot body.
- (D) None of the above

96. A path 1-2-3 is given. A system absorbs 100 kJ as heat and does 60 kJ of work while along the path 1-4-3, it does 20 kJ of work. The heat absorbed during the cycle 1-4-3 is

- (A) – 140 kJ
- (B) – 80 kJ
- (C) – 40 kJ
- (D) + 60 kJ



97. A vessel of 4m^3 contains oil which weighs 30 kN. The specific weight of the oil is

- (A) 4.5 kN/m^3
- (B) 6 kN/m^3
- (C) 7.5 kN/m^3
- (D) 10 kN/m^3

98. The unit of surface tension is

- (A) N/m
- (B) N/m^2
- (C) N/m^3
- (D) N–m

99. Workdone during adiabatic expansion is given by

- (A) $\frac{p_1 v_1 - p_2 v_2}{\gamma - 1}$
- (B) $\frac{mR(T_1 - T_2)}{\gamma - 1}$
- (C) $\frac{mRT_1}{\gamma - 1} \left(1 - \frac{p_2 v_2}{p_1 v_1} \right)$
- (D) All of the above

where p_1, v_1, T_1 = Pressure, volume and temperature for the initial condition of gas,

p_2, v_2, T_2 = Corresponding values for the final condition of gas,

R = Gas constant, and

γ = Ratio of specific heats

100. The expansion ratio R is the ratio of

- (A) $\frac{v_1}{v_2}$
- (B) $\frac{v_2}{v_1}$
- (C) $\frac{v_1 + v_2}{v_1}$
- (D) $\frac{v_1 + v_2}{v_2}$

where v_1 = volume at the beginning of expansion and v_2 = volume at the end of expansion.