a. 0
b. 0.5
c. 1.0
d. ∞

9. A vibrating machine is isolated from the floor using springs. If the ratio of excitation frequency of vibration of machine to the natural frequency of the isolation system is equal to 0.5, the transmissibility of ratio of isolation is
a. $\frac{1}{2}$
b. $\frac{3}{4}$
c. $\frac{4}{3}$
d. 2

10. Two mating spur gears have 40 and 120 teeth respectively. The pinion rotates at 1200 rpm and transmits a torque of 20 N. m. The torque transmitted by gear is
a. 6.6 Nm
b. 20 Nm
c. 40 Nm
d. 60 Nm

11. In terms of theoretical stress concentration factor (K_t) and fatigue stress concentration factor (K_f), the notch sensitivity 'q' is expressed as
a. $\frac{(k_f - 1)}{(k_t - 1)}$
b. $\frac{(k_f - 1)}{(k_t + 1)}$
c. $\frac{(k_t - 1)}{(k_f - 1)}$
d. $\frac{(k_f + 1)}{(k_t + 1)}$

12. The S-N curve for steel becomes asymptotic nearly at
a. 10^3 cycles
b. 10^4 cycles
c. 10^6 cycles
d. 10^9 cycles

13. An incompressible fluid (kinematics viscosity, 7.4×10^{-7} m^2/s, specific gravity, 0.88) is held between two parallel plates. if the top plate is moved with a velocity of 0.5 m/s while the bottom one is held stationary, the fluid attains a linear velocity profile in the gap of 0.5 mm between these plates: the shear stress in Pascals on the surface of top plate is
a. 0.651×10^{-3}
b. 0.651
c. 6.51
d. 0.651×10^{3}

14. A fluid flow is represented by the velocity field $\vec{V} = ax\,\vec{i} + ay\,\vec{j}$, where a constant is. The equation of stream line passing through a point (1,2) is
a. x - 2y = 0
b. 2x + y = 0
c. 2x − y = 0
d. x + 2y = 0

15. One dimensional unsteady state heat transfer equation for a sphere with heat generation at the rate of 'q' can be written
a. $\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right) + \frac{q}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$
b. $\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial T}{\partial r}\right) + \frac{q}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$
c. $\frac{\partial^2 T}{\partial r^2} + \frac{q}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$
d. $\frac{\partial^2}{\partial r^2}(rT) + \frac{q}{k} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$

16. A gas contained in a cylinder is compressed, the work required for compression being 5000 kJ. During the process, heat interaction of 2000 kJ causes the surroundings to the heated. The changes in internal energy of the gas during the process is
a. -7000 kJ
b. -3000 kJ
c. +3000kJ
d. +7000 kJ

17. The compression ratio of a gas power plant cycle corresponding to maximum work output for the given temperature limits of T_{min} and T_{max} will be
a. $\left(\frac{T_{max}}{T_{min}}\right)^{\frac{\gamma}{2(\gamma-1)}}$
b. $\left(\frac{T_{max}}{T_{min}}\right)^{\frac{\gamma}{2(\gamma-1)}}$
c. $\left(\frac{T_{max}}{T_{min}}\right)^{\frac{\gamma-1}{\gamma}}$

TWO MARKS QUESTIONS

31. From a pack of regular from playing cards, two cards are drawn at random. What is the probability that both cards will be Kings, if first card in NOT replaced?
    a. 1/26
    b. 1/52
    c. 1/169
    d. 1/221

32. A delayed unit step function is defined as $u(t-a)=\begin{cases}0, & for\ t<a\\ 1, & for\ t\geq a\end{cases}$. Its Laplace transform is
    a. ae^{-as}
    b. $\frac{e^{-as}}{s}$
    c. $\frac{e^{as}}{s}$
    d. $\frac{e^{as}}{a}$

33. The values of a function f(x) are tabulated below

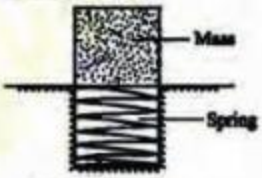
x	f(x)
0	1
1	2
2	1
3	10

    Using Newton's forward difference formula, the cubic polynomial that can be fitted to the above data, is
    a. $2x^3 + 7x^2 - 6x + 2$
    b. $2x^3 - 7x^2 + 6x - 2$
    c. $x^3 - 7x^2 - 6x^2 + 1$
    d. $2x^3 - 7x^2 + 6x + 1$

34. The volume of an object expressed in spherical co-ordinates is given by
    $V=\int_0^{2\pi}\int_0^{\pi/3}\int_0^{1} r^2 \sin\phi\, dr\, d\phi\, d\theta$
    The value of the intergal is
    a. $\frac{\pi}{3}$
    b. $\frac{\pi}{6}$
    c. $\frac{2\pi}{3}$
    d. $\frac{\pi}{4}$

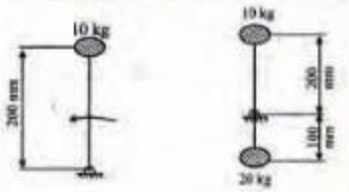
35. For which value of x will the matrix given below become singular?
$$\begin{bmatrix}8 & x & 0\\ 4 & 0 & 2\\ 12 & 6 & 0\end{bmatrix}$$
    a. 4
    b. 6
    c. 8
    d. 12

36. An ejector mechanism consists of a helical compression spring having a spring constant of K= 981 $\times 10^3$ N/m. It is pre-compressed by 100mm from its free state. If it is used to eject a mass of 100 kg held on it, the mass will move up through a distance of



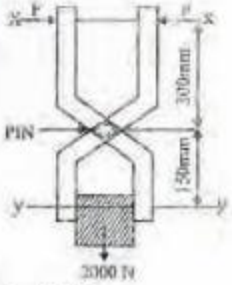
    a. 100 mm
    b. 500 mm
    c. 581 mm
    d. 1000 mm

37. A rigid body shown in the fig. (a) has a mass of 10kg. It rotates with a uniform angular velocity 'ω'. A balancing mass of 20 kg is attached as shown in fig. (b). The percentage increase in mass moment of inertia as a result of this addition is



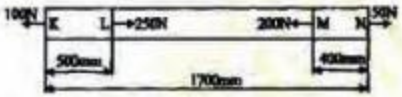
    a. 25%
    b. 50%
    c. 100%
    d. 200%

38. The figure shows a pair of pin-jointed gripper-tongs holding an object weighting 2000 N. The co-efficient of friction (μ) at the gripping surface is 0.1 XX is the line of action of the input force and YY is the line of application of gripping force. If the pin-joint is assumed to be frictionless, the magnitude of force F required to hold the weight is



a. 1000N
b. 2000N
c. 2500N
d. 5000N

39. The figure below shows a steel rod of 25mm^2 cross sectional area. It is loaded at four points, K, L, M and N. Assume E = 200 GPa. The total change in length of the rod due to loading is

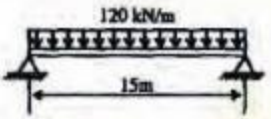


a. 1 μm
b. - 10μm
c. 16 μm
d. – 20 μm

40. A solid circular shaft of 60 mm diameter transmits a torque of 1600 N. m. The value of maximum shear stress developed is
a. 37.72 MPa
b. 47.72 MPa
c. 57.72 MPa
d. 67.72 MPa

Data for Q. 41 & 42 are given below. Solve the problems and choose correct answers.

A steel beam of breadth 120 mm and height 750mm is loaded as shown in the figure. Assume E_{steel} = 200 GPa.



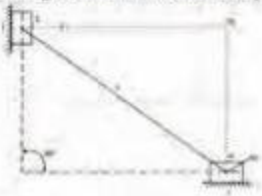
41. The beam is subjected to a maximum bending moment of
a. 3375 kNm
b. 4750 kNm
c. 6750 kNm
d. 8750 kNm

42. The value of maximum deflection of the beam is
a. 93.75mm
b. 83.75mm
c. 73.75mm
d. 63.75mm

43. In the figure shown, the relative velocity of link 1 with respect of link 2 is 12 m/sec. Link 2 rotates at a constant speed of 120 rpm. The magnitude of Coriolis component of acceleration of link 1 is

a. 302 m/s^2
b. 604 m/s^2
c. 906 m/s^2
d. 1208 m/s^2

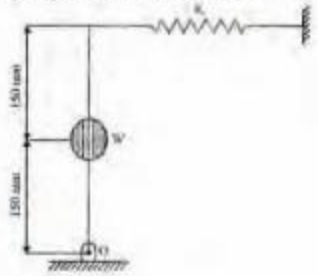
44. The figure below shows a planar mechanism with single degree of freedom. The instant center 24 for the given configuration in located at a position



a. L
b. M
c. N

d. ∞

45. A uniform stiff rod of length 300mm and having a weight of 300 N is pivoted at one end and connected to a spring at the other end. For keeping the rod vertical in a stable position the minimum value of spring constant K needed is



a. 300 N/m
b. 400 N/m
c. 500 N/m
d. 1000 N/m

46. A mass M, of 20Kg is attached to the free end of a steel cantilever beam of length 1000mm having a cross-section of 25 × 25 mm. Assume the mass of the cantilever to be neglible and E_{steel} = 200 GPa. If the lateral vibration of this system is critically damped using a viscous damper, the damping constant of the damper is

a. 1250 Ns/m
b. 625 L/m
c. 312.50 Ns/m
d. 156.25 Ns/m

47. Match the following

Type of Mechanism

P. Scott - Russell mechanism
Q. Geneva mechanism
R. Off-set slider-crank mechanism
S. Scotch Yoke mechanism

Motion achieved

1. Intermittent motion
2. Quick return motion
3. Simple harmonic motion
4. Straight line motion

a. P-2 Q-3 R-1 S-4
b. P-3 Q-2 R-4 S-1
c. P-4 Q-1 R-2 S-3
d. P-4 Q-3 R-1 S-2

48. Match the following with respect to spatial mechanisms.

Type of Joint

P-Revolute
Q-Cylindrical
R-Spherical

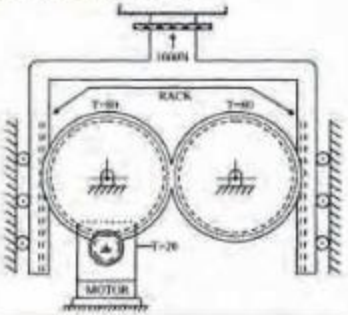
Degrees of constraint

1. Three
2. Five
3. Four
4. Two
5. Zero

a. P-1 Q-3 R-1
b. P-5 Q-4 R-3
c. P-2 Q-3 R-1
d. P-4 Q-5 R-3

Data for Q. 49-50 are given below. Solve the problems and choose correct answers.

A compacting machine shown in the figure below is used to create a desired thrust force by using a rack and pinion arrangement. The input gear in mounted on the motor shaft. The gears have in volute teeth of 2 mm module.



49. If the drive efficiency is 80%, the torque required on the input shaft to create 1000 N output thrust is

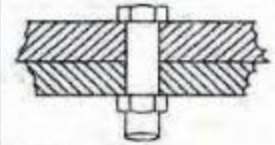
a. 20 Nm
b. 25 Nm
c. 32 Nm
d. 50 Nm

50. 19. If the pressure angle of the rack is 20°, the force acting along the line of action between the rack and the gear teeth is

a. 250 N

b. 342 N
c. 532 N
d. 600 N

51. In a bolted joint two members are connected with an axial tightening force of 2200 N. If the bolt used has metric threads of 4 mm pitch, the torque required for achieving the tightening force is



a. 0.7 Nm
b. 1.0 Nm
c. 1.4 Nm
d. 2.8 Nm

52. Match the following

Type of gears

P. Bevel gears
Q. Worm gears
R. Herringbone gears
S. Hypoid gears

Arrangement of shafts

1. Non-parallel off-set shafts
2. Non-parallel intersecting shafts
3. Non-parallel, non-intersecting shafts
4. Parallel shafts

a. P-4, Q-2, R-1, S-3
b. P-2, Q-3, R-4, S- 1
c. P-3, Q-2, R-l, S-4
d. P-l, Q-3, R-4, S-2

53. The following data about the flow of liquid was observed in a continuous chemical process plant

Flow rate	Mean value of flow rate (x)	Frequency (f)	fx
7.5 – 7.7	7.6	1	7.6
7.7 – 7.9	7.8	5	39
7.9 – 8.1	8.0	35	280
8.1 – 8.3	8.2	14	139
8.3 – 8.5	8.4	12	100.8
8.5 – 8.7	8.6	10	86

Mean flow rate of the liquid is

a. 8.00 liters/sec
b. 8.06 liters/sec
c. 8.16 liters/sec
d. 8.26 liters/sec

54. For a fluid flow through a divergent pipe of length L having inlet and outlet radii of R_1 and R_2 respectively and a constant flow rate of Q, assuming the velocity to be axial and unifonu at any cross-section, the acceleration at the exit is

a. $\frac{2Q(R_1 - R_2)}{\pi L R_2^3}$

b. $\frac{2Q^2(R_1 - R_2)}{\pi L R_2^3}$

c. $\frac{2Q^2(R_1 - R_2)}{\pi^2 L R_2^5}$

d. $\frac{2Q^2(R_2 - R_1)}{\pi^2 L R_2^5}$

55. A closed cylinder having a radius R and height H is filled with oil of density ρ. If the cylinder is rotated about its axis at an angular velocity of ω, the thrust at the bottom of the cylinder is

a. $\pi R^2 \rho g H$

b. $\pi R^2 \frac{\rho \omega^2 R^2}{4}$

c. $\pi R^2 \left(\rho \omega^2 R^2 + \rho g H\right)$

d. $\pi R^2 \left(\frac{\rho \omega^2 R^2}{4} + \rho g H\right)$

56. For air flow over a flat plate, velocity (U) and boundary layer thickness (δ) can be expressed respectively, as

$$\frac{U}{U_\infty} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3, \delta = \frac{4.64x}{\sqrt{Re_x}}$$

If the free stream velocity is 2m/s, and air has kinematics viscosity of 1.5×10^{-5} m²/s and density of 1.23 kg/m³, the wall stree at x = 1m, is

a. 2.36×10^2 N/m²
b. 43.6×10^{-3} N/m²
c. 4.36×10^{-3} N/m²
d. 2.18×10^{-3} N/m²

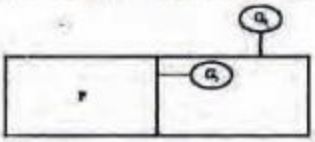
57. A centrifugal pump is required to pump water to an open water tank situated 4 km away from the location of the pump through a pipe of diameter 0.2 m having Darcy's friction factor of 0.01. the average speed of water in the pipe is 2m/s. If it is to maintain a constant head of 5-m in the tank neglecting other minor losses, the

absolute discharge pressure at the pump exit is

a. 0.449 bat
b. 5.50. bar
c. 44.911 bar
d. 55.20. bar

58. The pressure gauges G_1 and G_2 installed on the system show pressure of $P_{G1} = 5.00$ bar and $P_{G2} = 1.00$ bar. Then value of unknown pressure P is

ATMOSPHERIC PRESSURE 1.01 Bar



a. 1.01 bar
b. 2.01 bar
c. 5.00 bar
d. 7.01 bar

59. At a hydro electric power plant site, available head and flow rate are 24.5 m and 10. $1m^3/s$ respectively. If the turbine to be installed is required to run at 4.0 revolution per second (rps) with an overall efficiency of 90%, the suitable type of turbine for this site is

a. Francis
b. Kaplan
c. Pelton
d. Propeller

60. Match the following

P - Reciprocating pump
Q - Axial flow pump
R - Microhydel plant
S - Backward curved vanes

1. Plant with power output below 100 kW
2. Plant with power output between 100kW to 1MW
3. Positive displacement
4. Draft tube
5. High flow rate, low pressure ratio
6. Centrifugal pump impeller

Codes;

a. P-3, Q-5, R-6, S-2
b. P-3, Q-5, R-2, S-6
c. P-3, Q-5, R-1, S-6
d. P-4, Q-5, R-1, S-6

61. A solar collector receiving solar radiation at the rate of 0.6 kW/m^2 transforms it to the internal energy of a fluid at an overall efficiency of 50%. The fluid heated to 350 K is used to run a heat engine which rejects heat at 315 K. If the heat engine is to deliver 2.5 kW power, the minimum area of the solar collector required would be

a. 83.33 m^2
b. 16.66 m^2
c. 39.68 m^2
d. 79.36 m^2

62. A stainless steel tube ($k_s = 19$ W/mK) of 2 cm ID and 5 cm OD in insulated with 3 cm thick asbestos ($k_a = 0.2$ W/mK). If the temperature difference between the inner most and outermost surfaces is 600°c, the heat transfer rate per unit length is

a. 0.94 W/m
b. 9.44 W/m
c. 944.72 W/m
d. 9447.21 W/m

63. A spherical thermocouple junction of diameter 0.706 mm is to be used for the measurement of temperature of a gas stream. The convective heat transfer co-coefficient on bend surface is 400 W/m^2 K. Thermo physical properties of thermocouple material are k = 20 W/m^2K, C = 400 J/kg K and $\rho = 8500$ kg/m^3. If the thermocouple initially at 30° C is placed in a hot stream of 300°C, the time taken by the bead to reach 298°C, is

a. 2.35 s
b. 4.9 s
c. 14.7 s
d. 29.4 s

64. In a condenser, water enters at 30°C and flows at the rate 1500 kg/hr. The condensing steam is at a temperature of 120°C and cooling water leaves the condenser at 80°C. Specific heat of water is 4.187 kJ/kgK. If the overall heat transfer coefficient is 2000 W/m^2 K, the heat transfer area is

a. 0.707 m^2
b. 7.07 m^2
c. 70.7 m^2
d. 141.4 m^2

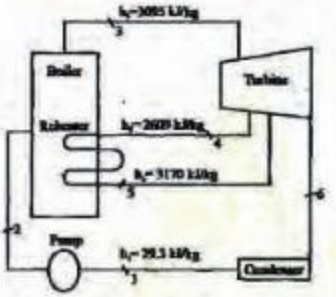
65. A steel billet of 2000 kg mass is to be cooled from 1250 K to 450 K. The heat released during this process is to be used as a source of energy. The ambient temperature is 303 K and specific heat of steel is 0.5 kJ/kg K. The available energy of this billet is
   a. 490.44 MJ
   b. 30.95 MJ
   c. 10.35 MJ
   d. 0.10 MJ

66. During a Morse test on a 4 cylinder engine, the following measurements of brake power were taken at constant speed.
   All cylinders firing- 3037 kW
   Number 1 cylinder not firing -2102 kW
   Number 2 cylinder not firing -2102 kW
   Number 3 cylinder not firing -2100 kW
   Number 4 cylinder not firing -2098kW
   The mechanical efficiency of the engine is
   a. 91.53%
   b. 8 5,07%
   c. 81.07%
   d. 61.22%

67. An engine working on air standard Otto cycle has a cylinder diameter of 10 cm and stroke length of 15 cm. The ratio of specific heats for air is 1.4. If the clearance volume is 196.3 cc and the heat supplied per kg of air per cycle is 1800 kJ/kg, the work output per cycle per kg of air is
   a. 879.1 kJ
   b. 890.2 kJ
   c. 895.3 kJ
   d. 973.5 kJ

Data for Q. 68 & 69 are given below. Solve the problem and choose the correct answers.

Consider a steam power plant using a reheat cycle as shown. Steam leaves the boiler and enters the turbine at 4 MPa, 350°C ($h_3 = 3095$ kJ/kg). After expansion in the turbine to 400 kPa ($h_4 = 2609$ kJ/kg), the steam is reheated to 350°C ($h_5 = 3170$ kJ/kg), and then expanded in a low pressure turbine to 10 kPa ($h_6 = 2165$ kJ/kg) the specific volume of liquid handled by the pump can be assumed to be



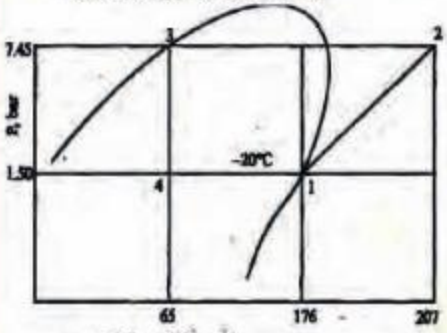
68. The thermal efficiency of the plant neglecting pump work is
   a. 15.8%
   b. 41.1%
   c. 48.5%
   d. 58.6%

69. The enthalpy at the pump discharge (h_2)is
   a. 0.33 kJ/kg
   b. 3.33 kJ/kg
   c. 4.0 kJ/kg (d)
   d. 33.3 kJ/kg

70. is used to drive a refrigerator having a coefficient of performance of 5. The energy absorbed from low temperature reservoir by the refrigerator for each U of energy absorbed from high temperature source by the engine is
   a. 0.14 kJ
   b. 0.71 kJ
   c. 3.5 kJ
   d. 7.1 kJ

71. Dew point temperature of air at one atmospheric pressure (1.013 bar) is 18°C. The air dry bulb temperature is 30°C. The saturation pressure of water at 18°C and 30°C are 0.02062 bar and 0.04241 bar respectively. The specific heat of air and water vapour respectively are 1.005 and 1.88 id/kg K and the latent heat of vaporization water of 0°C is 2500 kJ/kg. The specific humidity (kg/kg of dry air) and enthalpy (kg/kg of dry air) of this moist air respectively, are
   a. 0.0105 1, 52.64
   b. 0.01291, 63.15
   c. 0.01481, 78.60
   d. 0.01532, 81.40

72. A R-12 refrigerant reciprocating compressor operates between the condensing temperature of 30°C and evaporator temperature of -20°C. The clearance volume ratio of the compressor is 0.03. Specific heat ratio of the vapour is 1.15 and the specific volume at the suction is 0.1089 m^3/kg. Other properties at various states are given in the figure. To realize 2 tons of refrigeration, the actual volume effect of clearance is



a. $6.35 \times 10^{-3}\ m^3/s$
b. $63.5 \times 10^{-3}\ m^3/s$
c. $635 \times 10^{-3}\ m^3/s$
d. $4.88 \times 10^{-3}/s$

73. Go and NO-GO plug gauges are to be designed for a hole $20.000^{+0.021}$ mm. Gauge tolerances can be taken as 10% of the hole tolerance, Following ISO system of gauge design, sizes of GO and NO-GO gauge will be respectively
a. 20.010 mm and 20.050mm
b. 20.014 mm and 20.046
c. 20.006 mm and 20.054mm
d. 20.014 mm and 20.054

74. 10mm diameter holes are to be punched in a steel sheet of 3 mm thickness. Shear strength of the material is 400 N/mm^2 and penetration is 40%. Shear provided on the punch is 2 mm. The blanking force during the operation will be
a. 22.6kN
b. 37.7kN
c. 61.6kN
d. 94.3kN

75. Through holes of 10mm diameter are to be drilled in a steel plate of20 mm thickness, Drill spindle speed is 300 rpm, feed 0.2 mm/rev and drill point angle is 120°. Assuming drill over travel of 2 mm, the time for producing a hole will be
a. 4 seconds
b. 25 seconds
c. 100 seconds
d. 110 seconds

76. In a 2-D CAD package, clockwise circular are of radius 5, specified from P_1 (15, 10) to P_2 (10, 15) will have its center at
a. (10,10)
b. (15,10)
c. (15,15)
d. (10,15)

77. Gray cast iron blocks 200 × 100 × 10 mm are to be cast in sand moulds. Shrinkage allowance for pattern making is 1%. The ratio of the volume of pattern to that of the casting will be
a. 0.97
b. 0.99
c. 1.01
d. 1.03

78. In an orthogonal cutting test on mild steel, the following data were obtained

Cutting speed	: 40 m/min
Depth of cut	: 0.3mm
Tool rake angle	: + 5°
Chip thickness	: 1.5mm
Cutting force	: 900 N
Thrust force	: 450 N

Using Merchant's analysis, the Friction angle during the machining will be
a. 26.6°
b. 31.5°
c. 45°
d. 63.4°

79. In a rolling process, sheet of 25 mm thickness is rolled to 20 mm thickness. Roll is of diameter 600mm and it rotates at 100prm. The roll strip contact length will be
a. 5 mm
b. 39 mm
c. 78 mm
d. 120mm

80. In a machining operation, doubling the cutting speed reduces the tool life to $\frac{1}{8}$ th

of the original value. The exponent n in Taylor's tool life equation $VT^n = C$, is

a. $\frac{1}{8}$

b. $\frac{1}{4}$

c. $\frac{1}{3}$

d. $\frac{1}{2}$

81. Match the following

Feature to be inspected

P-Pitch and Angle errors of screw thread

Q-Flatness error of a surface

R-Alignment error of a surface plate

S-Profile of a cam

Instrument

1. Auto Collimator
2. Optical Interferometer
3. Dividing Head and Dial Gauge
4. Spirit Level
5. Sine bar
6. Tool maker's Microscope

a. P-6 Q-2 R-4 S-6

b. P-5 Q-2 R-1 S-6

c. P-6 Q-4 R-1 S-3

d. P-1 Q-4 R-4 S-2

82. Match the following

Product

P-Molded luggage

Q-Packaging containers for liquid

R-Long structural shapes

S-Collapsible tubes

Process

1. Injection molding
2. Hot rolling
3. Impact extrusion
4. Transfer molding
5. Blow molding
6. Coining

a. P-1 Q-4 R-6 S-3

b. P-4 Q-5 R-2 S-3

c. P-1 Q-5 R-3 S-2

d. P-5 Q-1 R-2 S-2

83. Typical machining operations are to be performed on hard-to-machine materials by using the processes listed below. Choose the best set of Operation- Process combinations

Operation

P-Debarring (internal surface)

Q-Die sinking

R-Fine hole drifting in thin sheets

S-Tool sharpening

Process

1. Plasma Arc Machining
2. Abrasive Flow Machining
3. Electric Discharge Machining
4. Ultrasonic Machining
5. Laser beam Machining
6. Electrochemical Grinding

a. P-1 Q-5 R-3 S-4

b. P-1 Q-4 R-1 S-2

c. P-5 Q-1 R-2 S-6

d. P-2 Q-3 R-5 S-6

84. From the lists given below, choose the most appropriate set of heat treatment process and the corresponding process characteristics

Process

P - Tempering.

Q - Austempering

R - Martempering

Characteristics

1. Austenite is converted into bainite
2. Austenite is converted into marten site
3. Cementite is converted into globular structure
4. Both hardness and brittleness are reduced
5. Carbon is absorbed into the metal

a. P-3 Q-1 R-5

b. P-4 Q-3 R-2

c. P-4 Q-1 R-2

d. P-1 Q-5 R-4

85. A standard machine tool and an automatic machine tool are being compared for the production of a component. Following data refers to the two machines.

	Standard Machine Tool	Automatic Machine Tool
Setup time	30 mm.	2 hours
Machining time per piece	22 mm.	5 min
Machine rate	Rs. 200 per hour	Rs. 800 per hours

The breakeven production batch size above which the automatic machine tool will be economical to use, will be

a. 4
b. 5
c. 24
d. 225

86. A soldering operation was work-sampled over two days (16 hours) during which an employee soldered 108 joints. Actual working time was 90% of the total time and the performance rating was estimated to be 120 percent. If the contract provides allowance of 20 percent of the total time available, the standard time for the operation would be

a. 8 min.
b. 8.9 min
c. 10 min
d. 12 min

87. An electronic equipment manufacturer has decided to add a component sub-assembly operation that can produce 80 units during a regular 8-hour shift. This operation consists of three activities as below

Activity	Standard time (mm)
M. Mechanical assembly	12
E. Electric wiring	16
T. Test	3

For line balancing the number of work stations required for the activities M, E and T would respectively be

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

88. A maintenance service facility has Poisson arrival rates, negative exponential service time and operates on a 'first come first served' queue discipline. Break-downs occur on an average of 3 per day with a range of zero to eight. The maintenance crew can service an average of 6 machines per day with a range of zero to seven,

The mean waiting time for an item to be serviced would be

a. 1/6 day
b. 1/3 day
c. 1 day
d. 3 day

89. A company has an annual demand of 1000 units, ordering cost of Rs.100/ order and carrying cost of Rs. 100/unit-year. If the stock-out costs are estimated to be nearly Rs. 400 each time the company runs out-of-stock, the safety stock justified by the carrying cost will be

a. 4
b. 20
c. 40
d. 100

90. A company produces two types of toys: P and Q. Production time of Q is twice that of P and the company has a maximum of 2000 time units per day. The supply of raw material is just sufficient to produce 1500 toys (of any type) per day. Toy type Q requires an electric switch which is available @600 pieces per day only. The company makes a profit of Rs.3 and Ps. 5 on type P and Q respectively. For maximization of profits, the daily production quantities of P and Q toys should respectively be

a. 1000, 500
b. 500, 1000
c. 800, 600
d. 1000, 1000

MECHANICAL ENGINEERING

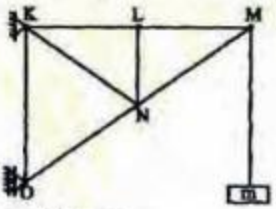
ONE MARKS QUESTIONS

1. If $x = a(\theta + \sin\theta)$ and $y = a(1 - \cos\theta)$, then $\frac{dy}{dx}$ will be equal to
   a. $\sin\left(\frac{\theta}{2}\right)$
   b. $\cos\left(\frac{\theta}{2}\right)$
   c. $\tan\left(\frac{\theta}{2}\right)$
   d. $\cot\left(\frac{\theta}{2}\right)$

2. The angle between two unit-magnitude coplanar vectors P(0.866, 0.500,0) and Q(0.259, 0.966,0) will be
   a. 0°
   b. 30°
   c. 45°
   d. 60°

3. The sum of the eigen values of the matrix given below is $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$
   a. 5
   b. 7
   c. 9
   d. 18

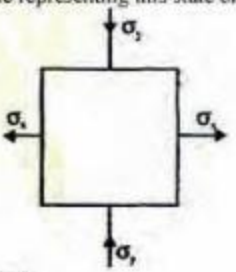
4. The figure shows a pin-jointed plane truss loaded at the point M by hanging a mass of 100 kg. The member LN of the truss is subjected to a load of member LN of the truss is subjected to a load of



   a. 0 Newton
   b. 490 Newtons in compression
   c. 981 Newtons in compression
   d. 981 Newtons in tension

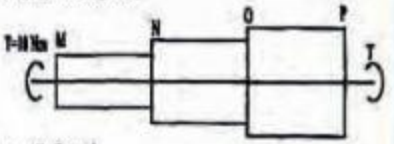
5. In terms of Poisson's ratio (v) the ratio of Young's Modulus (E) to Shear Modulus (G) of elastic materials is
   a. 2(1 + v)
   b. 2(1 - v)
   c. $\frac{1}{2}(1+v)$
   d. $\frac{1}{2}(1-v)$

6. The figure shows the state of stress at a certain point in a stressed body. The magnitudes of normal stresses in the x and y directions are 100 MPa and 20 MPa respectively. The radius of Mohr's stress circle representing this state of stress is



   a. 120
   b. 80
   c. 40
   d. 60

7. A torque of 10 Nm is transmitted through a stepped shall as shown in figure. The torsional stiff nesses of individual sections of lengths MN, NO and OP are 20 Nm/rad, 30 Nm/rad & 60 Nm/md respectively. The angular deflection between the ends M and P of the shaft is



   a. 0.5 rad
   b. 1.0
   c. 5.0 rad
   d. 10.0 rad

8. For a mechanism shown below, the mechanical advantage for the given configuration is