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Test Booklet Series

A

T. B. C. : AEM – 1 / 2019

TEST BOOKLET

ASSISTANT EXECUTIVE ENGINEER
MECHANICAL ENGINEERING
PAPER – I

Sl. No. 103721

Time Allowed : 3 Hours

Maximum Marks : 180

: INSTRUCTIONS TO CANDIDATES :

1. IMMEDIATELY AFTER COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET **DOES NOT** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET OF SAME SERIES ISSUED TO YOU.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D**, AS THE CASE MAY BE, IN THE APPROPRIATE PLACE IN THE ANSWER SHEET USING BALL POINT PEN (BLUE OR BLACK).
3. You have to enter your **Roll No.** on the Test Booklet in the Box provided alongside. **DO NOT** write *anything else* on the Test Booklet.
4. **YOU ARE REQUIRED TO FILL UP & DARKEN ROLL NO., TEST BOOKLET / QUESTION BOOKLET SERIES IN THE ANSWER SHEET AS WELL AS FILL UP TEST BOOKLET / QUESTION BOOKLET SERIES AND SERIAL NO. AND ANSWER SHEET SERIAL NO. IN THE ATTENDANCE SHEET CAREFULLY. WRONGLY FILLED UP ANSWER SHEETS ARE LIABLE FOR REJECTION AT THE RISK OF THE CANDIDATE.**
5. This Test Booklet contains **180** items (questions). Each item (question) comprises four responses (answers). You have to select the correct response (answer) which you want to mark (darken) on the Answer Sheet. In case, you feel that there is more than one correct response (answer), you should mark (darken) the response (answer) which you consider the best. In any case, choose **ONLY ONE** response (answer) for each item (question).
6. You have to mark (darken) all your responses (answers) **ONLY** on the **separate Answer Sheet** provided by **using BALL POINT PEN (BLUE OR BLACK)**. See instructions in the Answer Sheet.
7. All items (questions) carry equal marks. All items (questions) are compulsory. Your total marks will depend only on the number of correct responses (answers) marked by you in the Answer Sheet. **There will be negative markings for wrong responses (answers).**
8. Before you proceed to mark (darken) in the Answer Sheet the responses (answers) to various items (questions) in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per the instructions sent to you with your **Admission Certificate**.
9. After you have completed filling in all your responses (answers) on the Answer Sheet and after conclusion of the examination, you should hand over to the Invigilator the *Answer Sheet* issued to you. You are allowed to take with you the candidate's copy / second page of the Answer Sheet along with the **Test Booklet**, after completion of the examination, for your reference.
10. Sheets for rough work are appended in the Test Booklet at the end.

SEAL

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1. True strain for a steel bar which is doubled its length by tension is :

(A) 0.307

(B) 0.5

(C) 0.693

(D) 1.0

2. Hot rolling of mild steel is carried out at :

(A) Below recrystallization temp

(B) Between 100°C to 150°C

(C) Above recrystallization temp.

(D) At 100°C

3. The welding torch angle in forehand gas welding technique is :

(A) 60°

(B) 50°

(C) 60°-70°

(D) 90°

4. Collapsible tubes are made by :

(A) Drawing

(B) Spinning

(C) Impact Extrusion

(D) Tube rolling

5. A moving mandrel used in :

(A) Wire drawing

(B) Tube drawing

(C) Metal cutting

(D) Forging

6. What happens to metal deposition if welding operation is performed with reverse polarity ?

(A) Increases

(B) Decreases

(C) Remain same

(D) First decreases then increases

7. A built up edge is formed while machining :

(A) Ductile material at high speed

(B) Ductile material at low speed

(C) Brittle material at high speed

(D) Brittle material at low speed

8. Trepanning is performed for :

(A) Finishing a hole

(B) Producing large hole without drilling

(C) Enlarging hole

(D) Threading

9. Abrasive are not used in :

(A) Buffering process

(B) Burnishing process

(C) Polishing process

(D) Super finishing process

10. A milling cutter is having 8 teeth rotating at 100 rpm. Workpiece feed is set at 40 mm/min. So feed per tooth is :

(A) 5 mm

(B) 0.05 mm

(C) 0.4 mm

(D) 0.2 mm

11. In HSS, tungsten can be substitute by :

(A) Chromium

(B) Nickel

(C) Molybdenum

(D) Cobalt

12. In an orthogonal cutting, depth of cut is halved and feed rate is doubled. If the chip thickness ratio is unaffected with the changed cutting conditions, the actual chip thickness will be :

(A) Doubled

(B) Halved

(C) Unchanged

(D) Quadrupled

13. Ductile materials can be machined in Ultrasonic machining process.

(A) True

(B) False

(C) Partly true

(D) Partly false

14. Non-conductive material can be machined by :

(A) LBM

(B) EDM

(C) ECM

(D) All of these

15. Electrolyte is used in which of the following process ?

(A) EDM

(B) WJM

(C) WEDM

(D) ECM

16. In a top gating system pouring basin is 5 meter above choke. If $g = 10\ m/s^2$, velocity of metal at gate is :

(A) 5 m/s

(B) 10 m/s

(C) 20 m/s

(D) 25 m/s

17. Fettling is an operation performed to :

(A) Melt metal

(B) Clean casting

(C) Inspection of casting

(D) Heat treatment of casting

18. Cupola in foundry shop is used mostly to melt :

(A) Cast Iron

(B) Non-ferrous Metal

(C) Steel

(D) Stainless Steel

19. In investment casting pattern used is made of :

(A) Wood

(B) Plastic

(C) Metal

(D) Wax

20. Ideal profile of sprue to avoid aspiration effect is :

(A) Taper

(B) Parabolic

(C) Straight

(D) Sinusoidal

21. The volume of metal in a casting and A is its surface area, then the time of solidification will be proportional to :

(A) V, 1/A

(B) V, $1/A^2$

(C) V^2, 1/A

(D) V^2, $1/A^2$

22. A carburizing flame is obtained by supplying :

(A) Equal volumes of oxygen and acetylene

(B) More volume of oxygen than acetylene

(C) More volume of acetylene than oxygen

(D) None of these

23. In brazing the usual melting temperature of the filler rod is :

(A) Above 1500°C

(B) Above 450°C

(C) Below 450°C

(D) Above melting temp. of parent metal

24. In laser welding the laser material used is :

(A) Molybdenum

(B) Ruby crystal

(C) Titanium

(D) Lithium

25. After fusion welding, the nature of residual stress in weldment area is :

(A) Compressive

(B) Tensile

(C) Shear

(D) No stress

26. In TIG welding, the electrode is made of :

(A) Graphite

(B) Tungsten

(C) Same composition that of weld material

(D) Copper

27. In cold working of metals, the temperature of material is at :

(A) Room temperature

(B) Higher than the room temperature

(C) Lower than the room temperature

(D) Below recrystallisation temperature

28. If coefficient of friction μ in a rolling process is 0.5 and radius of roller is 1,000 mm, what is the maximum reduction or draft possible ?

(A) 500 mm

(B) 250 mm

(C) 750 mm

(D) 1,000 mm

29. Forging hammers are called :

(A) Stroke restricted machines

(B) Energy restricted machines

(C) Load restricted machines

(D) Stress restricted machines

30. In punching operation clearance is provided in :

(A) Punch

(B) Die

(C) Blank holder

(D) Blank

31. Collapsible tubes like that of toothpaste, shaving cream, etc., are produced by :

(A) Direct extrusion

(B) Piercing

(C) Indirect extrusion

(D) Impact extrusion

32. Which of the following is a technique for forecasting ?

(A) Exponential smoothing

(B) PERT

(C) CPM

(D) Control charts

33. If there are m sources and n destinations in a transportation matrix, the total number of basic variables in a basic feasible solution is :

(A) $m + n$

(B) $m + n + 1$

(C) $m + n - 1$

(D) m

34. The word KANBAN is most appropriately associated with :

(A) EOQ

(B) JIT

(C) Capacity planning

(D) Product design

35. Vehicle manufacturing assmebly line is an example of _____ layout.

(A) Product

(B) Process

(C) Manual

(D) Fixed

36. When using a simple moving average to forecast demand, one would :

(A) Given equal weight to all the demand data

(B) Assign more weight to the recent demand data

(C) Include new demand data in the average after discarding some of the earlier demand data

(D) All of these

37. The total number of decision variables in the objective function of an assignment problem of $n \times n$ (n jobs and n machines) is :

(A) n^2

(B) $2n$

(C) $2n - 1$

(D) n

38. In an ideal inventory control system, the economic lot size for a part is 1,000. If the annual demand for the part is doubled, then new economic lot size required will be :

(A) 500

(B) 2,000

(C) $1,000/\sqrt{2}$

(D) $1,000\sqrt{2}$

39. In a single server finite population queuing model arrival follows Poisson distribution with mean $\lambda = 4$ per hour. The service times are exponential with mean service time equals to 12 minutes. The expected length of the queue will be :

(A) 4

(B) 3.2

(C) 1.25

(D) 24.3

40. For a product, the forecast and actual sales for December 2018 were 25 and 20 respectively. If the exponential smoothing constant is taken as 0.2, the forecast sales for January 2019 would be :

(A) 21

(B) 23

(C) 24

(D) 27

41. Manufacturing area of a plant is divided into four quadrants. Four machines have to locate one in each quadrant. The total number of possible layout is :

(A) 4

(B) 8

(C) 16

(D) 24

42. In PERT chart activity time distribution is :

(A) Normal

(B) Binomial

(C) Poisson

(D) Beta

43. Symbol used for transport in work study is :

(A) □

(B) =>

(C) T

(D) 0

44. In PERT analysis a critical activity has :

(A) Maximum float

(B) Maximum cost

(C) Zero float

(D) Minimum cost

45. In an assembly line for assembling toys, five workers are assigned tasks which takes time of 10, 8, 6, 9 and 10 minutes respectively. The balance delay for line is :

(A) 43.3%

(B) 14.8%

(C) 14.0%

(D) 16.3%

46. The product is assembled from parts A and B. The probability of defective parts A and B are 0.2 and 0.1 respectively. Then the probability of the assembly of A and B to be non-defective is :

(A) 0.72

(B) 0.7

(C) 0.02

(D) 0.3

47. Routing in production planning and control refers to the :

(A) Balancing of load on machines

(B) Sequence of operations to be performed

(C) Authorization of work to be performed

(D) Progress of work performed

48. AOQL stands for :

(A) Average Outgoing Quality Level

(B) Accepted Outgoing Quality Level

(C) Average Outgoing Quality Limit

(D) Accepted Outgoing Quality Limit

49. Shewart Control Charts are used in :

(A) Quality control

(B) Inventory management

(C) Work study

(D) Production activity

50. In an assembly line for assembling of table fan, five workers are given tasks which take times of 10, 8, 6, 9, 10 minutes respectively. The balance delay for the line is :

(A) 86.0%

(B) 14.0%

(C) 90.0%

(D) 10.0%

51. Johnson's rule is applicable for planning a job shop for :

(A) 1 machine and n jobs

(B) n machines and 2 jobs

(C) n machines and n jobs

(D) 2 machines and n jobs

52. Market demand for ball bearings is 8,00,000 per annum. A company purchases these bearings in lots and sells them. The cost of making a purchase order is Rs. 1,200. The cost of storage of bearings is Rs. 120 per stored piece per annum. The economic order quantity is :

(A) 4,000

(B) 8,500

(C) 6,000

(D) 4,500

53. A production line is said to be balanced when :

(A) The waiting time for service at each station is the same

(B) There are equal number of machines at each work station

(C) The operation time at each station is the same

(D) There are equal number of operations at each work station

54. The value engineering technique in which experts of the same rank assemble for product development is called :

(A) Morphological analysis

(B) Delphi

(C) Direct expert comparison

(D) Brain storming

55. The term value in value engineering refers to which aspect of the product :

(A) Manufacturing cost

(B) Material cost

(C) Utility

(D) Selling price

56. Dispatching function of production planning and control refers to :

(A) Authorizing a production work order to be performed

(B) A dispatch of finished goods on order

(C) Dispatch of bills and invoices to the customer

(D) Movement of in-process material from shop to shop

57. All machines and equipments are grouped together at one location according to their functions in which type of layout ?

(A) Product layout

(B) Process layout

(C) Fixed position layout

(D) Hybrid layout

58. Consider a system having three subsystems with reliability 0.6, 0.9 and 0.8. If the subsystems are put in series then the reliability of the system would be :

(A) 0.187

(B) 0.655

(C) 0.821

(D) 0.432

59. Choose the false statement :

(A) Control charts indicate whether the process is in control or not.

(B) p-chart is a control charge for percent defectives.

(C) $\bar{X}$ and R-charts are used to evaluate dispersion of measurements.

(D) C-charts are prepared for large and complex components.

60. Which one of the following charts gives simultaneously, information about the progress of work and machine loading ?

(A) Man-machine chart

(B) Process chart

(C) Machine load chart

(D) Gantt chart

61. Corrosion resistance of steel is increased by addition of :

(A) Sulphur, phosphorus, lead

(B) Chromium and nickel

(C) Vanadium, aluminium

(D) Tungsten, molybdenum, vanadium, chromium

62. Ductility of a material can be defined as :

(A) Ability to undergo large permanent deformations in compression

(B) Ability to recover its original form

(C) Ability to undergo large permanent deformations in tension

(D) All of these

63. Which of the following constituents of steels is softest and least strong ?

(A) Austenite

(B) Pearlite

(C) Cementite

(D) Ferrite

64. A solid + a liquid result in a liquid upon heating during _____ reaction.

(A) Eutectic

(B) Peritectic

(C) Monotectic

(D) Syntectic

65. Gibbs phase rule for general system is :

(A) $P + F = C - 1$

(B) $P + F = C + 1$

(C) $P + F = C - 2$

(D) $P + F = C + 2$

66. Pearlite is a combination of :

(A) Ferrite and cementite

(B) Cementite and gamma iron

(C) Ferrite and austenite

(D) Ferrite and iron graphite

67. The abbreviation T.T.T. Diagrams stand for :

(A) Tensile Temperature Time Diagrams

(B) Time Temperature Transformations diagrams

(C) Temperature Time Testing Diagrams

(D) Time Transformation Testing Diagrams

68. Connecting rod is usually made of :

(A) Aluminium

(B) Low carbon steel

(C) Medium carbon steel

(D) High carbon steel

69. What is the packing factor of FCC crystal structure ?

(A) 0.64

(B) 0.68

(C) 0.74

(D) 0.78

70. A beam supported on more than two supports is called :

(A) Simply supported beam

(B) Fixed beam

(C) Overhanging beam

(D) Continuous beam

71. Which is false statement about annealing ?

(A) Annealing is done to relieve stresses .

(B) Annealing is done to harden steel slightly.

(C) Annealing is done to improve machining characteristics.

(D) Annealing is done to soften material.

72. In a single-component condensed system, if degree of freedom is zero, maximum number of phases that can co-exist _____.

(A) 0

(B) 1

(C) 2

(D) 3

73. Engineering stress-strain curve and true stress-strain curve are equal up to :

(A) Proportional limit

(B) Elastic limit

(C) Yield point

(D) Tensile strength point

74. Eutectoid product in Fe-C system is called :

(A) Pearlite

(B) Bainite

(C) Ledeburite

(D) Spheroidite

75. The crystal structure of gamma iron is :

(A) Body centred cubic

(B) Face centred cubic

(C) Hexagonal close packed

(D) Cubic structure

76. Cyaniding is the process of :

(A) Dipping steel in cyanide bath

(B) Reacting steel surface with cyanide salts

(C) Adding carbon and nitrogen by heat treatment of steel to increase its surface hardness

(D) Making corrosion resistant steel

77. Which is false statement about normalizing ?

(A) Normalizing is done to refine grain structure.

(B) Normalizing is done to reduce segregation in casting.

(C) Normalizing is done to improve mechanical properties.

(D) Normalizing is done to induce stresses.

78. Longitudinal strength of fibre reinforced composite is mainly influenced by :

(A) Fibre strength

(B) Fibre orientation

(C) Fibre volume fraction

(D) Fibre length

79. During sintering densification is not due to :

(A) Atomic diffusion

(B) Surface diffusion

(C) Bulk diffusion

(D) Grain growth

80. Most commercial glasses consist of :

(A) Lime

(B) Soda

(C) Silica

(D) All of these

81. Usually stronger constituent of a composite is :

(A) Matrix

(B) Reinforcement

(C) Both are of equal strength

(D) Can't define

82. Railway rails are normally made of :

(A) Mild steel

(B) Alloy steel

(C) High carbon steel

(D) Tungsten steel

83. The presence of hydrogen in steel causes :

(A) Reduced neutron absorption cross-section

(B) Improved weldability

(C) Embrittlement

(D) Corrosion resistance

84. Points of arrest for iron correspond to :

(A) Stages at which allotropic forms change

(B) Stages at which further heating does not increase temp for some time

(C) Stages at which properties do not change with increase in temperature

(D) There is nothing like points of arrest

85. Atomic packing factor is :

(A) Distance between two adjacent atoms

(B) Projected area fraction of atoms on a plane

(C) Volume fraction of atoms in cell

(D) None of these

86. What is coordination number of BCC crystal structure ?

(A) 4

(B) 8

(C) 12

(D) 1

87. Relative amounts of phases in a region can be deduced using :

(A) Phase rule

(B) Lever rule

(C) Either (A) or (B)

(D) None of these

88. Wt. % of carbon in mild steels :

(A) < 0.008

(B) 0.008-0.3

(C) 03-0.8

(D) 0.8-2.11

89. A material is known as allotropic or polymorphic if it :

(A) Has a fixed structure under all conditions

(B) Exists in several crystal forms at different temperatures

(C) Responds to heat treatment

(D) Has its atoms distributed in a random pattern

90. A shear stress at the centre of a circular shaft under torsion is :

(A) Zero

(B) Minimum

(C) Maximum

(D) Infinity

91. What tapers in a tapered roller bearing ?

(A) Inner race

(B) Outer race

(C) Roller

(D) Cage

92. Spherical roller bearings are normally used :

(A) For increased radial load

(B) When there is less radial space

(C) For increased thrust load

(D) To compensate for angular misalignment

93. Square key of side "d/4" each and length l is used to transmit torque "T" from the shaft of diameter "d" to the hub of a pulley. Assuming the length of the key to be equal to the thickness of the pulley, the average shear stress developed in the key is given by :

(A) $\frac{4T}{ld}$

(B) $\frac{16T}{ld^2}$

(C) $\frac{8T}{ld^2}$

(D) $\frac{16T}{\pi d^3}$

94. The permissible stress in a field weld is 100 N/mm^2. The fillet weld has equal leg lengths of 15 mm each. The allowable shearing load on weldment per cm length of the weld is :

(A) 22.5 kN

(B) 15.0 kN

(C) 10.6 kN

(D) 7.5 kN

95. **Assertion (A)** : Uniform-strength bolts are used for resisting impact loads.

Reason (R) : The area of cross-section of the threaded and unthreaded parts is made equal.

(A) Both (A) and (R) are individually true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are individually true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

96. Match List – I (Parts to be joined) with List – II (Type of Joint) and select the correct answer using the code given below :

	List – I		List – II
(a)	Two rods having relative axial motion	(i)	Pin Joint
(b)	Strap end of the connecting rod	(ii)	Knuckle Joint
(c)	Piston rod and cross head	(iii)	Gib and Cotter Joint
(d)	Links of four-bar chain	(iv)	Cotter Joint

	(a)	(b)	(c)	(d)
(A)	(i)	(iii)	(iv)	(ii)
(B)	(ii)	(iv)	(iii)	(i)
(C)	(i)	(iv)	(iii)	(ii)
(D)	(ii)	(iii)	(iv)	(i)

97. Which one of the following is the value of helix angle for maximum efficiency of a square threaded screw ?

$[\phi = \tan^{-1} \mu]$

(A) $45^\circ + \phi$

(B) $45^\circ - \phi$

(C) $45^\circ + \phi/2$

(D) $45^\circ - \phi/2$

98. Consider the following statements :

Radius of friction circle for a journal bearing depends upon :

(i) Coefficient of friction

(ii) Radius of the journal

(iii) Angular speed of rotation of the shaft

Which of the statements given above are correct ?

(A) (i), (ii) and (iii)

(B) Only (i) and (ii)

(C) Only (ii) and (iii)

(D) Only (i) and (iii)

99. What is the efficiency of a self-locking power screw ?

(A) 70%

(B) 60%

(C) 55%

(D) < 50%

100. Match the type of gears with their most appropriate description :

Type of gear		Description
(P) Helical	(I)	Axes non-parallel and intersecting
(Q) Spiral	(II)	Axes parallel and teeth are inclined to the axis
(R) Hypoid	(III)	Axes parallel and teeth are parallel to the axis
(S) Rack and pinion	(IV)	Axes are perpendicular and intersecting and teeth are inclined to the axis
	(V)	Axes are perpendicular and used for large speed reduction
	(VI)	Axes parallel and one of the gears has infinite radius

(A) P – II, Q – IV, R – I, S – VI

(B) P – II, Q – VI, R – IV, S – II

(C) P – I, Q – IV, R – V, S – VI

(D) P – VI, Q – III, R – I, S – V

101. Sources of power loss in a chain drive are given below :

(i) Friction between chain and sprocket teeth.

(ii) Overcoming the chain stiffness.

(iii) Overcoming the friction in shaft bearing.

(iv) Frictional resistance to the motion of the chain in air or lubricant.

The correct sequence of descending order of power loss due to these sources is :

(A) (i), (ii), (iii), (iv)

(B) (i), (ii), (iv), (iii)

(C) (ii), (i), (iii), (iv)

(D) (ii), (i), (iv), (iii)

102. In the assembly of pulley, key and shaft :

(A) Pulley is made weakest

(B) Key is made weakest

(C) Shaft is made weakest

(D) All the three are designed for equal strength

103. In order to have interference fit, it is essential that the lower limit of the shaft should be :

(A) Greater than the upper limit of the hole

(B) Lesser than the upper limit of the hole

(C) Greater than the lower limit of the hole

(D) Lesser than the lower limit of the hole

104. The ratio of tension on the tight side to that on the slack side in a flat belt drive is :

(A) Proportional to the product of coefficient of friction and lap angle

(B) An exponential function of the product of coefficient of friction and lap angle

(C) Proportional to the lap angle

(D) Proportional to the coefficient of friction

105. In case of a multiple disc clutch, if n_1 is the number of discs on the driving shaft and n_2 is the number of discs on the driven shaft, then what is the number of pairs of contact surfaces ?

(A) $n_1 + n_2$

(B) $n_1 + n_2 - 1$

(C) $n_1 + n_2 + 1$

(D) $n_1 + 2n_2$

106. Match List – I (Type of keys) with List – II (Characteristics) and select the correct answer using the codes given below the lists :

List – I		List – II
(a) Woodruff Key	(i)	Loose fitting, Light duty
(b) Kennedy Key	(ii)	Heavy duty
(c) Feather Key	(iii)	Self-aligning
(d) Flat Key	(iv)	Normal industrial use

	(a)	(b)	(c)	(d)
(A)	(ii)	(iii)	(i)	(iv)
(B)	(iii)	(ii)	(i)	(iv)
(C)	(ii)	(iii)	(iv)	(i)
(D)	(iii)	(ii)	(iv)	(i)

107. A key connecting a flange coupling to a shaft is likely to fail :

(A) Shear

(B) Tension

(C) Torsion

(D) Bending

108. Total slip will occur in a belt drive when :

(A) Angle of rest is zero

(B) Angle of creep is zero

(C) Angle of rest is greater than angle of creep

(D) Angle of creep is greater than angle of rest

109. **Assertion (A) :** In pulley design of flat belt drive, the cross-sections of arms are made elliptical with major axis lying in the plane of rotation.

Reason (R) : Arms of a pulley in belt drive are subjected to torsional shear stresses and are designed for torsion.

(A) Both (A) and (R) are individually true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are individually true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

110. Which of the following is an interference fit ?

(A) Push fit

(B) Running fit

(C) Sliding fit

(D) Shrink fit

111. The diameter of the manila and cotton ropes used for power transmission usually ranges from :

(A) 10-20 mm

(B) 15-25 mm

(C) 20-35 mm

(D) 38-50 mm

112. In heavy duty gear drives, heat treatment of gears is necessary to :

(A) Avoid interference

(B) Prevent noisy operation

(C) Minimize wear of gear tooth

(D) Provide resistance against impact loading on gear tooth

113. In three ball bearings indentified as **SKF 2015, 3115 and 4215** :

(A) Bore is common but width is increasing

(B) Outer diameter is common but bore is increasing

(C) Width is common but outer diameter is decreasing

(D) Bore is common but outer diameter is decreasing

114. A ball-bearing is characterized by basic static capacity = 11,000 N and dynamic capacity = 18,000 N. This bearing is subjected to equivalent static load = 5500 N. The bearing loading ratio and life in million revolutions respectively are :

(A) 3.27 and 52.0

(B) 3.27 and 35.0

(C) 2.00 and 10.1

(D) 1.60 and 4.1

115. Which bearing is preferred for oscillating conditions ?

(A) Double row roller bearing

(B) Angular contact single row ball bearing

(C) Taper roller bearing

(D) Needle roller bearing

116. A hydrodynamic slider bearing develops load bearing capacity mainly because of :

(A) Slider velocity

(B) Wedge shaped oil film

(C) Oil compressibility

(D) Oil viscosity

117. Consider the following statements in respect of flexible couplings :

(i) The flanges of flexible coupling are usually made of grey cast iron FG200.

(ii) In the analysis of flexible coupling, it is assumed that the power is transmitted by the shear resistance of the pins.

(iii) Rubber bushes with brass lining are provided to absorb misalignment between the two shafts.

Which of the statements given above are correct ?

(A) (i), (ii) and (iii)

(B) Only (i) and (ii)

(C) Only (ii) and (iii)

(D) Only (i) and (iii)

118. Splines are used when :

(A) Power to be transmitted is low

(B) High rotational speeds are involved

(C) High torque is to be transmitted

(D) There is need for axial relative motion between the shaft and hub

119. How can shock absorbing capacity of a bolt be increased ?

(A) By tightening it properly

(B) By increasing the shank diameter

(C) By grinding the shank

(D) By making the shank diameter equal to the core diameter of thread

120. Which of the following stresses are associated with the design of pins in bushed pin-type flexible coupling ?

(i) Bearing stress

(ii) Bending stress

(iii) Axial tensile stress

(iv) Transverse shear stress

Select the correct answer using the codes given below :

(A) (i), (iii) and (iv)

(B) (ii), (iii) and (iv)

(C) (i), (ii) and (iii)

(D) (i), (ii) and (iv)

121. Strain is defined as the ratio of :

(A) Change in volume to original volume

(B) Change in length to original length

(C) Change in cross-sectional area to original cross-sectional area

(D) Any one of these

122. If both the mean coil diameter and wire diameter of a helical compression or tension spring be doubled, then the deflection of the spring close coiled under same applied load will :

(A) Be doubled

(B) Be halved

(C) Increase four times

(D) Get reduced to one-fourth

123. Which one of the following statements is correct ? A beam is said to be of uniform strength, if :

(A) The bending moment is the same throughout the beam

(B) The shear stress is the same throughout the beam

(C) The deflection is the same throughout the beam

(D) The bending stress is the same at every section along its longitudinal axis

124. Two tapering bars of the material are subjected to a tensile load P. The lengths of both the bars are the same. The larger diameter of each of the bars is D. The diameter of the bar A at its smaller end is D/2 and that of the bar B is D/3. What is the ratio of elongation of the bar A to that of the bar B ?

(A) 3 : 2

(B) 2 : 3

(C) 4 : 9

(D) 1 : 3

125. In a homogenous, isotropic elastic material, the modulus of ealsticity E in terms of G and K is equal to :

(A) $\frac{G+3K}{9KG}$

(B) $\frac{3G+K}{9KG}$

(C) $\frac{9KG}{G+3K}$

(D) $\frac{9KG}{K+3G}$

126. If the value of Poisson's ratio is zero, then it means that :

(A) The material is rigid

(B) The material is perfectly plastic

(C) There is no longitudinal strain in the material

(D) The longitudinal strain in the material is infinite

127. Consider the following statements :

Thermal stress is induced in a component in general, when :

(i) A temperature gradient exists in the component

(ii) The component is free from any restraint

(iii) It is restrained to expand or contract freely

Which of the above statements are correct ?

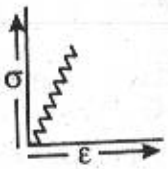
(A) (i) and (ii)

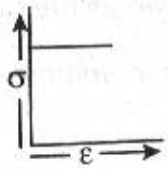
(B) (ii) and (iii)

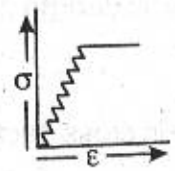
(C) (iii) alone

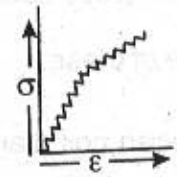
(D) (ii) alone

128. The stress-strain curve of an rigid-plastic material will be as :

(A) 

(B) 

(C) 

(D) 

129. The state of stress at a point under plane stress condition is $\sigma_{xx} = 40$ MPa, $\sigma_{yy} = 100$ MPa and $\tau_{xy} = 40$ MPa. The radius of the Mohr's circle representing the given state of stress in MPa is :

(A) 40

(B) 50

(C) 60

(D) 100

130. Mohr's circle for the state of stress defined by $\begin{bmatrix} 20 & 0 \\ 0 & 20 \end{bmatrix}$ is a circle with :

(A) Centre at (0, 0) and radius 20 MPa

(B) Centre at (0, 0) and radius 40 MPa

(C) Centre at (20, 0) and radius 20 MPa

(D) Centre at (20, 0) and zero radius

131. Polar moment of inertia (Ip), in cm^4, of a rectangular section having width, b = 2 cm and depth, d = 6 cm is :

(A) 40

(B) 20

(C) 8

(D) 80

132. Angle of twist of a shaft of diameter 'd' is inversely proportional to :

(A) d

(B) d^2

(C) d^3

(D) d^4

133. The point of contraflexure is a point where :

(A) Shear force changes sign

(B) Bending moment changes sign

(C) Shear force is maximun

(D) Bending moment is maximum

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

(A) 1

(B) 2/3

(C) 3/2

(D) 2

135. The nature of distribution of horizontal shear stress in a rectangular beam is :

(A) Linear

(B) Parabolic

(C) Hyperbolic

(D) Elliptic

136. In a cantilever beam, if the length is doubled while keeping the cross-section and the concentrated load acting at the free end the same, the deflection at the free end will increase by :

(A) 2.66 times

(B) 3 times

(C) 6 times

(D) 8 times

137. Pure bending means :

(A) The bending beam shall be accompanied by twisting

(B) Shear force is zero

(C) There is no twisting

(D) None of these

138. Which is the correct relation in a beam ?

(A) $\frac{M}{\sigma} = \frac{I}{y} = \frac{R}{E}$

(B) $\frac{M}{I} = \frac{y}{\sigma} = \frac{E}{R}$

(C) $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$

(D) $\frac{M}{y} = \frac{E}{R} = \frac{\sigma}{I}$

139. The point within the cross-sectional plane of a beam through which the resultant of the external loading on the beam has to pass through to ensure pure bending without twisting of the cross-section of the beam is called :

(A) Moment centre

(B) Centroid

(C) Shear center

(D) Elastic center

140. **Assertion (A) :** In a simply supported beam subjected to a concentrated load P at mid-span, the elastic curve slope becomes zero under the load.

Reason (R) : The deflection of the beam is maximum at mid-span.

(A) Both (A) and (R) are individually true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are individually true but (R) is NOT the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

141. The diameter of a shaft is increased from 30 mm to 60 mm, all other conditions remaining unchanged. How many times is its torque carrying capacity increased ?

(A) 2 times

(B) 4 times

(C) 8 times

(D) 16 times

142. A thin gas cylinder with an internal radius of 100 mm is subject to an internal pressure of 10 MPa. The maximum permissible working stress is restricted to 100 MPa. The minimum cylinder wall thickness (in mm) for safe design must be :

(A) 5

(B) 10

(C) 20

(D) 2

143. Which of the following is applied to brittle materials ?

(A) Maximum principal stress theory

(B) Maximum principal strain theory

(C) Maximum strain energy theory

(D) Maximum shear stress theory

144. Where does the maximum hoop stress in a thick cylinder under external pressure occur ?

(A) At the outer surface

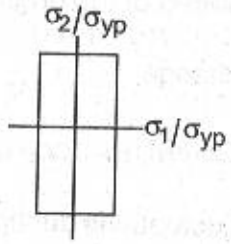
(B) At the inner surface

(C) At the mid-thickness

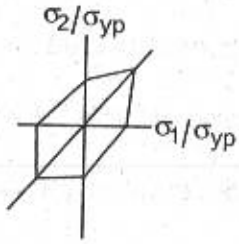
(D) At the 2/3rd outer radius

145. Which one of the following figures represents the maximum principal stress theory ?

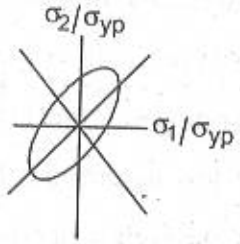
(A)



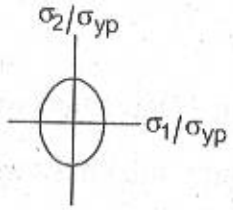
(B)



(C)



(D)



146. A uniformly distributed load ω(in kN/m) is acting over the entire length of a 3 m long cantilever beam. If the shear force at the midpoint of cantilever is 6 kN, what is the value of ω ?

(A) 2

(B) 3

(C) 4

(D) 5

147. Section modulus of a beam is defined as :

(A) Iy

(B) $\frac{y}{I}$

(C) $\frac{I}{y_{max}}$

(D) y^2I

148. If E = elasticity modulus, I = moment of inertia about the neutral axis and M = bending moment in pure bending under the symmetric loading of a beam, the radius of curvature of the beam :

(i) Increases with E

(ii) Increases with M

(iii) Decreases with I

(iv) Decreases with M

Which of these are correct ?

(A) (i) and (iii)

(B) (ii) and (iii)

(C) (iii) and (iv)

(D) (i) and (iv)

149. Hooke's law holds good up to :

(A) Yield point

(B) Limit of proportionality

(C) Breaking point

(D) Elastic limit

150. In a body, thermal stress is induced because of the existence of :

(A) Latent heat

(B) Total heat

(C) Temperature gradient

(D) Specific heat

151. Which of the following statement is correct ?

(A) Flywheel reduces speed fluctuations during a cycle for a constant load, but flywheel does not control the mean speed of the engine if the load changes.

(B) Flywheel does not reduce speed fluctuations during a cycle for a constant load, but flyweel does control the mean speed of the engine if the load changes.

(C) Governor control a speed fluctuations during a cycle for a constant load, but governor does not control the mean speed of the engine if the load change.

(D) Governor controls speed fluctuations during a cycle for a constant load, and governor also controls the mean speed of the engine if the load changes.

152. **Assertion (A)** : The Ackermann steering gear is commonly used in all automobiles.

Reason (R) : It has the correct inner turning angle for all positions.

(A) Both (A) and (R) are individually true and (R) is not the correct explanation of (A).

(B) Both (A) and (R) are individually true but (R) is not the correct explanaiton of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

153. Sensitiveness of a governor is defined as :

(A) $\frac{Range\ of\ speed}{2 \times Mean\ speed}$

(B) $\frac{2 \times Mean\ speed}{Range\ of\ speed}$

(C) $Mean\ speed \times Range\ of\ speed$

(D) $\frac{Range\ of\ speed}{Mean\ speed}$

154. For a given lift of the follower in a given angular motion of the cam, the acceleration/retardation of the follower will be the least when the profile of the cam during the rise portion is :

(A) Such that the follower motion is simple harmonic

(B) Such that the follower motion has a constant velocity from start to end

(C) A straight line, it being a tangent cam

(D) Such that the follower velocity increases linearly for half the rise portion and then decreases linearly for the remaining half of the rise portion

155. What is the number of nodes in a shaft carrying three rotors ?

(A) Zero

(B) 2

(C) 3

(D) 4

156. The turning moment diagram for a single cylinder double acting steam engine consists of +ve and –ve loops above and below the average torque line. For the +ve loop, the ratio of the speeds of the flywheel at the beginning and the end is which one of the following ?

(A) Less than unity

(B) Equal to unity

(C) Greater than unity

(D) Zero

157. The equation of free vibrations of a system is $\ddot{x} + 36\pi^2 x = 0$. Its natural frequency is :

(A) 6 Hz

(B) 3π Hz

(C) 3 Hz

(D) 6π Hz

158. Match the following :

Type of gears	Arrangement of shafts
(P) Bevel gears	(I) Non-parallel offset shafts
(Q) Worm gears	(II) Non-parallel intersecting shafts
(R) Herringbone gears	(III) None-parallel non-intersecting shafts
(S) Hypoid gears	(IV) Parallel shafts

(A) P – IV, Q – II, R – I, S – III

(B) P – II, Q – III, R – IV, S – I

(C) P – III, Q – II, R – I, S – IV

(D) P – I, Q – III, R – IV, S – II

159. In meshing gears with involute gears teeth, the contact begins at the intersection of the :

(A) Line of action and the addendum circle of the driven gear

(B) Line of action and the pitch circle of the driven gear

(C) Dedendum circle of the driver gear and the addendum circle of the driven gear

(D) Addendum circle of the driver gear and the pitch circle of the driven gear

160. In which of the following case, the turning moment diagram will have least variations ?

(A) Double acting steam engine

(B) Four stroke single cylinder petrol engine

(C) 8 cylinder, 4 stroke diesel engine

(D) Pelton wheel

161. The mechanism used in a shaping machine is :

(A) A closed 4-bar chain having 4 revolute pairs

(B) A closed 6-bar chain having 6 revolute pairs

(C) A closed 4-bar chain having 2 revolute and 2 sliding pairs

(D) An inversion of the single slider-crank chain

162. In a four-bar linkage, S denotes the shortest link length, L is the longest link length, P and Q are the lengths of other two links. At least one of the three moving links will rotate by 360° if :

(A) $S + L \leq P + Q$

(B) $S + L > P + Q$

(C) $S + P \geq L + Q$

(D) $S + P > L + Q$

163. When a cylinder is located in a Vee-block, then number of degrees of freedom which are arrested is :

(A) 2

(B) 4

(C) 7

(D) 8

164. In a single slider four-bar linkage, when the slider is fixed, it forms a mechanism of :

(A) Hand pump

(B) Reciprocating engine

(C) Quick return

(D) Oscillating cylinder

165. A system has viscous damped output. There is no steady-state lag if input is :

(A) Unit step displacement

(B) Step velocity

(C) Harmonic

(D) Step velocity with error-rate damping

166. The balancing weights are introduced in planes parallel to the plane of rotation of the disturbing mass. To obtain complete dynamic balance, the minimum number of balancing weights to be introduced in different planes is :

(A) 1

(B) 2

(C) 3

(D) 4

167. For a governor running at constant speed, what is the value of the force acting on the sleeve ?

(A) Zero

(B) Variable depending upon the load

(C) Maximum

(D) Minimum

168. Match the following :

Column – I	Column – II
(P) Higher Kinematic pair	(I) Grubler's equation
(Q) Lower Kinematic pair	(II) Line contact
(R) Quick return mechanism	(III) Euler's equation
(S) Mobility of a linkage	(IV) Planer
	(V) Shaper
	(VI) Surface contact

(A) P – II, Q – VI, R – IV, S – III

(B) P – VI, Q – II, R – IV, S – I

(C) P – VI, Q – II, R – V, S – III

(D) P – II, Q – VI, R – V, S – I

169. A planar mechanism has 8 links and 10 rotary joints. The number of degrees of freedom of the mechanism, using Grubler's criterion, is :

(A) 0

(B) 1

(C) 2

(D) 3

170. The coupling used to connect two shafts with large angular misalignment is :

(A) A Flange coupling

(B) An Oldham's coupling

(C) A Flexible bush coupling

(D) A Hooker's joint

171. In automobiles, Hook's joint is used between which of the following ?

(A) Clutch and gear box

(B) Gear box and differential

(C) Differential and wheels

(D) Flywheel and clutch

172. In case of partial balancing of single-cylinder reciprocating engine, what is the primary disturbing force along the line of stroke ?

(A) $cmr\omega^2 \cos\theta$

(B) $(1-c^2)mr\omega^2 \cos\theta$

(C) $(1-c)mr\omega^2 \cos\theta$

(D) $(1-c)mr\omega^2 \cos 2\theta$

173. The undamped natural frequency of oscillations of the bar about the hinge point is :

(A) 42.43 rad/s

(B) 30 rad/s

(C) 17.32 rad/s

(D) 14.14 rad/s

174. The 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

175. In involute gears the pressure angle is :

(A) Dependent on the size of teeth

(B) Dependent on the size of gears

(C) Always constant

(D) Always variable

176. When the speed of the engine fluctuates continuously above and below the mean speed, then the governor is said to be :

(A) Stable

(B) Unstable

(C) Isochronous

(D) Hunt

177. In a radial cam, the follower moves :

(A) In a direction perpendicular to the cam axis

(B) In a direction parallel to the cam axis

(C) In any direction irrespective of the cam axis

(D) Along the cam axis

178. The retardation of a flat faced follower when it has contact at the apex of the nose of a circular arm cam, is given by :

(A) $\omega^2 \times OQ$

(B) $\omega^2 \times OQ \sin \theta$

(C) $\omega^2 \times OQ \cos \theta$

(D) $\omega^2 \times OQ \tan \theta$

where OQ = Distance between the centre of circular flank and centre of nose.

179. The efficiency of a screw jack is maximum, when :

(A) $\alpha = 45° + \frac{\phi}{2}$

(B) $\alpha = 45° - \frac{\phi}{2}$

(C) $\alpha = 90° + \phi$

(D) $\alpha = 90° - \phi$

180. Scotch yoke mechanism is used to generate :

(A) Sine functions

(B) Square roots

(C) Logarithms

(D) Inversions

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