MECHANICAL ENGINEERING

PAPER-II

1. A new facility has to be designed to do all the welding for 3 products: A, B and C. Per unit welding time for each product is 20 s, 40 s and 50 s respectively. Daily demand forecast for product A is 450, for B is 360 and for C is 240. A welding line can operate efficiently for 220 minutes a day. Number of welding lines required is
   a. 5
   b. 4
   c. 3
   d. 2

2. Consider the following statements:
   Control chart for variables provides the
   1. basic variability of the quality characteristic.
   2. consistency of performance.
   3. number of products falling outside the tolerance limits.

   Which of these statements are correct?
   a. 1, 2 and 3
   b. 1 and 2
   c. 2 and 3
   d. 1 and 3

3. Match List I with List II and select the correct answer:

   List I (OR- technique)
   A. Branch and Bound technique
   B. Expected value approach
   C. Smoothing and Levelling
   D. Exponential distribution

   List II (Model)
   1. PERT and CPM
   2. Integer programming
   3. Queuing theory
   4. Decision theory

	A	B	C	D
a.	2	1	4	3
b.	2	4	1	3
c.	3	4	1	2
d.	3	1	4	2

4. Match List I with List II and select the correct answer :

   List I
   A. Decision making under complete certainty
   B. Decision making under risk
   C. Decision making under complete uncertainty
   D. Decision making based on expert opinion

   List II
   1. Delphi approach
   2. Maximax criterion
   3. Transportation model
   4. Decision tree

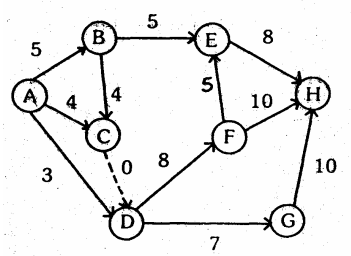
	A	B	C	D
a.	3	4	1	2
b.	4	3	2	1
c.	3	4	2	1
d.	4	3	1	2

5. During manufacture of cement, the handling of limestone is done by
   a. belt conveyor
   b. bucket conveyor
   c. overhead crane
   d. fork-lift crane

6. Consider the following statements regarding linear programming:
   1. Dual of a dual is the primal.
   2. When two minimum ratios of the right-hand side to the coefficient in the key column are equal, degeneracy may take place.
   3. When an artificial variable leaves the basis, its column can be deleted from he subsequent Simplex tables.

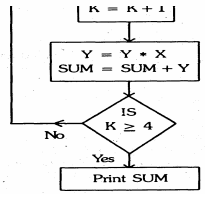
   Select the correct answer from the codes given below:
   a. 1, 2 and 3
   b. 1 and 2
   c. 2 and 3
   d. 1 and 3

7. Latest start time of an activity in CPM is the
   a. latest occurrence time of the successor event minus the duration of the activity
   b. earliest occurrence time for the predecessor event plus the duration of the activity
   c. latest occurrence time of the successor event
   d. earliest occurrence time for the predecessor event

8. 

For the network shown in the given figure, the earliest expected completion time of the project is
   a. 26 days
   b. 27 days
   c. 30 days
   d. indeterminable

9. Arrivals at a telephone booth are considered to be according to Poisson distribution, with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean of 3 minutes. The probability that a person arriving at the booth will have to wait, is
   a. 3/10
   b. 7/10
   c. 7/30
   d. 13/30

10. 

For the given flowchart, if input X = 3, then the printed value of SUM is
   a. 12
   b. 39
   c. 120
   d. 363

11. Which of the following hand-motion belongs to Therbligs' in motion study ?
   1. Unavoidable delay
   2. a Pre-position
   3. Select
   4. Reach

Select the correct answer using the codes given below :
   a. 1 and 4
   b. 1 and 2
   c. 1, 2 and 3
   d. 2, 3 and 4

12. Which one of the following combinations is valid for product layout?
   a. General purpose machine and skilled labour
   b. General purpose machine and unskilled labour
   c. Special purpose machine and semiskilled labour
   d. Special purpose machine and skilled labour

13. Match List I with List II and select the correct answer:

List I

A. OC curve
B. AOQL
C. Binomial distribution
D. Normal curve

List II

1. Acceptance sampling
2. Dodge Romig table
3. p-charts
4. Control charts for variables

	A	B	C	D
a.	1	2	3	4
b.	1	3	2	4
c.	4	2	3	1
d.	4	3	2	1

14. Dispatching function of production, planning & control is
   a. the dispatch of finished goods on order

b. the movement of in-process material from shop to shop
c. authorising a production work order to be launched
d. the dispatch of bills and invoice to the customers

15. Match List I with List II and select the correct answer:

List I (Charts)

A. Standard process Sheet
B. Multiple activity chart
C. Right and left hand operation chart
D. SIMO chart

List II (Operations/Informations)

1. Operations involving assembly and inspection without machine
2. Operations involving the combination of men and machines
3. Work measurement
4. Basic information for routing Therbligs

	A	B	C	D
a.	4	3	1	2
b.	1	2	4	5
c.	1	3	4	2
d.	4	2	1	5

16. If α is the rake angle of the cutting tool, ϕ is the shear angle and V is the cutting velocity, then the velocity of chip sliding along the shear plane is given by

a. $\frac{V\cos\alpha}{\cos(\phi-\alpha)}$

b. $\frac{V\sin\alpha}{\cos(\phi-\alpha)}$

c. $\frac{V\cos\alpha}{\sin(\phi-\alpha)}$

d. $\frac{V\sin\alpha}{\sin(\phi-\alpha)}$

17. Match List I with List II and select the correct answer :

List I (Cutting Tools)

A. Trepanning tool
B. Side milling cutter
C. Hob cutter
D. Abrasive sticks

List II (Applications)

1. For surface finishing by honing
2. for machining gears
3. For cutting keyways in shafts
4. For drilling large diameter holes

	A	B	C	D
a.	1	3	2	4
b.	4	3	2	1
c.	1	2	3	4
d.	4	2	3	1

18. Dry and compressed air is used as cutting fluid for machining

a. steel
b. aluminium
c. cast iron
d. brass

19. For cutting of brass with single-point cutting tool on a lathe, tool should have

a. Negative rake angle
b. positive rake angle
c. zero rake angle
d. zero side relief angle

20. Power consumption in metal cutting is mainly due to

a. tangential component of the force
b. longitudinal component of the force
c. normal component of the force
d. friction at the metal-toot interface

21. In a shaper machine, the mechanism for tool feed is

a. Geneva mechanism
b. Whitworth mechanism
c. Ratchet and Pawl mechanism
d. Ward-Leonard system

22. Match List I with List II and select The correct answer:

List I (Components)

A. Car body (metal)
B. Clutch lining
C. Gears
D. Engine block

List II (Manufacturing Processes)

1. Machining
2. Casting
3. Sheetmetal pressing
4. powder metallurgy

	A	B	C	D
a.	3	4	2	1
b.	4	3	1	2
c.	4	3	2	1
d.	3	4	1	2

23. The marking on a grinding wheel is '51 A 36' L 5 V 93'. The code '36' represents the
    a. Structure
    b. Grade
    c. Gain size
    d. Manufacturer's number
24. In the forging operation, fullering is done to
    a. draw out the, material
    b. bend the material
    c. upset the material
    d. extrude the material
25. The main purpose of chaplets is
    a. to ensure directional solidification
    b. to provide efficient venting
    c. for aligning the mold boxes
    d. to support the cores
26. Scrab is a
    a. sand casting defect
    b. maching defect
    c. welding defect
    d. forging defect
27. Specific cutting energy is more in grinding process compared to turning because
    a. grinding (cutting) speed is higher
    b. the wheel has multiple cutting edges (grains)
    c. ploughing force is significant due to small chip size
    d. grinding wheel undergoes continuous wear
28. The maximum heat in resistance, welding is at the
    a. tip of the positive electrode
    b. tip of the negative electrode
    c. top surface of the plate at the time of electric contact with the electrode
    d. interface between the two plates being joined
29. Arc blow is more common in
    a. a.c. welding
    b. d.c. welding with straight polarity
    c. d.c. welding with bare electrodes
    d. a.c. welding with bare electrodes
30. Pinch effect in welding is the result of
    a. expansion of gases in the arc
    b. electromagnetic forces
    c. electric force
    d. surface tension of the molten metal
31. In manual arc welding, the equipment should have drooping characteristics in order to maintain the
    a. voltage constant when arc length changes
    b. current constant when arc length changes
    c. temperature in the arc constant
    d. weld pool red-hot
32. In arc welding, dc. reverse polarity is used to bear greater advantage in
    a. overhead welding
    b. flat welding of lap joints
    c. edge welding
    d. flat welding of butt joints
33. Which of the following assumptions are correct for cold rolling ?
    1. The material is plastic.
    2. The arc of contact is circular with a radius greater than the radius of the roll.
    3. Coefficient of friction is contact over the arc of contact and acts in one direction throughout the arc of contact.

    Select the correct answer using the codes given below:
    a. 1 and 2
    b. 1 and 3
    c. 2 and 3
    d. 1, 2 and 3
34. A strip is to be rolled from a thickness of 30 mm to 15 mm using a two-high mill having rolls of diameter 300 mm. The coefficient of friction for unaided bite should nearly be
    a. 0.35
    b. 0.5
    c. 0.25
    d. 0.07
35. Which of the following statements are the salient features of hydrostatic extrusion?
    1. It is suitable for soft and ductile material.
    2. It is suitable for high-strength super-alloys
    3. The billet is inserted into the extrusion chamber and pressure is applied by a ram to extrude the ballet through the die.

4. The billet is inserted into the extrusion chamber where it is surrounded by suitable liquid. The billet is extruded through the die by aping pressure to the liquid.

Select the correct answer using tie codes given below:

a. 1 and 3
b. 1 and 4
c. 2 and 3
d. 2 and 4

36. The spindle speed range in a general-purpose lathe is divided info steps which approximately follow
a. arithmetic progression
b. geometric progression
c. harmonic progression
d. logarithmic progression

37. The Indexing of the turret in a single spindle automatic lathe as done using
a. Geneva mechanism
b. Ratchet and Pawl mechanism
c. Rack and pinion mechanism
d. Whitworth mechanism

38. Martensite is a super-saturated solution of carbon in
a. alpha iron
b. beta iron
c. gamma iron
d. delta iron

39. Which one of the following sets of elements are quick-acting clamping elements for fixtures?
a. Wedge and Cam
b. Cam and Toggle
c. Toggle and Wedge
d. Wedge, Cam and toggle

40. The correct sequence of creep deformation in a creep curve in order of their elongation is
a. steady state, transient, accelerated
b. transient, steady state, accelerated
c. transient, accelerated, steady state
d. accelerated, steady state, transient

41. Oxyacetylene reducing flame is used while carrying out the welding on
a. mild steel
b. high carbon steel
c. grey cast iron
d. alloy steels

42. For the same internal diameter, wall thickness, material and internal pressure, the ratio of maximum stress, induced in a thin cylindrical and in a thin spherical pressure vessel will be
a. 2
b. 1/2
c. 4
d. 1/4

43. Nodular grey cast iron is obtained from the grey cast iron by adding a small amount of
a. Manganese
b. Phosphorus
c. Magnesium
d. Chromium

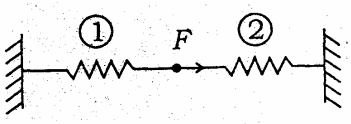
44. Wire diameter, mean coil diameter and number of turns of a closely-coiled steel spring are d, D and N respectively and stiffness of the spring is K. A second spring is made of same steel but with wire diameter, mean coil diameter and number of turns 2d, 2D and 2N respectively. The stiffness of the new spring is
a. K
b. 2K
c. 4K
d. 8K

45. Which one of the following pairs of axis lengths (a, b, c) and interaxial angles (α,β,γ) represents the tetragonal crystal system ?
a. $a = b = c$; $\alpha = \beta = \gamma = 90^o$
b. $a = b \neq c$; $\alpha = \beta = \gamma = 90^o$
c. $a \neq b \neq c$; $\alpha = \beta = \gamma = 90^o$
d. $a = b = c$; $\alpha = \beta = \gamma \neq 90^o$

46. Consider the following quenching media :
1. Oil
2. Water
3. Water + NaOH
4. Brine

The correct sequence of these media in order of increasing hardness of steel undergoing heat treatment is
a. 1, 3, 2, 4
b. 2, 1, 3, 4
c. 1, 2, 3, 4
d. 4, 3, 2, 1

47. Two identical springs labelled as ① and ② are arranged in series and subjected to force F as shown in the given figure



Assume that each spring constant is K. The strain energy stored in spring ① is

a. $F^2/2K$
b. $F^2/4K$
c. $F^2/8K$
d. $F^2/16K$

48. A rod having cross-sectional area 100×10^{-6} m^2 is subjected to a tensile load. Based on the Tresca failure criterion, if the uniaxial yield stress of the material is 200 MPa, the failure load is

a. 10 kN
b. 20 kN
c. 100 kN
d. 200 kN

49. If diameter of a long column is reduced by 20%, the percentage of reduction in Euler buckling load is

a. 4
b. 36
c. 49
d. 59

50. With one fixed end and other free end, a column of length L buckles at load P_1. Mother column of same length and same cross-section fixed at both ends buckles Vat load P_2. The ratio of P_2/P_1 is

a. 1
b. 2
c. 4
d. 16

51. In a two-dimensional problem, the state of pure shear at a point is characterized by

a. $\varepsilon_x = \varepsilon_y$ and $\gamma_{xy} = 0$
b. $\varepsilon_x = -\varepsilon_y$ and $\gamma_{xy} \neq 0$
c. $\varepsilon_x = 2\varepsilon_y$ and $\gamma_{xy} \neq 0$
d. $\varepsilon_x = 0.5\ \varepsilon_y$ and $\gamma_{xy} = 0$

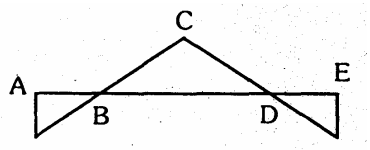
52. The principal stresses σ_1 , σ_2 and σ_3 at a point respectively are 80 MPa, 30 MPa and —40 MPa. The maximum shear stress is

a. 25 MPa
b. 35 MPa
c. 55 MPa
d. 60 MPa

53. The Poisson's ratio of a material which has Young's modulus of 120 GPa and shear modulus of 50 GPa, is

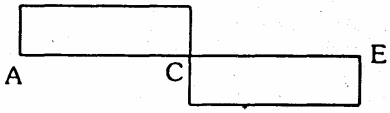
a. 0.1
b. 0.2
c. 0.3
d. 0.4

54. Bending moment distribution in a built beam is shown in the given figure

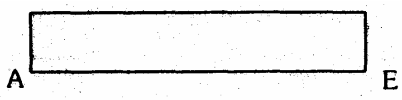


The shear force distribution in the beam is represented by

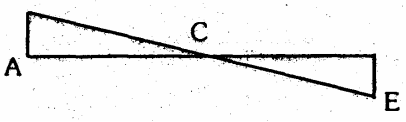
a.



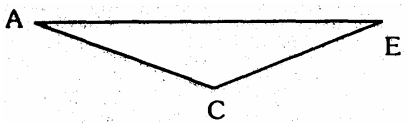
b.



c.



d.



55. A thick cylinder is subjected to internal pressure of 100 N/mm^2. If hoop stress developed at the outer radius of the cylinder is N/mm^2, the hoop stress developed at the inner radius is

a. 100 N/mm^2
b. 200 N/mm^2
c. 300 N/mm^2
d. 400 N/mm^2

56. The outside diameter of a hollow shaft is twice that of its inside diameter. The torque-carrying capacity of this shaft is Mt_1. A solid shaft of the same material has the diameter equal to the outside diameter of the hollow shaft. The solid shaft can

carry a torque of Mt_2. The ratio Mt_1 / Mt_2 is

a. 15/16
b. 3/4
c. 1/2
d. 1/16

57. Which one of the following pairs is correctly matched?

a. Solid solution strengthening : Increasing density of dislocations
b. Dispersion-hardening : Creating strained region in the crystal
c. Strain-hardening : Creating particles to resist the movement of dislocations
d. Precipitation-hardening : Creating particles by decreasing solubility of one phase in another

58. The alloy steel designed as 40 Cr 18 Ni 2 by Bureau of Indian Standard contains

a. 0.4% C, 18% Cr and 2% Ni
b. 4.0% C, 1.8% Cr and 0.2% Ni
c. 0.4% C, 1.8% Cr and 2% Ni
d. 0.4% C, 1.8% Cr and 0.2% Ni

59. Tempering' of quenched martensitic steel is necessary to improve the

a. hardness of the metal
b. surface texture of the metal
c. corrosion resistance of the metal
d. ductility of the metal

60. The molecular weight of vinyl chloride is 62.5. Thus the molecular weight of a polyvinyl chloride with a degree of polymerisation of 20000 is

a. 20000/62.5
b. 62.5/20000
c. 62.5 × 20000
d. 20000

61. Carbide-tipped cuttin tools are manufactured by powder-metal technology process and have a composition of

a. Zirconium-Tungsten (35%-65%)
b. Tungsten carbide-Cobalt (90% - 10%)
c. Aluminium oxide-Silica (70%-30%)
d. Nickel-Chromium-Tungsten (30% - 15% - 55%)

62. Match List I (Name of the Element) with list II (Crystal Structure) and select the correct answer :

List I

A. Fluorspar
B. Alpha-Iron
C. Silver
D. Zinc

List II

1. Body-centered cubic
2. Hexagonal close packed
3. Simple cubic
4. Face-centered cubic

	A	B	C	D
a.	3	2	4	1
b.	4	1	3	2
c.	4	2	3	1
d.	3	1	4	2

63. Which of the following factors govern solubility of two non-ferrous metals both in liquid state, as well as in solid state?

1. Crystal structure
2. Relative size factor
3. Chemical-affinity factor
4. Relative valence factor

Select the correct answer using the codes given below:

a. 1, 2 and 3
b. 2, 3 and 4
c. 1 and 4
d. 1, 2, 3 arid 4

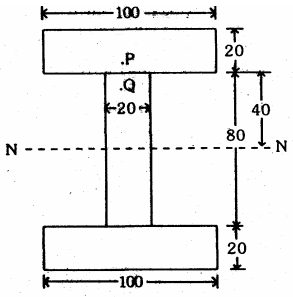
64. A body having weight of 1000 N is dropped from a height of 10 cm over a close-coiled helical spring of stiffness 200 N/cm. The resulting deflection of spring is nearly

a. 5 cm
b. 16 cm
c. 35 cm
d. 100 cm

65. The diameter of shaft A is twice the diameter of shaft B and both are made of the same material. Assuming both the shafts to rotate at the same speed, the maximum power transmitted by B is

a. the same as that of A
b. half of A
c. 1/8 th of A
d. 1/4 th of A

66. The given figure (all dimensions are in mm) shows an I-section of the beam



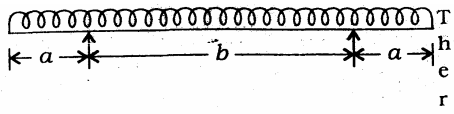
The shear stress at point P (very close to the bottom of the flange) is 12 MPa. The stress at point Q in the web (very close to the flange) is

a. indeterminable due to incomplete data
b. 60 MPa
c. 18 MPa
d. 12 MPa

67. A close-coiled helical spring is made of 5 mm diameter wire coiled to 50 mm mean diameter. Maximum shear stress in the spring under the action of an axial force is 20 N/mm^2. The maximum shear stress in a spring made of 3 mm diameter wire coiled to 30 mm mean diameters under the action of the same force will be nearly

a. 20 N/mm^2
b. 33.3 N/mm^2
c. 55.6 N/mm^2
d. 92.6 N/mm^2

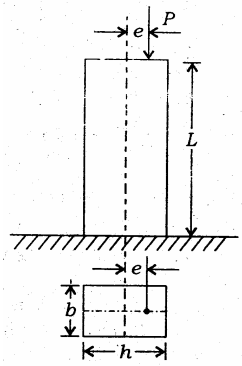
68. A horizontal beam carrying uniformly distributed load is supported with equal overhangs as shown in the given figure



resultant bending moment at the mid-span shell be zero if a/b is

a. 3/4
b. 2/3
c. 1/2
d. 1/3

69. A short column of symmetric cross-section made of symmetric cross-section made of a brittle material is subjected to an eccentric vertical load P at an eccentricity e. To avoid tensile stress in the short co1umn the eccentricity e should be less than or equal to



a. h/12
b. h/6
c. h/3
d. h/2

70. A thin cylindrical shell is subjected to internal pressure p. The Poisson's ratio of the material of the shell is 0.3. Due to tntem1 pressure the shell is subjected to circumferential strain and axial strain. The ratio of circumferential strain to axial strain is

a. 0.425
b. 2.25
c. 0.225
d. 4.25

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

a. $WL^2/2EI$
b. $WL^2/4EI$
c. $WL^2/8EI$
d. $WL^2/16EI$

72. When the intensity of pressure is uniform in a flat pivot bearing of radius r, the friction force is assumed to act at

a. R
b. r/2
c. 2r/3
d. r/3

73. Consider a harmonic motion x = 1.25 sin (5t – π/6) cm. Match List I with List II and select the correct answer ?

List I

A. Amplitude (cm)
B. Frequency (cycle/s)
C. Phase angle (rad)
D. Time period (s)

List II

1. 5/2π
2. 1.25
3. 1/5

4. π/6

	A	B	C	D
a.	4	1	2	3
b.	2	3	4	1
c.	4	3	2	1
d.	2	1	4	3

74. Which of the following pairs of devices and their functions are correctly matches ?
1. Flywheel : For storing kinetic energy
2. Governors : For controlling speeds
3. Lead screw in lathe : For providing feed to the slides
4. Fixtures : For locating workpiece and guiding tools

Select the correct answer using the codes given below:
a. 1, 3 and 4
b. 2 and 3
c. 1 and 2
d. 2 and 4

75. Match List I with List II and select the correct answer:
(Notations have their usual meanings)
List I
A. Law of correct steering
B. Displacement relation of Hooke's joint
C. Relation between kinematic pairs and links
D. Displacement equation of reciprocating engine piston

	A	B	C	D
a.	1	4	3	2
b.	1	2	3	4
c.	3	4	1	2
d.	3	2	1	4

76. Force required to accelerate a cylindrical body which rolls without slipping on a horizontal plane (mass of cylindrical body is m, radius of the cylindrical surface in contact with plane is r, radius of gyration of body is k and acceleration of the body is a is
a. $m\,(k^2/r^2 + 1).\,a$
b. $(mk^2 / r^2)\,.\,a$
c. $mk^2\,.\,a$
d. $(mk^2 / r + 1).\,a$

77. Consider the following statements regarding motions in machines:
1. Tangential acceleration is a function of angular velocity and the radial acceleration is a function of angular acceleration.
2. The resultant acceleration of a point A with respect to a point B on a rotating link is perpendicular to AB.
3. The direction of the relative velocity of a point A with respect to a point B on a rotating link is perpendicular to AB.

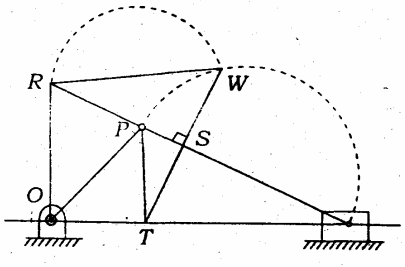
Which f these statements is/ate correct?
a. 1 alone
b. 2 and 3
c. 1 and 2
d. 3 alone

78. Consider the following statements :
In petrol engine mechanism, the piston at its dead centre position when piston
1. acceleration is zero.
2. acceleration is maximum.
3. velocity is zero.
4. velocity is infinity.

Which of these statements are correct?
a. 1 and 4
b. 1 and 3
c. 2 and 3
d. 2 and 4

79. The speed of driving shaft of a Hooke's joint of angle 19.5^0 (given sin 19.5° = .33, cos 19.5° = 9.4) is 500 r.p.m. The maximum speed of the driving shaft is nearly
a. 168 r.p.m.
b. 444 r.p.m.
c. 471 r.p.m.
d. 531 r.p.m.

80. The given figure shows the Klein's construction for acceleration of the slider-crank mechanism



Which one of the following quadrilaterals represents the required acceleration diagram?
a. ORST

b. OPST
c. ORWT
d. ORPT

81. The spigot of a cotter joint has a diameter of D and carries a slot for cotter. The permissible crushing stress is x times the permissible tensile stress for the material of spigot where x > 1. The joint carries an axial load P. Which one of the following equations will give the diameter of the spigot?

a. $D = 2\sqrt{\frac{P}{\pi\sigma_t}\frac{x-1}{x}}$

b. $D = 2\sqrt{\frac{P}{\pi\sigma_t}\frac{x+1}{x}}$

c. $D = \frac{2}{\pi}\sqrt{\frac{P}{\sigma_t}\frac{x+1}{x}}$

d. $D = \frac{2P}{\pi\sigma_t}\sqrt{x+1}$

82. The screw and nut in a broaching machine are changed from square thread to Acme thread. The power requirement of the machine at the same r.p.m. will
a. remain same
b. decrease
c. increase
d. depend on the operator

83. The creep in a belt drive is due to the
a. material of the pulleys
b. material of the belt
c. unequal size of the pulleys
d. unequal tension on tight and slack sides of the belt

84. The designation 6 × 7 of a wire rope means
a. 6 wires
b. 7 wires
c. 13 wires
d. 42 wires

85. A servomotor is connected through a gear ratio of 10 (i.e. motor speed: load side speed = 10 : 1) to a load having moment of inertia J. The equivalent parameter referred to motor shaft side is
a. j_{eq} = 0.01 J
b. J_{eq} = 10 J
c. J_{eq} = 0.1 J
d. J_{eq} = 100J

86. Match List I with List II and select the correct answer :

List I

A. Cam and follower
B. Screw pair
C. 4-bar mechanism
D. Degree of freedom of planar mechanism

List II

1. Grubler's rule
2. Grashof's linkage
3. Pressure angle
4. Single degree of freedom

	A	B	C	D
a.	3	4	2	1
b.	1	2	4	3
c.	1	4	2	3
d.	3	2	4	1

87. Consider the following statements :-

When two gears are meshing, the clearance is given by the

1. difference between dedendum of one gear and addendum of the mating gear.
2. difference between total and the working depth of a gear tooth.
3. distance between the bottom land of one gear and the top land of the mating gear.
4. difference between the radii of the base circle and the dedendum circle.

Which of these statements are correct?
a. 1, 2 and 3
b. 2, 3 and 4
c. 1, 3 and 4
d. 1, 2 and 4

88. A body of mass m and radius of gyration k is to be replaced by two mass m_1 and m_2 located at distances h_1 and h_2 from the CO of the origina1 body. An equivalent dynamic system will result, if
a. $h_1 + h_2 = k$
b. $h_1^2 + h_2^2 = k^2$
c. $h_1h_2 = k^2$
d. $\sqrt{h_1h_2} = k^2$

89. Match list I with List II and select the correct answer:

List I

A. Undercutting
B. Addendum
C. Lewis equation
D. Worm and wheel

List II

1. Beam strength
2. Interference
3. Large speed reduction
4. Intersecting axes
5. Module

	A	B	C	D
a.	2	5	1	3
b.	1	5	4	3
c.	1	3	4	5
d.	2	3	1	5

90. The natural frequency of transverse vibration of a mass-less beam of length L having a mass m attached at its midspan is given by (EI is the flexural rigidity of the beam)

a. $\left(\frac{mL^3}{48EI}\right)^{\frac{1}{2}}$ rad/s

b. $\left(\frac{48mL^3}{EI}\right)^{\frac{1}{2}}$ rad/s

c. $\left(\frac{48EL}{mL^3}\right)^{\frac{1}{2}}$ rad/s

d. $\left(\frac{3EL}{mL^3}\right)^{\frac{1}{2}}$ rad/s

91. A ball-bearing is characterized by basic static capacity = 11000 N and dynamic capacity = 18000 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

92. Match List I with List II and select the correct answer

List I

A. 6 d.o.f. system
B. 1 d.o.f. system
C. 2 d.o.f. system
D. Multi d.o.f. system

List II

1. Vibrating beam
2. Vibration absorber
3. A rigid body in space
4. Pure rolling of a cylinder

	A	B	C	D
a.	1	2	4	3
b.	1	4	2	3
c.	3	2	4	1
d.	3	4	2	1

93. A shaft carries a weight W at the centre. The CG of the weight is displaced by an amount e from the axis of the rotation. If y is the additional displacement of the CG from the axis of rotation due to the centrifugal force, then the ratio of y to e (where ω_c the critical speed of Shaft and ω is the angular speed of shaft) is given by

a. $\frac{1}{\left[\frac{\omega_c}{\omega}\right]^2+1}$

b. $\frac{1}{\left[\frac{\omega_c}{\omega}\right]^2-1}$

c. $\left[\frac{\omega_c}{\omega}\right]^2+1$

d. $\frac{\omega}{\left[\frac{\omega_c}{\omega}\right]^2-1}$

94. In a simple gear train, if the number of idler gears is odd, then the direction of motion of driven gear will

a. be same as that of the driving gear
b. be opposite to that of the driving gear
c. depend upon the number of teeth on the driving gear
d. depend upon the total number of teeth on all gears of the train

95. When a vehicle travels on a rough road whose undulations can be assumed to be sinusoidal, the resonant conditions of the

base-excited vibrations, are determined by the

a. mass of the vehicle stiffness of the suspension spring, speed of the vehicle, wavelength of the roughness curve
b. speed of the vehicle only
c. speed of the vehicle and the stiffness of the suspension spring
d. amplitude of the undulations

96. During torsional vibration of a shaft, the node is characterized by the

a. maximum angular velocity
b. maximum angular displacement
c. maximum angular acceleration
d. zero angular displacement

97. Match List I (Bearings) with List II (Applications) and select the correct answer :

List I

A. Cylindrical roller
B. Ball-bearing
C. Taper rolling bearing
D. Angular contact ball-bearing

List II

1. Radial loads
2. Machine needs frequent dismantling and assembling
3. Radial loads with lesser thrust
4. Shock loads
5. Axial expansion of shaft due to rise in temperature

	A	B	C	D
a.	4	3	1	5
b.	1	3	2	5
c.	4	1	2	3
d.	5	4	1	3

98. A system has viscous damped output. There is not steady- state lag if input is

a. unit step displacement
b. step velocity
c. harmonic
d. step velocity with error-rate damping

99. A motor car has wheel base of 280 cm and the pivot distance of front stub axles is 140 cm. When the outer wheel has turned through 30°, the angle of the turn of the inner front wheel for correct steering will be

a. 60^0
b. $\cot^{-1} 2.23$
c. $\cot^{-1} 1.23$
d. 30^0

100. Match list I (Properties) with list II (Units) and select the correct answer:

List I

A. Dynamic viscosity
B. Kinematic viscosity
C. Torsional stiffness
D. Modulus of rigidity

List II

1. Pa
2. m^2/ s
3. $N s / m^2$
4. Nm
5. N/m

	A	B	C	D
a.	3	2	4	1
b.	5	2	4	3
c.	3	4	2	3
d.	5	4	2	1

101. In a multi-plate clutch with n_o number of outer discs and n_i number of inner discs, the number of pairs of active surfaces is

a. $n_i + n_o$
b. $n_i + n_o + 1$
c. $n_i + n_o – 1$
d. $n_i + n_o – 2$

102. A full journal bearing having clearance to radius ratio of 1/100, using a lubricant with $\mu = 28 \times 10^{-3}$ Pa s supports the shaft journal running at N = 2400 r.p.m. If bearing pressure is 1.4 MPa, the Sommerfeld number is

a. 8×10^{-3}
b. 8×10^{-5}
c. 0.48
d. 0.48×10^{-2}

103. A sliding contact bearing is operating under stable condition. The pressure developed in oil film is p when the journal rotates at N r.p.m. The dynamic viscosity of lubricant is μ and effective coefficient of friction between bearing and journal of diameter D is *f*. Which one of the

following statements is correct for the bearing?

a. f is directly proportiona1 to μ and p
b. f is directly proportional to μ and N
c. f is inversely proportional to p and D
d. f is directly proportional to μ and inversely proportional to n.

104. In a slider-crank mechanism, the maximum acceleration of slider is obtained when the crank is
a. at the inner dead centre position
b. at the outer dead centre position
c. exactly midway position between the two dead centres
d. slightly in advance of the midway position between the two dead centres

105. Assertion (A) : There is a danger of locomotive wheels being lifted above rails at certain speeds.
Reason (R) : Lifting of the locomotive wheel above rails at certain speed is due to gyroscopic action.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

106. Assertion (A) : A statically and dynamically balanced system of multiple rotors on a shaft can rotate smoothly even at the 'critical speeds' of the system.
Reason (R) : Total balancing eliminates all the 'in plane' and 'out of plane' unbalanced forces of the system.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

107. Assertion (A) : Inertia force always acts through the centroid of the body and is directed opposite to the acceleration of the centroid.
Reason (R) : It has always a tendency to retard the motion.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

108. Assertion (A) : The supply of fuel is automatically regulated by governor accordingly to the engine speed.
Reason (R) : The automatic function is the application of d'Alembert's principle.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

109. Assertion (A) : For similar materials having the same maximum permissible tension. V- belt transmits more power than flat belt with same velocity ratio and centre distance.
Reason (R) : As two sides of V-belt are in contact with side faces of pulley groove, larger contact area gives greater effective frictional force.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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. Assertion (A) : In design of arms of a pulley, in belt drive, the cross-section of the aim is elliptical with minor axis placed along the plane of rotation.
Reason (R) : Arms of a pulley in belt drive are subjected to complete reversal of stresses and is designed for bending in the plane of rotation.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

111. Assertion (A) : In a boiler shell with riveted construction, the longitudinal seam is jointed by butt joint.
Reason (R) : A butt joint is stronger than a lap joint in a riveted construction.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

112. Assertion (A) : Diamond tools can be used at high speeds.

Reason (R) : Diamond tools have very low coefficient of friction.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

113. Assertion (A) : Hard wheels are chosed for grinding hard metals.

Reason (R) : In hard wheels only the abrasive grains are retained for long time.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

114. Assertion (A) : Buttress thread is a modified square thread profile which is employed on the lead screw of machine tools.

Reason (R) : Frequent engagement and disengagement of lead screw for automatic feed is not possible with perfect square threads, therefore, the square profile has to be modified.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

115. Assertion (A) : No separate feed motion is required during broaching.

Reason (R) : The broaching machines are generally hydraulically operated.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

116. Assertion (A) : In Dodge Romig sampling tables, the screening inspection of rejected lots is also included.

Reason (R) : Dodge Romig plans are indexed at an LTPD of 10 percent.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are 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

117. Assertion (A) : Time series analysis technique of sales-forecasting can be applied to only medium and short – range forecasting.

Reason (R) : Qualitative information about, the market is necessary for long-range forecasting.

118. In production, planning and control, the document which authorizes the start of an operation on the shop floor is the

a. Dispatch order
b. Route plan
c. Loading chart
d. Schedule

119. In a study to estimate the idle time of a machine, out of 100 random observations the machine was found idle on 40 observations. The total random observations required for 95% confidence level and ±5% accuracy are

a. 384
b. 600
c. 2400
d. 9600

120. Flow process chart contains

a. inspection and operation
b. inspection, operation and transportation
c. inspection, operation, transportation and delay
d. inspection, operation, transportation, delay and storage