SEAL

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900153

Series : **a**

Question Booklet No.

ESE/25/RT/MCE/2025

Invigilator's Signature

MECHANICAL ENGINEERING

Candidate's Signature

Time : 3 Hours **Maximum Marks : 200**

ROLL NO. | | | | | | |

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1. A bolt of 30 × 2 means that

[A] the pitch of the thread is 30 mm and the depth is 2 mm

[B] the nominal diameter of the bolt is 30 mm and the pitch is 2 mm

[C] the effective diameter of the bolt is 30 mm and the pitch is 2 mm

[D] None of the above

2. The relation between modulus of elasticity (E), modulus of rigidity (C) and bulk modulus (K) is given by

[A] $E = (9KC) / (C + 3K)$

[B] $E = (3KC) / (C + 9K)$

[C] $E = (C + 9K) / (3KC)$

[D] $E = (C + 3K) / (9KC)$

3. Four forces P, $2P$, $3P$ and $4P$ act along the sides taken in order of a square. The resultant force is

[A] zero

[B] $2\sqrt{2}\ P$

[C] $2P$

[D] $\sqrt{5}\ P$

4. If two bodies, one light and the other heavy, have equal kinetic energies, then which one of the following has a greater momentum?

[A] Heavy body

[B] Light body

[C] Both have equal momentum

[D] It depends on the actual velocities

5. A steel ball is dropped from a height h_1 onto a steel plate and rebounds to a height h_2. The coefficient of restitution between the ball and the plate will be

[A] h_1 / h_2

[B] $h_2 / (2h_1)$

[C] $(h_2 / 2h_1)^{0.5}$

[D] $(h_2 / h_1)^{0.5}$

6. A person standing on a uniformly rotating turntable has his arms held close to his chest. If he outstretches his arms

[A] the moment of inertia will decrease

[B] the angular momentum will increase

[C] the speed of rotation will decrease

[D] the angular velocity will remain constant

7. If D is the diameter of a sphere, then volumetric strain is equal to

[A] two times the strain of the diameter

[B] 1.5 times the strain of the diameter

[C] three times the strain of the diameter

[D] None of the above

8. Torsional rigidity of a shaft is equal to the

[A] product of modulus of rigidity and polar moment of inertia

[B] sum of the modulus of rigidity and polar moment of inertia

[C] difference in modulus of rigidity and polar moment of inertia

[D] ratio of modulus of rigidity and polar moment of inertia

9. A Mohr's circle reduces to a point when the body is subjected to

[A] pure shear

[B] uniaxial stress only

[C] equal and opposite axial stresses on two mutually perpendicular planes, the planes being free of shear

[D] equal axial stresses on two mutually perpendicular planes, the planes being free of shear

10. A stone falls freely from rest and the distance covered by it in the last second of its motion equals the distance covered by it in the first four seconds of its motion. The stone then remains in the air for a total period of (Take $g = 10$ m/sec^2)

[A] 6 sec

[B] 8.5 sec

[C] 10.5 sec

[D] 12.5 sec

11. The displacement-time graphs for particles A and B are straight lines inclined at angles of 30° and 45° with the time axis. The ratio of velocities $V_a : V_b$ will be

[A] 0.337

[B] 0.527

[C] 0.577

[D] 0.877

12. Two metallic blocks having masses in the ratio of 2 : 3 are made to slide down a frictionless inclined plane starting initially from rest. When these blocks reach the bottom of the inclined plane, they will have their kinetic energies in the ratio

[A] 2 : 3

[B] 3 : 5

[C] 3 : 2

[D] 7 : 4

13. A free bar of length L is uniformly heated from 0 °C to a temperature t °C. α is the coefficient of linear expansion and E is the modulus of elasticity. The stress in the bar is

[A] αtE

[B] $\alpha tE/2$

[C] zero

[D] None of the above

14. Bending moment M and torque T are applied to a solid circular shaft. If the maximum bending stress due to bending moment (M) equals to maximum shear stress developed due to torque (T), then M is equal to

[A] $T/2$

[B] T

[C] $2T$

[D] $4T$

15. Ratio of the moment of inertia of a circle and that of a square having the same area about their centroidal axis is

[A] $3/2\pi$

[B] $3/\pi$

[C] $5/4\pi$

[D] $4/\pi$

16. A mechanism has 5 links and 6 pairs. Find the number of Degrees of Freedom (DOF) using Gruebler's equation for planar mechanisms.

[A] 0

[B] 5

[C] 2

[D] 8

17. In a simple gear train, gear A has 20 teeth and drives gear B with 40 teeth. If gear A rotates at 600 r.p.m, then find the speed of gear B.

[A] 1200 r.p.m.

[B] 300 r.p.m.

[C] 600 r.p.m.

[D] 900 r.p.m.

18. In a cantilever beam with a point load at the free end, the maximum bending moment occurs at

[A] free end

[B] mid-span

[C] fixed end

[D] load point

19. If the rotating mass of a rim type flywheel is distributed on another rim type flywheel whose mean radius is half the mean radius of the former, then the energy stored in the latter at the same speed will be

[A] four times the first one

[B] same as the first one

[C] one and a half times the first one

[D] one-fourth of the first one

20. In spur gears, the circle on which the involute is generated is called the

[A] pitch circle

[B] clearance circle

[C] base circle

[D] addendum circle

21. A thin-walled cylindrical vessel of wall thickness t and diameter d is filled with gas to a gauge pressure of p. The maximum shear stress on the vessel wall will be

[A] $pd/8t$

[B] $pd/4t$

[C] $pd/2t$

[D] pd/t

22. Critical or whirling speed is the speed at which the shaft tends to vibrate violently in

[A] linear direction

[B] transverse direction

[C] longitudinal direction

[D] None of the above

23. Stress concentration in cyclic loading

[A] is more serious in ductile materials

[B] is more serious in brittle materials

[C] is equally serious in both cases

[D] depends on other factors

24. A wire of circular cross-section of diameter 1.0 mm is bent into a circular arc of radius 1.0 m by application of pure bending at its ends. The Young's modulus of the material of the wire is 100 GPa. The maximum tensile stress developed in the wire is

[A] 200 MPa

[B] 150 MPa

[C] 100 MPa

[D] 50 MPa

25. The ratio of the average shear stress to the maximum shear stress in a beam with a square cross-section is

[A] 1

[B] 2

[C] 3/2

[D] 2/3

26. In the assembly of pulley, key and shaft

[A] pulley is made the weakest

[B] key is made the weakest

[C] key is made the strongest

[D] all the three are designed for equal strength

27. Rivet diameter as compared to plate thickness should be

[A] less

[B] equal

[C] half

[D] more

28. A column has a rectangular cross-section of 10 mm × 20 mm and a length of 1 m. The slenderness ratio of the column is close to

[A] 200

[B] 346

[C] 477

[D] 1000

29. A clutch has outer and inner diameters of 100 mm and 40 mm respectively. Assuming a uniform pressure of 2 MPa and a coefficient of friction of the liner material of 0.4, the torque-carrying capacity of the clutch is

[A] 490 Nm

[B] 372 Nm

[C] 196 Nm

[D] 148 Nm

30. A cantilever beam of length L, with uniform cross-section and flexural rigidity EI, is loaded uniformly by a vertical load w per unit length. The maximum vertical deflection of the beam is given by

[A] $wL^4/8EI$

[B] $wL^4/16EI$

[C] $wL^4/4EI$

[D] $wL^4/24EI$

31. The effective number of lattice points in unit cell, in case of FCC structure, is

[A] 2

[B] 3

[C] 4

[D] 6

32. Find out the APF of a simple cubic cell.

[A] 0.52

[B] 0.48

[C] 0.40

[D] 0.60

33. For iron, BCC lattice structure is found in case of temperature range

[A] above 1410 °C

[B] between 910 °C to 1410 °C

[C] above 910 °C

[D] below 910 °C

34. According to standard marking system, the fourth element of grinding wheel specification is

[A] grade

[B] structure

[C] bond type

[D] grain size

35. To increase the rigidity, a single point cutting tool should have

[A] positive rake angle

[B] negative rake angle

[C] zero rake angle

[D] zero relief angle

36. To conduct a good surface finish, which of the following is required?

[A] Small relief angle

[B] Small rake angle

[C] Large relief angle

[D] Large rake angle

37. For a three-piece pattern, middle portion of the mould box is called

[A] cheek

[B] cope

[C] drag

[D] split

38. Which operation is similar to shaping operation?

[A] Turning

[B] Drilling

[C] Facing

[D] Boring

39. The device used to hold smaller size drill is

[A] sleeve

[B] socket

[C] drift

[D] drill chuck

40. Which of the following is an example of super finishing operation of small diameter hole?

[A] Drilling

[B] Lapping

[C] Boring

[D] Reaming

41. In cold extrusion, which of the following forces dominates the deformation process?

[A] Inertial

[B] Tensile

[C] Compressive

[D] Shear

42. Crater wear takes place on the

[A] rake face of the tool

[B] flank face of the tool

[C] relief face of the tool

[D] cutting edge of the tool

43. Find out the suitable combination of arc welding operation.

[A] High voltage-high current

[B] Low voltage-high current

[C] High voltage-low current

[D] Low voltage-low current

44. In which machine tool, automatic feed movement is ***not*** possible?

[A] Radial drilling machine

[B] Upright drilling machine

[C] Sensitive drilling machine

[D] Gang drilling machine

45. Find out the ***correct*** statement.

[A] For a hole, upper limit is the maximum metal condition

[B] For a shaft, lower limit is the maximum metal condition

[C] For a shaft, upper limit is the minimum metal condition

[D] For a shaft, upper limit is the maximum metal condition

46. Tolerance dimension belongs to the category of

[A] monolateral

[B] bilateral

[C] trilateral

[D] All of the above

47. Flatness of a surface is checked by

[A] surface plate

[B] spirit level

[C] planer gauge

[D] surface gauge

48. Dial indicator is used for purpose of

[A] measuring linear dimension

[B] measuring angular dimension

[C] comparing the dimension

[D] None of the above

49. The sintering temperature in powder metallurgy is generally

[A] above the melting point

[B] equal to the melting point

[C] below the melting point

[D] irrelevant to the process

50. According to IS : 919, tolerances are designated for dimension

[A] above 3150 mm

[B] between 500 mm to 3150 mm

[C] above 500 mm

[D] upto 500 mm

51. Exponential smoothing is one of the methods for

[A] dispatching

[B] scheduling

[C] inventory

[D] forecasting

52. Which of the following is ***not*** the major strategy used for aggregate production planning?

[A] Varying work force size

[B] Calculation of normal time

[C] Varying inventory

[D] Accepting backorder

53. According to Job-Shop scheduling, for n-job m-machine problem can be divided broadly into

[A] four groups

[B] five groups

[C] three groups

[D] six groups

54. For high-speed steel tools, the typical range of cobalt addition for improved hot hardness is

[A] 2–4%

[B] 5–8%

[C] 10–15%

[D] 18–25%

55. In the context of economics of machining, the minimum cost per piece is achieved when

[A] tool life is maximum

[B] cutting speed is minimum

[C] tool cost = machining cost

[D] tool replacement cost = tool operating cost

56. A 3-2-1 principle is used for

[A] CNC programming

[B] fixture design

[C] heat treatment

[D] EDM electrode positioning

57. In a sine bar experiment, the height difference between rollers is 10 mm and the distance between rollers is 200 mm. What is the angle measured?

[A] 2.86°

[B] 3.00°

[C] 4.12°

[D] 5.73°

58. Identify the full form of PERT.

[A] Program Evaluation and Review Technique

[B] Program Evaluation with Review Technique

[C] Project Evaluation and Review Technique

[D] Project Evaluation with Review Technique

59. Overageing refers to

[A] long ageing time

[B] coarsening of precipitate particles

[C] ultrafine precipitate size

[D] ageing above room temperature

60. Phase boundary between alpha and (alpha + beta) region is called

[A] liquidus

[B] solidus

[C] liquivus

[D] solvus

61. 'The best person for the job' is an apt description of

[A] transportation model

[B] network model

[C] assignment model

[D] All of the above

62. For a plant, if Q_1 is the quantity required to produce and Q_2 is the capacity to produce at working condition, then margin of safety can be expressed as

[A] $(Q_2 - Q_1)/Q_2$

[B] $(Q_1 - Q_2)/Q_2$

[C] $(Q_2 - Q_1)/Q_1$

[D] $(Q_1 - Q_2)/Q_1$

63. The aim of CAD is to apply/use computers for the purpose of

[A] drafting

[B] modelling

[C] communication

[D] All of the above

64. Full form of CAM is

[A] Computer Aided Mining

[B] Computer Added Manufacturing

[C] Computer Aided Milling

[D] Computer Aided Machining

65. Advantage of built-up-edge formation in cutting tool is

[A] increasing tool wear

[B] reducing tool life

[C] reducing tool wear

[D] improving surface finish

66. Number of force components acting during oblique cutting is

[A] 2

[B] 3

[C] 4

[D] 5

67. Electrons act as the transfer media in which of the following non-conventional machining processes?

[A] EDM

[B] ECM

[C] IBM

[D] LBM

68. Which one of the following is ***not*** used as the abrasive slurry in USM?

[A] Aluminium oxide

[B] Boron carbide

[C] Aluminium carbide

[D] Silicon carbide

69. Fixture may ***not*** be used for which of the following tasks?

[A] Holding the workpiece

[B] Controlling the cutting tool

[C] Locating the workpiece

[D] Inspection

70. In a CNC program, M06 is used to

[A] start spindle

[B] call subprogram

[C] change tool

[D] coolant on

71. Kinematic viscosity and dynamic viscosity are expressed in

[A] poise and stoke respectively

[B] stoke and poise respectively

[C] pascal-second and stoke respectively

[D] pascal-second and poise respectively

72. For the atmospheric air within the troposphere, with the increasing altitude

[A] temperature increases, pressure decreases and density decreases

[B] temperature increases, pressure increases and density decreases

[C] temperature decreases, pressure decreases and density decreases

[D] temperature increases, pressure increases and density increases

73. The velocity distribution in a laminar boundary layer is given by (where u is velocity at distance y from the boundary and U is velocity at a distance δ, the thickness of boundary layer)

$$\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$$

The displacement thickness will be

[A] $\frac{7}{72}\delta$

[B] $\frac{1}{8}\delta$

[C] $\frac{7}{40}\delta$

[D] $\frac{7}{8}\delta$

74. Major head losses in the pipe flow is evaluated using

[A] Bazin's formula

[B] Francis' formula

[C] Manning's formula

[D] Darcy-Weisbach formula

75. Consider the following equation :

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

This differential equation fundamentally represents the

[A] conservation of energy

[B] conservation of momentum

[C] conservation of angular momentum

[D] conservation of mass

76. Bernoulli's equation is derived under the assumption of

[A] compressible, viscous, steady flow

[B] compressible, inviscid, unsteady flow

[C] incompressible, inviscid, steady flow

[D] incompressible, viscous, unsteady flow

77. The primary feature that differentiates turbulent flow from laminar flow is the

[A] constant velocity across the flow field

[B] smooth and uniform flow with no mixing involved

[C] irregular, disorderly fluctuations in velocity and pressure

[D] linear relationship between shear stress and velocity gradient

78. In ascending order of magnitude, the thermal conductivity of (v) air, (w) silver, (x) glass and (z) aluminum can be arranged as

[A] $x\ v\ w\ z$

[B] $v\ x\ w\ z$

[C] $x\ v\ z\ w$

[D] $v\ x\ z\ w$

79. Consider a hollow cylinder with length L, inner radius r_1, outer radius r_2 and thermal conductivity k. Assuming steady-state heat conduction through the hollow cylinder, the thermal resistance will be

[A] $\frac{\ln(r_2 / r_1)}{4\pi kL}$

[B] $\frac{\ln(r_2 / r_1)}{2\pi kL}$

[C] $\frac{\ln(r_1 / r_2)}{4\pi kL}$

[D] $\frac{\ln(r_1 / r_2)}{2\pi kL}$

80. The use of fins (extended surface) is most effective in applications involving a

[A] high thermal conductivity and high convective heat transfer coefficient

[B] low thermal conductivity and high convective heat transfer coefficient

[C] high thermal conductivity and low convective heat transfer coefficient

[D] low thermal conductivity and low convective heat transfer coefficient

81. What is the shape of the velocity profile for laminar flow through a circular pipe?

[A] Uniform across the section

[B] Hyperbolic

[C] Parabolic

[D] Linear

82. For specified inlet and outlet temperatures, the log mean temperature difference for a parallel-flow heat exchanger is

[A] greater than counter-flow heat exchanger

[B] less than counter-flow heat exchanger

[C] equal to counter-flow heat exchanger

[D] greater or less than counter-flow heat exchanger

83. For a black body (where ε is emissivity, α is absorptivity and τ is transmissivity)

[A] $\varepsilon = 1, \alpha = 0, \tau = 0$

[B] $\varepsilon = 1, \alpha = 0, \tau = 1$

[C] $\varepsilon = 0, \alpha = 1, \tau = 1$

[D] $\varepsilon = 1, \alpha = 1, \tau = 0$

84. Unsteady heat conduction analysis based on lumped system generally gives best results if Biot number is

[A] less than 0.1

[B] greater than 0.1

[C] less than 1

[D] greater than 1

85. Which of the following are the extensive properties of thermodynamic system?

[A] Specific volume and density

[B] Specific volume and mass

[C] Volume and density

[D] Mass and volume

86. The instrument which works on the principle of Zeroth law of thermodynamics is

[A] hygrometer

[B] anemometer

[C] thermometer

[D] manometer

87. Carnot cycle consists of

[A] 2-isentropic and 2-isobaric processes

[B] 2-isentropic and 2-isothermal processes

[C] 2-isenthalpic and 2-isothermal processes

[D] 2-isenthalpic and 2-isobaric processes

88. Specific heat at the constant volume is expressed as (where T is temperature and h, u, v are specific enthalpy, internal energy, volume respectively)

[A] $\left(\frac{\partial h}{\partial T}\right)_v$

[B] $\left(\frac{\partial u}{\partial T}\right)_v$

[C] $\left(\frac{\partial T}{\partial h}\right)_v$

[D] $\left(\frac{\partial T}{\partial u}\right)_v$

89. In a reversible cycle, the entropy of the system

[A] decreases

[B] increases

[C] remains constant

[D] increases and then decreases

90. In a pressure-volume phase diagram of pure substance, dryness fraction is

[A] zero at saturated liquid line and one at saturated vapour line

[B] one at saturated liquid line and one at saturated vapour line

[C] zero at saturated liquid line and zero at saturated vapour line

[D] one at saturated liquid line and zero at saturated vapour line

91. Availability of a system at any given state is

[A] the total enthalpy of the system

[B] the total internal energy of the system

[C] the maximum work that can be obtained from a system as it reaches equilibrium with its surroundings

[D] the maximum useful work that can be obtained from a system as it reaches equilibrium with its surroundings

92. In the Rankine cycle

[A] condensation process is isobaric and expansion process in turbine is isenthalpic

[B] condensation process is isochoric and expansion process in turbine is isenthalpic

[C] condensation process is isobaric and expansion process in turbine is isentropic

[D] condensation process is isochoric and expansion process in turbine is isentropic

93. Which of the following expressions represents the efficiency of Brayton cycle (r is compression ratio and r_p is pressure ratio)?

[A] $1-\frac{1}{(r)^{\frac{\gamma}{\gamma-1}}}$

[B] $1-\frac{1}{(r)^{\frac{\gamma-1}{\gamma}}}$

[C] $1-\frac{1}{(r_p)^{\frac{\gamma}{\gamma-1}}}$

[D] $1-\frac{1}{(r_p)^{\frac{\gamma-1}{\gamma}}}$

94. In diesel cycle

[A] heat is added and rejected at constant volume

[B] heat is added and rejected at constant pressure

[C] heat is added at constant volume and rejected at constant pressure

[D] heat is added at constant pressure and rejected at constant volume

95. The efficiency of Otto cycle increases with

[A] increase in compression ratio and decrease in ratio of specific heat of gases

[B] decrease in compression ratio and decrease in ratio of specific heat of gases

[C] increase in compression ratio and increase in ratio of specific heat of gases

[D] decrease in compression ratio and decrease in ratio of specific heat of gases

96. In vapour compression refrigeration cycle, the enthalpies of refrigerant at the end of compression, end of throttling or expansion and end of evaporation are 210 kJ/kg, 70 kJ/kg and 170 kJ/kg respectively. The coefficient of performance of the system will be

[A] 0.4

[B] 0.82

[C] 2.5

[D] 2.1

97. Air cycle refrigeration cycle works on the principle of

[A] reversed Carnot cycle

[B] Brayton cycle

[C] Bell-Coleman cycle

[D] Joule cycle

98. During a free expansion process, the amount of work done by the system

[A] is positive

[B] is zero

[C] is negative

[D] can be both negative and positive

99. Which of the following is the ***correct*** sequence of turbines in decreasing order of specific speed?

[A] Pelton, Kaplan, Francis

[B] Kaplan, Francis, Pelton

[C] Francis, Pelton, Kaplan

[D] Francis, Kaplan Pelton

100. Reciprocating pumps are suitable for

[A] low capacity and high head

[B] high capacity and high head

[C] high capacity and low head

[D] low capacity and low head

SPACE FOR ROUGH WORK

PROVISIONAL ANSWER KEY OF
ARUNACHAL ENGINEERING SERVICE
(RECRUITMENT TEST) EXAMINATION-2025
MECHANICAL ENGINEERING
SET- A

Q NO.	ANS
1	B
2	A
3	B
4	A
5	D
6	C
7	C
8	A
9	D
10	B
11	C
12	A
13	C
14	A
15	B
16	A
17	B
18	C
19	D
20	C
21	A
22	B
23	A
24	D
25	D

Q NO.	ANS
26	B
27	D
28	B
29	C
30	A
31	C
32	A
33	D
34	A
35	B
36	D
37	A
38	C
39	D
40	B
41	C
42	A
43	B
44	C
45	D
46	B
47	A
48	C
49	C
50	D

Q NO.	ANS
51	D
52	B
53	A
54	C
55	C
56	B
57	A
58	A
59	B
60	D
61	C
62	A
63	D
64	B
65	C
66	B
67	A
68	C
69	B
70	C
71	B
72	C
73	B
74	D
75	D

Q NO.	ANS
76	C
77	C
78	D
79	B
80	C
81	C
82	B
83	D
84	A
85	D
86	C
87	B
88	B
89	C
90	A
91	D
92	C
93	D
94	D
95	C
96	C
97	C
98	B
99	B
100	A