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

Test Booklet No. :

02525

Series

A

TEST BOOKLET

Paper—I

(MECHANICAL ENGINEERING)

Time Allowed : 2 Hours **Full Marks : 100**

Read the following instructions carefully before you begin to answer the questions :

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Series are to be written legibly and correctly in the space provided on the Answer-Sheet with Black/Blue ballpoint pen.
2. **Answer-Sheet without marking Series as mentioned above in the space provided for in the Answer-Sheet shall not be evaluated.**
3. All questions carry equal marks.

   The Answer-Sheet should be submitted to the Invigilator.

   Directions for giving the answers : Directions for answering questions have already been issued to the respective candidates in the 'Instructions for marking in the OMR Answer-Sheet' along with the Admit Card and Specimen Copy of the OMR Answer-Sheet.

   Example :

   Suppose the following question is asked :

   The capital of Bangladesh is
   (A) Chennai
   (B) London
   (C) Dhaka
   (D) Dhubri

   You will have four alternatives in the Answer-Sheet for your response corresponding to each question of the Test Booklet as below :

   Ⓐ Ⓑ Ⓒ Ⓓ

   In the above illustration, if your chosen response is alternative (C), i.e., Dhaka, then the same should be marked on the Answer-Sheet by blackening the relevant circle with a Black/Blue ballpoint pen only as below :

   Ⓐ Ⓑ ● Ⓓ

   The example shown above is the only correct method of answering.
4. Use of eraser, blade, chemical whitener fluid to rectify any response is prohibited.
5. Please ensure that the Test Booklet has the required number of pages (16) and 100 questions immediately after opening the Booklet. In case of any discrepancy, please report the same to the Invigilator.
6. No candidate shall be admitted to the Examination Hall/Room 20 minutes after the commencement of the examination.
7. No candidate shall leave the Examination Hall/Room without prior permission of the Supervisor/Invigilator. No candidate shall be permitted to hand over his/her Answer-Sheet and leave the Examination Hall/Room before expiry of the full time allotted for each paper.
8. No Mobile Phone, Electronic Communication Device, etc., are allowed to be carried inside the Examination Hall/Room by the candidates. Any Mobile Phone, Electronic Communication Device, etc., found in possession of the candidate inside the Examination Hall/Room, even if on off mode, shall be liable for confiscation.
9. No candidate shall have in his/her possession inside the Examination Hall/Room any book, notebook or loose paper, except his/her Admission Certificate and other connected papers permitted by the Commission.
10. Complete silence must be observed in the Examination Hall/Room. No candidate shall copy from the paper of any other candidate, or permit his/her own paper to be copied, or give, or attempt to give, or obtain, or attempt to obtain irregular assistance of any kind.
11. This Test Booklet can be carried with you after answering the questions in the prescribed Answer-Sheet.
12. Noncompliance with any of the above instructions will render a candidate liable to penalty as may be deemed fit.
13. No rough work is to be done on the OMR Answer-Sheet. You can do the rough work on the space provided in the Test Booklet.

N.B. : There will be negative marking @ 0·25 per 1 (one) mark against each wrong answer.

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[No. of Questions : 100]

1. According to equilibrium law, two forces can be in equilibrium if they are

(A) equal in magnitude

(B) collinear in action

(C) opposite in direction

(D) All of the above

2. The resultant of two equal forces is equal to either of these forces. The angle between them is

(A) 90°

(B) 120°

(C) 0°

(D) 60°

3. In order to determine the effects of a force acting on a body, we must know

(A) the magnitude of the force

(B) the line of action of the force

(C) the nature of the force, i.e., whether the force is push or pull

(D) All of the above

4. Two like parallel forces are acting at a distance of 24 mm apart and their resultant is 20 N. If the line of action of the resultant is 6 mm from any given force, the two forces are

(A) 15 N and 5 N

(B) 20 N and 5 N

(C) 15 N and 15 N

(D) None of the above

5. A body of weight W is required to move up the rough inclined plane whose angle of inclination with the horizontal is α. The effort applied parallel to the plane is given by

(A) $P = W \tan \alpha$

(B) $P = W \tan (\alpha + \varphi)$

(C) $P = W (\sin \alpha + \mu \cos \alpha)$

(D) $P = W (\cos \alpha + \mu \sin \alpha)$

where $\mu = \tan \varphi$ = coefficient of friction between the plane and the body.

6. Two balls of equal mass and of perfectly elastic material are lying on the floor. One of the balls with velocity v is made to strike the second ball. Both the balls after impact will move with a velocity

(A) v

(B) $\frac{v}{2}$

(C) $\frac{v}{4}$

(D) $\frac{v}{8}$

7. The coefficient of static friction between two surfaces depends on

(A) the nature of the surface

(B) the shape of the surface in contact

(C) the area of contact

(D) All of the above

8. The limiting friction between two bodies in contact is independent of

(A) the nature of the surfaces in contact

(B) the area of the surfaces in contact

(C) the normal reaction between the surfaces

(D) All of the above

9. The point of application where the total weight can be expected to be concentrated if the gravitational force is dispersed across the volume of the body is called

(A) the surface of the body

(B) the centroid of the body

(C) the centre of gravity of the body

(D) moment of inertia

10. An ideal fluid is defined as the fluid which is

(A) incompressible and non-viscous

(B) compressible only

(C) incompressible only

(D) compressible and viscous

11. Poise is the unit of

(A) surface tension

(B) viscosity

(C) capillarity

(D) shear stress in fluids

12. The liquid surfaces have a tendency to contract. This phenomenon is due to

(A) surface tension

(B) viscosity

(C) friction

(D) dispersion

13. A streamline is a line

(A) which is normal to the velocity vector at every point

(B) which represents the lines of constant velocity potential

(C) which is normal to the lines of constant stream function

(D) which is tangential to the velocity vector everywhere at a given instant

14. The Bernoulli's equation refers to the conservation of

(A) mass

(B) linear momentum

(C) viscosity

(D) energy

15. The ratio of the specific weight of liquid to the specific weight of pure water at a standard temperature is called as

(A) surface density

(B) specific gravity

(C) mass density

(D) surface tension

16. In flow through a pipe, the transition from laminar to turbulent flow does not depend on the

(A) density of the fluid

(B) length of the pipe

(C) diameter of the pipe

(D) velocity of the fluid

17. The pressure of fluid is measured by

(A) pitot tube

(B) barometer

(C) manometer

(D) lactometer

18. When a vertical wall is subjected to pressure due to liquid on both sides, the resultant pressure is the _____ of the two pressures.

(A) sum

(B) difference

(C) arithmetic mean

(D) geometric mean

19. A uniform body 3 m long, 2 m wide and 1 m deep floats in water. If the depth of immersion is 0·6 m, then the weight of the body is

(A) 3·53 kN

(B) 33·3 kN

(C) 35·3 kN

(D) None of the above

20. A vessel of $4\ m^3$ contains an oil which weighs 30 kN. The specific weight of the oil is

(A) $4{\cdot}5\ kN/m^3$

(B) $6\ kN/m^3$

(C) $7{\cdot}5\ kN/m^3$

(D) $10\ kN/m^3$

21. A jet of water discharging from a 40 mm diameter orifice has minimum area corresponding to dia of 24·4 mm at its vena contracta. The coefficient of contraction is

(A) 0·46

(B) 0·37

(C) 0·78

(D) 0·87

22. The length AB of a pipe ABC in which a liquid is flowing has diameter d_1 and is suddenly enlarged to diameter d_2 at B which is constant for the length BC. The loss of head due to sudden enlargement is

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

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

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

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

23. The most economical section of a trapezoidal channel is one which has hydraulic mean depth equal to

(A) $\frac{1}{2} \times$ depth

(B) $\frac{1}{2} \times$ breadth

(C) $\frac{1}{2} \times$ sloping side

(D) $\frac{1}{4} \times$ (depth + breadth)

24. The kinematic viscosity (in stokes) of an oil, whose specific gravity is 0·95 and viscosity is 0·011 poise, is

(A) 0·0116

(B) 0·116

(C) 0·0611

(D) 0·611

25. The ratio of the quantity of liquid discharged per second from the pump to the quantity of liquid passing per second through the impeller is known as

(A) manometric efficiency

(B) mechanical efficiency

(C) overall efficiency

(D) volumetric efficiency

26. On which of the following factors does the resistivity of a material depend?

(A) Resistance of the conductor

(B) Area of the conductor section

(C) Length of the conductor

(D) All of the above

27. Which of the following is the poor conductor of electricity?

(A) Silver

(B) Copper

(C) Carbon

(D) Steel

28. Which of the following will affect the resistance of a conductor inversely?

(A) Length of the conductor

(B) Potential difference

(C) Area of cross-section

(D) Temperature of the conductor

29. Which of the following can vary with AC, but not with DC?

(A) Power

(B) Voltage

(C) Frequency

(D) Magnitude

30. As capacitor plate area increases

(A) the capacitance increases

(B) the capacitance decreases

(C) the capacitance does not change

(D) the current-handling ability decreases

31. The period (in seconds) of an AC wave is

(A) the same as the frequency in hertz

(B) not related to the frequency in any way

(C) equal to 1 divided by the frequency in hertz

(D) equal to the peak amplitude in volts divided by the frequency in hertz

32. The sixth harmonic of an AC wave, whose period is 1·000 millisecond (1·000 ms), has a frequency of

(A) 0·006 Hz

(B) 167·0 Hz

(C) 7·000 kHz

(D) 6·000 kHz

33. Entropy change depends on

(A) heat transfer

(B) mass transfer

(C) change of temperature

(D) thermodynamic state

34. Carnot cycle consists of which of the following processes?

(A) Two isothermal processes and two isentropic processes

(B) Two isentropic processes and two constant-volume processes

(C) Two isentropic processes and two constant-pressure processes

(D) Two isentropic processes, one constant-volume process and one constant-pressure process

35. For the same compression ratio, the efficiency of an air-standard Otto cycle is

(A) more than the efficiency of an air-standard Diesel cycle

(B) less than the efficiency of an air-standard Diesel cycle

(C) equal to the efficiency of an air-standard Diesel cycle

(D) None of the above

36. An ideal gas at 27 °C is heated at constant pressure till its volume becomes three times. The final temperature of the gas will be

(A) 91 °C

(B) 910 °C

(C) 627 °C

(D) 927 °C

37. The bomb calorimeter is an apparatus to measure the

(A) calorific value of a gaseous fuel

(B) calorific value of solid and gaseous fuels

(C) calorimetric composition of any solid bomb material

(D) calorific value of a solid or liquid fuel

38. Internal energy is a function of

(A) only pressure

(B) only temperature (absolute)

(C) only volume

(D) pressure and temperature

39. Zeroth law of thermodynamics gives the concept of

(A) internal energy

(B) heat content

(C) pressure

(D) temperature

40. The specific heat of air at constant pressure (C_p) is equal to

(A) 0·17 kcal/kg-°C

(B) 0·21 kcal/kg-°C

(C) 0·24 kcal/kg-°C

(D) 1·41 kcal/kg-°C

41. When a system changes its state from one equilibrium state to another equilibrium state, then the path of successive states through which the system has passed is known as

(A) thermodynamic law

(B) thermodynamic process

(C) thermodynamic cycle

(D) None of the above

42. "When two bodies are in thermal equilibrium with a third body, they are also in thermal equilibrium with each other." This statement is called

(A) zeroth law of thermodynamics

(B) first law of thermodynamics

(C) second law of thermodynamics

(D) Kelvin-Planck law

43. The reading of the pressure gauge fitted on a vessel is 25 bar. The atmospheric pressure is 1·03 bar and the value of g is 9·81 m/s^2. The absolute pressure in the vessel is

(A) 23·97 bar

(B) 25·00 bar

(C) 26·03 bar

(D) 34·84 bar

44. The property of a working substance which increases or decreases according to the heat supplied or removed in a reversible manner is called

(A) enthalpy

(B) entropy

(C) reversibility

(D) None of the above

45. "The heat flows from a cold body to a hot body with the aid of an external source." This statement is given by

(A) Kelvin

(B) Joule

(C) Clausius

(D) Gay-Lussac

46. When there is mass transfer across the system boundary, the system is called

(A) isolated system

(B) closed system

(C) open system

(D) None of the above

47. Steady flow means that the rates of flow of mass and energy across the control surface

(A) vary

(B) remain constant

(C) depend on the control surface

(D) None of the above

48. A device in which some portion of waste heat of fuel gases is recovered to heat the air before it passes to the furnace for combustion purpose is known as

(A) superheater

(B) air preheater

(C) economizer

(D) injector

49. The mechanical draught _____ with the amount of smoke.

(A) increases

(B) decreases

(C) does not affect

(D) None of the above

50. The process of draining steam from the turbine at certain points during its expansion and using this steam for heating the feedwater in feed-water heaters and then supplying it to the boiler is known as

(A) regenerative heating

(B) reheating of steam

(C) bleeding

(D) None of the above

51. Addition of heat at constant pressure to a gas results in

(A) raising its temperature

(B) raising its pressure

(C) raising its volume

(D) raising its temperature and doing external work

52. For wire-drawing operation, the work material should be

(A) tough

(B) malleable

(C) ductile

(D) resilient

53. Which is the most ductile metal known?

(A) Silver

(B) Platinum

(C) Gold

(D) Copper

54. The product from blast furnace is called

(A) pig iron

(B) cast iron

(C) wrought iron

(D) steel

55. The percentage of carbon in cast iron usually varies between

(A) 0·1% to 0·2%

(B) 0·5% to 1·0%

(C) 1·0% to 1·5%

(D) 2·5% to 4·5%

56. Which one of the following crystal systems is valid for gold?

(A) Orthogonal

(B) Cubic

(C) Hexagonal

(D) Triclinic

57. The BCC and HCP metals undergo plastic deformation by

(A) slip

(B) twinning

(C) edge dislocation

(D) twinning in combination with slip

58. What is the purpose of annealing process?

(A) To increase hardness

(B) To decrease machinability

(C) To remove internal stress

(D) For surface hardening

59. Maximum surface hardness is attained by

(A) cyaniding

(B) carburizing

(C) flame hardening

(D) nitriding

60. The blade of a power hacksaw is made of

(A) high-carbon steel

(B) mild steel

(C) high-speed steel

(D) medium-carbon steel

61. What is the effect of the slip of the belt on the velocity ratio of the belt drive?

(A) Increases

(B) Decreases

(C) May increase or decrease

(D) Remains constant

62. If the number of links in a mechanism is 6, the number of pairs would be

(A) 1

(B) 2

(C) 4

(D) 5

63. The relation between the number of links (L) and the number of pairs (P) is

(A) $L = 2P - 3$

(B) $L = 2P - 2$

(C) $L = 2P - 4$

(D) $L = 3P - 4$

64. The two elements of a pair are said to form a higher pair, when they

(A) have a surface contact when in motion

(B) have a line or point contact when in motion

(C) are kept in contact by the action of external forces when in motion

(D) permit relative motion

65. One end of a helical spring is fixed while the other end carries the load W which moves with simple harmonic motion. The frequency of motion is given by

(A) $2\pi\sqrt{\frac{g}{\delta}}$

(B) $\frac{1}{2\pi}\sqrt{\frac{g}{\delta}}$

(C) $2\pi\sqrt{\frac{\delta}{g}}$

(D) $\frac{1}{2\pi}\sqrt{\frac{\delta}{g}}$

where δ = deflection of the spring.

66. There are six gears A, B, C, D, E and F in a compound train. The numbers of teeth in the gears are 20, 60, 30, 80, 25 and 75 respectively. The ratio of angular speeds of the driven (F) to the driver (A) of the drive is

(A) $\frac{1}{24}$

(B) $\frac{1}{8}$

(C) $\frac{4}{15}$

(D) 12

67. Porter governor is a/an

(A) dead-weight governor

(B) pendulum-type governor

(C) spring-loaded governor

(D) inertia governor

68. For two governors A and B, the lift of sleeve of governor A is more than that of governor B, for a given fractional change in speed. It indicates that

(A) governor A is more sensitive than governor B

(B) governor B is more sensitive than governor A

(C) both governors A and B are equally sensitive

(D) None of the above

69. A disturbing mass m_1 attached to the rotating shaft may be balanced by a single mass m_2 attached in the same plane of rotation as that of m_1, such that

(A) $m_1r_2 = m_2r_1$

(B) $m_1r_1 = m_2r_2$

(C) $m_1m_2 = r_1r_2$

(D) None of the above

70. When elements like nickel, chromium, copper and molybdenum are added to the molten cast iron, it produces

(A) white cast iron

(B) nodular cast iron

(C) malleable cast iron

(D) alloy cast iron

71. According to the Indian standard specifications, plain carbon steel designated by 40C8 means that the carbon content is

(A) 0·04%

(B) 0·35% to 0·45%

(C) 0·4% to 0·6%

(D) 0·6% to 0·8%

72. Which of the following gives the correct order of increasing hot hardness of cutting tool materials?

(A) High-speed steel, Diamond, Carbide

(B) Carbide, Diamond, High-speed steel

(C) Diamond, Carbide, High-speed steel

(D) High-speed steel, Carbide, Diamond

73. The relation between tool life (T) and cutting speed (V) is VT^n = constant. In this relation, the value of n depends upon

(A) work material

(B) tool material

(C) working conditions

(D) type of chip produced

74. A steel is heated at about 875 °C where the structure consists of austenite entirely. It is then cooled suddenly at a temperature of about 250 °C to 525 °C. This process of heat treatment is known as

(A) normalizing

(B) annealing

(C) austempering

(D) martempering

75. The process in which carbon and nitrogen both are absorbed by the metal surface to get it hardened is known as

(A) cyaniding

(B) carburizing

(C) flame hardening

(D) induction hardening

76. What is an IC engine?

(A) The fuel is ignited and burned inside the engine

(B) The fuel is burned inside a combustion chamber

(C) The fuel is ignited inside a combustion chamber

(D) None of the above

77. What is the function of an alternator?

(A) Recharging the battery

(B) Voltage regulator

(C) Auto-ignition

(D) None of the above

78. The internal resistance which the body offers to meet with the load or external force is called

(A) stress

(B) strain

(C) pressure

(D) None of the above

79. The law which states that within elastic limits, the strain produced is proportional to the stress producing it, is known as

(A) Bernoulli's law

(B) Hooke's law

(C) stress law

(D) Poisson's law

80. What is factor of safety?

(A) The ratio of stress to strain

(B) The ratio of permissible stress to ultimate stress

(C) The ratio of ultimate stress to permissible stress

(D) The ratio of longitudinal strain to longitudinal stress

81. Young's modulus is defined as the ratio of

(A) volumetric stress and volumetric strain

(B) lateral stress and lateral strain

(C) longitudinal stress and longitudinal strain

(D) shear stress and shear strain

82. A lap joint is always in _____ shear.

(A) single

(B) double

(C) Both (A) and (B)

(D) None of the above

83. Tearing of the plate between the edges of plate and rivet-hole takes place when

(A) they are near to each other

(B) the hole is too near the edge

(C) the diameter of the rivet is too small

(D) the rivet and plate are of different metals

84. In zigzag lap joint formation, when P is the pitch between the rivets, the distance between the rows of rivets should not be less than

(A) $0{\cdot}6P$

(B) $0{\cdot}8P$

(C) P

(D) $1{\cdot}2P$

85. In butt joint, when two straps are used, the thickness varies between _____ to _____ (t is the thickness of plate to be connected).

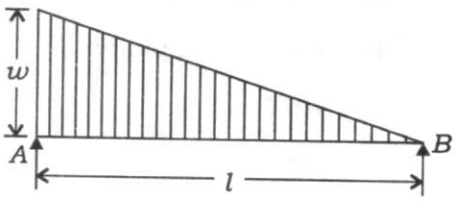
(A) t, $1{\cdot}125t$

(B) $0{\cdot}7t$, $0{\cdot}8t$

(C) $0{\cdot}5t$, t

(D) t, $1{\cdot}5t$

86. A simply supported beam with a gradually varying load from zero at B and w per unit length at A is shown in the figure below :



The shear force at B is equal to

(A) $\frac{wl}{6}$

(B) $\frac{wl}{3}$

(C) wl

(D) $\frac{2wl}{3}$

87. The columns, whose slenderness ratio is less than 80, are known as

(A) short columns

(B) long columns

(C) weak columns

(D) medium columns

88. Shear force at any point on the beam is the algebraic sum of

(A) all vertical forces

(B) all horizontal forces

(C) forces on either side of the point

(D) moments of forces on either side of the point

89. The point of contraflexure occurs only in

(A) continuous beams

(B) cantilever beams

(C) overhanging beams

(D) simply supported beams

90. A cantilever beam is loaded with udl throughout. The maximum shear force occurs at

(A) free end

(B) fixed end

(C) centre

(D) point of contraflexure

91. Which of the following refers to the term 'COP' of refrigeration?

(A) Cooling for Performance

(B) Coefficient of Performance

(C) Capacity of Performance

(D) Coefficient of Plant

92. Carnot heat pump works between 27 °C and 327 °C. What will be its COP?

(A) 0·09 (B) 1·00

(C) 1·09 (D) 2·0

93. The domestic refrigerator operating on vapour compression cycle uses which of the following devices for expansion?

(A) Thermostatic valve

(B) Thermostat

(C) Capillary tube

(D) Throttling valve

94. The commonly used refrigerant in domestic refrigerators is

(A) ammonia

(B) CO_2

(C) nitrogen

(D) R134a

95. Which is the desirable physical property of a refrigerant?

(A) Toxic

(B) Explosive

(C) Low boiling point

(D) High freezing point

96. Which of the following is a secondary refrigerant when used above 0 °C?

(A) Sodium chloride

(B) Glycol

(C) Brine

(D) Water

97. Which of the following is the material of tubes used for shell-and-tube condenser in ammonia refrigeration system?

(A) Copper

(B) Steel

(C) Brass

(D) Aluminum

98. Which of the following is represented by curved lines on the psychrometric chart?

(A) Specific humidity

(B) Relative humidity

(C) WBT

(D) DPT

99. What is represented by inclined straight lines but non-uniformly spaced on the psychrometric chart?

(A) Specific humidity

(B) Relative humidity

(C) WBT

(D) DPT

100. Which of the following processes is/are used in winter air-conditioning?

(A) Cooling and dehumidification

(B) Heating and humidification

(C) Dehumidification only

(D) Humidification only

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