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2018

TEST BOOKLET

MECHANICAL ENGINEERING

TEST BOOKLET SERIES

B

Time allowed : 2 hours

Full marks : 200

Answer ***all*** the questions.

Questions are of equal value.

Serial No. ..... 010298 ***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. According to I.B.R., the thickness of the boiler shell should not be less than

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

2. 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

3. 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

4. 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) $\frac{wL^2}{6}$

5. 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.

6. 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

7. 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

8. 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.

9. 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

10. Gear burnishing is a process for
   (A) surface finishing.
   (B) under cut gears.
   (C) producing cycloidal gears.
   (D) removing residual stress from teeth roots.

11. 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 canter distance.
   (D) it has long life.

12. 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

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. 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

15. In ultrasonic machining tool is made of
   (A) Tungsten carbide
   (B) Brass or Copper
   (C) Diamond
   (D) Stainless steel

16. 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.

17. 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.

18. 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

19. In die casting, machining allowance is

(A) small

(B) large

(C) very large

(D) not provided

20. 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.

21. 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.

22. 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.

23. 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

24. 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

25. Metal patterns are used for

(A) small castings

(B) large castings

(C) complicated castings

(D) large scale production of castings

26. 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.

27. 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

28. The unit of surface tension is

(A) N/m

(B) N/m^2

(C) N/m^3

(D) N–m

29. 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) $10\ kN/m^3$

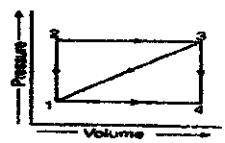
30. A path 1-2-3 is given. A system absorbs 100 kJ as heat and does 60 kJ of work while along the path 1-4-3, it does 20 kJ of work. The heat absorbed during the cycle 1-4-3 is

(A) – 140 kJ

(B) – 80 kJ

(C) – 40 kJ

(D) + 60 kJ



31. 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

32. Kelvin–Plank's statement deals with

(A) Conservation of work

(B) Conservation of heat

(C) Conservation of heat into work

(D) Conservation of work into heat

33. First law of thermodynamics deals with

(A) Conservation of heat

(B) Conservation of momentum

(C) Conservation of mass

(D) Conservation of energy

34. 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) $1333\ N/m^2$

35. 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

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

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

37. 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

38. Morse test is conducted on

(A) Single cylinder engines
(B) Multi-cylinder engines
(C) Vee engines
(D) Horizontal engines

39. The top ring nearest to the piston crown is known as

(A) Oil ring
(B) Scrapper ring
(C) Compression ring
(D) Groove ring

40. 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

41. Units of Kinematic viscosity are

(A) M^2/sec
(B) kg/sec/m^2
(C) Newton-sec/m^2
(D) Newton-sec^2/m

42. 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.

43. Capillarity is due to

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

44. 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

45. 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

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

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

47. Rain drops are spherical because of

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

48. 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

49. 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) $\frac{v_1^2 - v_2^2}{g}$

50. Kinematic viscosity is equal to

(A) $\frac{\text{Dynamic viscosity}}{\text{Density}}$

(B) Dynamic viscosity × Density

(C) $\frac{\text{Density}}{\text{Dynamic viscosity}}$

(D) $\frac{1}{(\text{Dynamic viscosity} \times \text{Density})}$

51. 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) $\frac{\pi D^4}{64}$

52. 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) $16 / \pi D^3 \left[\sqrt{\left(M^2 + T^2\right)}\right]$

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

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

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

53. 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

54. 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) $d = 1{\cdot}6\sqrt{t}$

(C) $d = 2t$

(D) $d = 6\sqrt{t}$

where d and t are in mm.

55. 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) $1{\cdot}5d$

(C) $2d$

(D) $2{\cdot}5d$

where d = diameter of rivet hole in mm.

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

(A) $0{\cdot}5s.l.\sigma_t$

(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.

57. 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) $\frac{pd}{6t}$

58. 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) $\frac{4\pi^2 EI}{l^2}$

59. The Rankine's formula holds good for

(A) short columns

(B) long columns

(C) both short and long columns

(D) weak columns

60. The tensile test is carried on _____ materials.

(A) ductile

(B) brittle

(C) malleable

(D) plastic

61. The compressive strength of brittle materials is _____ its tensile strength.

(A) equal to

(B) less than

(C) greater than

(D) double

62. 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.

63. The railway carriage couplings have
(A) square thread
(B) acme threads
(C) knuckle threads
(D) buttress threads

64. The eye bolts are used for
(A) transmission of power.
(B) locking devices.
(C) lifting and transporting heavy machines.
(D) absorbing shocks and vibrations.

65. 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

66. The sleeve and muff coupling is designed as a
(A) thin cylinder
(B) thick cylinder
(C) solid shaft
(D) hollow shaft

67. 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

68. The helix angle for double helical gears may be made up to
(A) 45°
(B) 60°
(C) 75°
(D) 90°

69. 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

70. The thermal conductivity is expressed as
(A) $\frac{W}{mK}$
(B) $\frac{W}{m^2 K}$
(C) $\frac{W}{hmK}$
(D) $\frac{W}{h^2 m^2 K}$

71. Stefan–Boltzmann law is expressed as
(A) $Q = \sigma A T^4$
(B) $Q = \sigma A^2 T^4$
(C) $Q = \sigma A T^2$
(D) $Q = A T^4$

72. 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

73. 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.

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

(A) 8

(B) 12

(C) 18

(D) 20

75. 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.

76. A mortise gauge is a

(A) striking tool

(B) planning tool

(C) boring tool

(D) marking tool

77. 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

78. 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.

79. 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.

80. 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

81. The recrystallization temperature of steel is

(A) 400°C

(B) 600°C

(C) 800°C

(D) None of the above

82. 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

83. 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

84. 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

85. 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

86. 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.

87. 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

88. 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°

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

(A) $+8{\cdot}9\ m/s^2$
(B) $-8{\cdot}9\ m/s^2$
(C) $+9{\cdot}8\ m/s^2$
(D) $-9{\cdot}8\ m/s^2$

90. 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

91. 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% managanese, 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.

92. 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

93. Blast furnace is used to produce

(A) Pig iron

(B) Cast iron

(C) Wrought iron

(D) Steel

94. 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

95. 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

96. 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

97. 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.

98. The compression ratio for petrol engines is

(A) 3 to 6

(B) 5 to 8

(C) 15 to 20

(D) 20 to 30

99. 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.

100. 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