DO NOT OPEN THIS BOOKLET UNTIL YOU ARE ASKED TO DO SO.

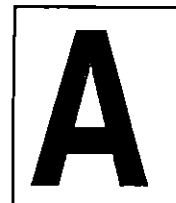**2022**

TEST BOOKLET

Mechanical Engineering

Time allowed : 2 hours

Full marks : 200

Answer *all* the questions.

Questions are of equal value.

TEST BOOKLET SERIES

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Serial No. ....

Roll No.:

Signature of the Candidate:

INSTRUCTIONS

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

1. This booklet consists of 12 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 OMR Sheet supplied for the purpose.

3. Before you proceed to mark in the OMR Sheet in response to various items in the Test Booklet, you have to fill in some particulars in the OMR Sheet. *Do not fold the OMR 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 OMR Sheet with **Black Ball Point Pen.**

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. If more than one circle is encoded for a particular answer, it will be treated as a wrong answer. Use of whitener is strictly prohibited.

6. *There will be negative marking of $\frac{2}{3}$ mark for each wrong answer.*

7. *There is a blank page at the end of this Booklet for Rough Work.*

8. *The OMR 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.*

1. Gears cannot be cut on
   - (A) lathe
   - (B) shaper
   - (C) milling machine
   - (D) hobbing machine

2. A block resting on an inclined plane begins to slide down the plane when the angle of inclination is gradually increased to 30°. Then the coefficient of friction between the block and plane is
   - (A) 0·866
   - (B) 0·72
   - (C) 0·578
   - (D) 0·50

3. The Kelvin temperature of a system can be measured by a
   - (A) mercury-in-glass thermometer.
   - (B) thermocouple.
   - (C) constant volume gas thermometer.
   - (D) resistance thermometer.

4. The efficiency of a thermodynamic cycle cannot be infinite since it
   - (A) violates first law.
   - (B) violates third law.
   - (C) violates second law.
   - (D) rejects no heat.

5. In Taylor's tool life equation VT^n=Constant, what is the value of n for ceramic tools?
   - (A) 0·15 to 0·25
   - (B) 0·4 to 0·55
   - (C) 0·6 to 0·75
   - (D) 0·8 to 0·9

6. An engine operates between 900 K and T_2 and another engine operates between T_2 and 400 K for both the engines to be equally efficient, T_2 will be
   - (A) 600 K
   - (B) 625 K
   - (C) 650 K
   - (D) 700 K

7. Suggest the drill to be used for drilling glass, slate ceramics etc.—
   - (A) tungsten carbide tipped bit drill
   - (B) twist drill
   - (C) straight fluted drill
   - (D) centre drill

8. Gang milling is a
   - (A) milling process for generating hexagonal surface.
   - (B) process of cutting gears.
   - (C) milling operation combined with turning.
   - (D) process in which two or more cutters are used simultaneously.

9. The refrigerant R-22 is
   - (A) monochloro difluoro methane.
   - (B) dichloro difluoro methane.
   - (C) trichloro monofluoro methane.
   - (D) tetrachloro difluoro methane.

10. Which is the costliest item in a refrigeration system?
    - (A) Condenser
    - (B) Evaporator
    - (C) Capillary tube
    - (D) Compressor

11. Why is multistaging used in centrifugal pump?

(A) For high flow rate

(B) For high speed

(C) For high head

(D) For high efficiency

12. Falling drops of water become spherical due to

(A) adhesion

(B) cohesion

(C) viscosity

(D) absorption

13. The work saved by fitting an air vessel to a single reciprocating pump is

(A) 28·9%

(B) 39·2%

(C) 48·8%

(D) 84·8%

14. The feeding of a job in a shaper is done by

(A) ram movement.

(B) table movement.

(C) indexing centres.

(D) dividing head.

15. The surface to be left unmachined is marked on the pattern by

(A) black colour

(B) green colour

(C) yellow colour

(D) blue colour

16. What does Euler's equation of turbo machines relate to?

(A) Discharge and power

(B) Discharge and velocity

(C) Head and power

(D) Head and velocity

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

(A) 1 kW

(B) 2 kW

(C) 3 kW

(D) 4 kW

18. The shear force at a certain section of a beam is stated to be zero. The bending moment at that section will be

(A) zero

(B) maximum

(C) minimum

(D) either minimum or maximum

19. Spot welding, projection welding and seam welding belong to the category of

(A) arc welding

(B) thermit welding

(C) forge welding

(D) electric resistance welding

20. Flat spiral springs are used in

(A) watches

(B) cycles

(C) road vehicles

(D) railway wagons

Please Turn Over

21. Two objects of masses 3 kg and 5 kg respectively are connected by a light cord passing over a smooth weightless pulley. The acceleration with which the masses moves is

(A) g/4

(B) g/2

(C) 2g

(D) 4g

22. For the same maximum pressure and temperature of the cycle and for the same heat rejection, which of the following cycles has maximum efficiency?

(A) Otto cycle

(B) Diesel cycle

(C) Dual cycle

(D) Brayton cycle

23. The efficiency of otto cycle is the highest for the same compression ratio if the working fluid is

(A) carbon dioxide

(B) air

(C) oxygen

(D) helium

24. Modulus of rigidity is the ratio of

(A) axial stress to lateral strain.

(B) shear stress to shear strain.

(C) linear stress to longitudinal strain.

(D) hydrostatic stress to volumetric strain.

25. Vacuum environment is required in

(A) ultrasonic welding

(B) laser beam welding
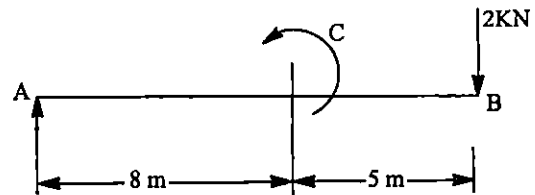
(C) plasma arc welding

(D) electron beam welding

26. The refrigerant R-502 is

(A) Freon-12

(B) NH_3

(C) SO_2

(D) Azeotrope

27. The wood pattern used for the production of a metal pattern is called

(A) skelton

(B) master

(C) duplicate

(D) investment

28. A beam is acted upon by a point load of 2 KN and a couple C as shown in the figure below:

If the beam is to remain in equilibrium, the couple C should have the value—

(A) 6 KNm

(B) 10 KNm

(C) 16 KNm

(D) 26 KNm

29. A knee is a part of

(A) lathe

(B) milling machine

(C) shaper

(D) slotter

30. The position of CG of a solid hemisphere of radius *r* lies on the central radius at a distance—

(A) $\frac{2}{3}r$

(B) $\frac{3}{8}r$

(C) $\frac{3}{4}r$

(D) $\frac{1}{2}r$

31. Gears are mass produced by
   (A) milling
   (B) shaping
   (C) hobbing
   (D) forming

32. A capillary tube is used in a small refrigerator to serve the purpose of
   (A) expansion valve
   (B) evaporator
   (C) thermostat
   (D) drier

33. Removal of metal in a drilling operation is by
   (A) shearing
   (B) shearing and extrusion
   (C) compression
   (D) shearing and compression

34. Which of the following expands in volume upon freezing?
   (A) Mercury
   (B) Alcohol
   (C) Water
   (D) Chloroform

35. The CG of a triangle lies at the point of intersection of
   (A) diagonals
   (B) altitudes
   (C) medians
   (D) bisector of angles

36. Consider the following components of a centrifugal pump:
   1. impeller
   2. suction pipe
   3. foot valve and strainer
   4. delivery pipe
   The correct sequence of these components through which the fluid flows is
   (A) 1-2-3-4
   (B) 1-2-4-3
   (C) 2-4-1-3
   (D) 3-2-1-4

37. A beam is said to be continuous if
   (A) it is infinitely long
   (B) it has only one support
   (C) it has more than two supports
   (D) it extends beyond its supports

38. Which process of welding is used for car bodies?
   (A) Resistance welding
   (B) Gas welding
   (C) Arc welding
   (D) Thermit welding

39. Cutting action of the grinding wheel is improved by a process called
   (A) facing
   (B) dressing
   (C) clearing
   (D) truing

40. Young's modulus of elasticity for a perfectly rigid body is
   (A) unity
   (B) zero
   (C) infinity
   (D) some finite non-zero constant

Please Turn Over

41. Cavitation in centrifugal pumps can be reduced by
    (A) reducing the discharge.
    (B) reducing the suction head.
    (C) throttling the discharge.
    (D) increasing the flow velocity.

42. A thermodynamic cycle is impossible if

    (A) $\oint \frac{dQ}{T} > 0$

    (B) $\oint \frac{dQ}{T} < 0$

    (C) $\oint \frac{dQ}{T} = 0$

    (D) $\oint ds < 0$

43. The path traced by a single particle of smoke issuing from a cigarette is a
    (A) streamline
    (B) flowline
    (C) pathline
    (D) streakline

44. Which of the following processes is used for the manufacturing of steel balls for ball bearings?
    (A) Die casting
    (B) Cold heading
    (C) Investment casting
    (D) Milling

45. The efficiency of air standard otto cycle depends on the
    (A) temperature levels between which the cycle operates.
    (B) pressure ratio.
    (C) compression ratio.
    (D) heat supplied.

46. Slenderness ratio has dimension of
    (A) cm
    (B) cm^{-1}
    (C) cm^2
    (D) dimensionless quantity

47. For perfectly elastic bodies, the value of coefficient of restitution is
    (A) zero to 0·5
    (B) 0·5 to 1
    (C) 1
    (D) zero

48. Pick up the most economical section for a beam—
    (A) Square
    (B) Circular
    (C) I-section
    (D) Rectangular

49. The property of a material by which it can be rolled into sheets is called
    (A) elasticity
    (B) plasticity
    (C) ductility
    (D) malleability

50. The part of milling machine upon which are mounted the milling cutters is known as
    (A) tool post
    (B) spindle
    (C) arbor
    (D) brace or bracket

51. The subcooling is a process of cooling the refrigerant in vapour compression refrigeration system before

(A) compression

(B) condensation

(C) throttling

(D) evaporation

52. With increase in clearance volume, the specific work input

(A) increases

(B) decreases

(C) remains constant

(D) may increase or decrease depending on compressor capacity

53. The most important parameter that specifies a lathe machine is

(A) length of bed.

(B) distance between centres.

(C) maximum diameter of the job it can swing.

(D) maximum speed of spindle.

54. The size of a shaper is specified by

(A) maximum travel of cutting tool.

(B) gross weight of machine.

(C) surface area that can be machined in one hour.

(D) quick return ratio.

55. The ideal compression in rotary bladed compressor is

(A) adiabatic

(B) isothermal

(C) isentropic

(D) polytropic with exponent intending to infinity

56. The moment of inertia about diagonal of a square plate of side a is

(A) $\dfrac{a^4}{12}$

(B) $\dfrac{a^4}{6}$

(C) $\dfrac{a^4}{6\sqrt{2}}$

(D) $\dfrac{a^4}{3}$

57. The Young's modulus E, the shear modulus G and the Poisson's ratio μ for a material are related by the expression:

(A) $E = 2G (1 + \mu)$

(B) $E = 3G (1 - \mu)$

(C) $E = 3G (1 - 2\mu)$

(D) $E = 3G (1 + 2\mu)$

58. When a gas is allowed to escape through a minute aperture, the leakage process is called

(A) throttling

(B) adiabatic

(C) constant pressure

(D) constant temperature

59. In general, the vanes of a centrifugal pump are

(A) curved forward

(B) curved backward

(C) radial

(D) twisted

60. The bending moment diagram for a simply supported beam with a load at mid span is a

(A) parabola

(B) hyperbola

(C) rectangle

(D) triangle

61. In a two stage reciprocating air compressor, the suction and delivery pressures are 1 bar and 4 bar respectively for maximum efficiency, the intercooler pressure is

(A) 1·5 bar

(B) 2·0 bar

(C) 2·5 bar

(D) 3·0 bar

62. Gate is provided in moulds to

(A) feed the casting at a constant rate.

(B) give passage to gases.

(C) compensate for shrinkage.

(D) avoid cavities.

63. The volumetric efficiency of a compressor is prescribed by the relation—

(A) $\eta_V = 1 - c + c \left(\dfrac{p_2}{p_1} \right)^n$

(B) $\eta_V = 1 + c - c \left(\dfrac{p_2}{p_1} \right)^{\frac{1}{n}}$

(C) $\eta_V = 1 + c - c \left(\dfrac{p_2}{p_1} \right)^{\frac{n-1}{n}}$

(D) $\eta_V = 1 - c + c \left(\dfrac{p_2}{p_1} \right)^{\frac{n-1}{n}}$

64. Which of the following is not a part of capstan lathe?

(A) Chuck

(B) Tailstock

(C) Spindle

(D) Tool post

65. The ratio of the polar moment of inertia to the radius of the shaft is known as

(A) shaft stiffness

(B) flexural rigidity

(C) torsional rigidity

(D) torsional section modulus

66. All of the following are cold working processes, except

(A) slitting

(B) blanking

(C) extrusion

(D) lancing

67. A centrifugal compressor is used for which of the following?

(A) High pressure ratio, low mass flow

(B) Low pressure ratio, low mass flow

(C) High pressure ratio, high mass flow

(D) Low pressure ratio, high mass flow

68. The slip in case of reciprocating pumps is

(A) positive

(B) negative

(C) positive or negative

(D) zero

69. The number of elements in tool signature are

(A) 5

(B) 7

(C) 9

(D) 11

70. The bulk modulus of water with respect to air is about

(A) 500 times

(B) 1,000 times

(C) 10,000 times

(D) 20,000 times

71. Which of the following statements about friction is true?

  (A) Friction can be reduced to zero.

  (B) Frictional force can accelerate a body.

  (C) Frictional force is proportional to the area of contact between the two surfaces.

  (D) Kinetic friction is always greater than rolling friction.

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

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

  (B) $\dfrac{N\sqrt{P}}{H^{\frac{5}{4}}}$

  (C) $\dfrac{N\sqrt{Q}}{H^{\frac{5}{4}}}$

  (D) $\dfrac{N\sqrt{H}}{Q^{\frac{3}{4}}}$

73. The type of tool used on a lathe machine is

  (A) single point cutting tool.

  (B) two point cutting tool.

  (C) three point cutting tool.

  (D) multipoint cutting tool.

74. First law of thermodynamics refers to conservation of

  (A) mass

  (B) momentum

  (C) energy

  (D) force

75. An ideal fluid

  (A) has no viscosity.

  (B) satisfies the relation pv = RT.

  (C) obeys the Newton's law of viscosity.

  (D) is both incompressible and non-viscous.

76. In SI units, the unit of power is

  (A) Pascal

  (B) Watt

  (C) Joule

  (D) N.m

77. Electronic components are usually joined by

  (A) soldering

  (B) brazing

  (C) sintering

  (D) resistance welding

78. Four vertical columns of same material height and weight have the same end conditions. Which cross section will carry the maximum load?

  (A) Solid circular

  (B) Thin hollow circular

  (C) Solid square

  (D) I-section

79. A cantilever beam of length L, moment of inertia I, Young's modulus E carries a concentrated load W at the middle of its length. The slope of the cantilever at the free end is

  (A) $\dfrac{WL^2}{2EI}$

  (B) $\dfrac{WL^2}{8EI}$

  (C) $\dfrac{WL^2}{4EI}$

  (D) $\dfrac{WL^2}{16EI}$

80. In laser welding, the heat is supplied by

  (A) the oxy-acetylene gas.

  (B) the collimated light beam.

  (C) inducing the current.

  (D) the electric arc.

81. The compression ratio in diesel engines is in the range of

- (A) 5 to 7
- (B) 7 to 10
- (C) 10 to 12
- (D) 14 to 22

82. Volumetric efficiency of an engine is a measure of

- (A) speed of the engine.
- (B) power of the engine.
- (C) pressure rise in the cylinder.
- (D) breathing capacity of the engine.

83. What is the dimension of kinematic viscosity of a fluid?

- (A) LT^{-2}
- (B) L^2T^{-1}
- (C) $ML^{-1}T^{-1}$
- (D) $ML^{-2}T^{-2}$

84. When a wire is stretched to double its length, the longitudinal strain produced in it is

- (A) 0·5
- (B) 1·0
- (C) 1·5
- (D) 2·0

85. Poise is the unit of

- (A) density
- (B) dynamic viscosity
- (C) kinematic viscosity
- (D) velocity gradient

86. The pump to be used for pumping highly viscous fluids belongs to the category of

- (A) screw pump
- (B) turbine pump
- (C) plunger pump
- (D) centrifugal pump

87. If closed coil helical spring absorbs 30 Nmm of energy while extending by 5 mm, its stiffness is

- (A) 2 N/mm
- (B) 4 N/mm
- (C) 6 N/mm
- (D) 10 N/mm

88. The flow in the volute casing outside the rotating impeller of a centrifugal pump is

- (A) radial flow
- (B) axial flow
- (C) free vortex flow
- (D) forced vortex flow

89. For real gases $C_P = C_V$ occurs at

- (A) critical temperature
- (B) triple point
- (C) all temperatures
- (D) absolute zero temperature

90. Brakes are applied to a car travelling at 90 km/hr and it comes to stop 5 secs thereafter. The coefficient of friction between the wheels and road surface is

[Assume: g = 10 m/s²]

- (A) 0·18
- (B) 0·25
- (C) 0·36
- (D) 0·5

91. Which of the following welding processes uses consumable electrodes?

    (A) Laser welding

    (B) Thermit welding

    (C) TIG welding

    (D) MIG welding

92. The relation $du = Cvdt$ is valid for

    (A) any substance in any process.

    (B) an ideal gas even if volume changes.

    (C) any process in a phase change.

    (D) any reversible process.

93. In comparison with slopes of constant pressure lines for an ideal gas on T-S plot, the slopes of constant volume lines are

    (A) less

    (B) more

    (C) equal

    (D) unpredicable

94. On T-S plot for a polytropic process $pv^n = C$, if $n = \gamma$ the isentropic curve will be

    (A) parabolic

    (B) vertical line

    (C) horizontal straight line

    (D) a straight line with regetive slope

95. The tool used for lifting the pattern from the mould is

    (A) lifter

    (B) slick

    (C) draw spike

    (D) trowel

96. Intercooling in multistage compressor reduces

    (A) the volume of free air developed.

    (B) the pressure of air at delivery.

    (C) the work input to compressor.

    (D) index of compression.

97. For warships, metacentric height of a ship should vary between

    (A) 0 – 1 m

    (B) 1 – 2 m

    (C) 5 – 10 m

    (D) more than 10 m

98. The metal moulds are used in

    (A) green sand mould

    (B) dry sand mould

    (C) die casting process

    (D) loam moulding

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

    (A) adiabatically

    (B) isothermally

    (C) isentropically

    (D) polytropically

100. In machining aluminium parts, the chips produced are in the form of

    (A) fragments

    (B) snarls

    (C) helix

    (D) closed spirals