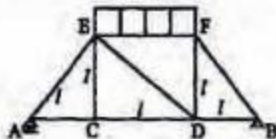


18. A 2 kW, 40 liters water heater is switched on for 20 minutes. The heat capacity  $C_p$  for water is 4.2 kJ/kg K. Assuming all the electrical energy has gone into heating the water, increase of the water temperature in degree centigrade is
- 2.7
  - 4.0
  - 14.3
  - 25.25
19. A plate having 10 cm<sup>2</sup> areas each side is hanging in the middle of a room of 100m<sup>2</sup> total surface area. The plate temperature and emissivity are respectively 800 K and 0.6. The temperature and emissivity values for the surfaces of the room are 300 K and 0.3 respectively Boltzmann's constant  $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$ . The total heat loss from the two surfaces of the plate is
- 13.66 W
  - 27.32 W
  - 27.87 W
  - 13.66 MW
20. For a spark ignition engine, the equivalence ratio ( $\phi$ ) of mixture entering the combustion chamber has values
- $\phi < 1$  for idling and  $\phi > 1$  for peak power conditions
  - $\phi > 1$  for both idling and peak power conditions
  - $\phi > 1$  for idling and  $\phi < 1$  for peak power conditions
  - $\phi < 1$  for both idling and peak power conditions
21. A diesel engine is usually more efficient than a spark ignition engine because
- diesel being a heavier hydrocarbon, releases more heat per kg than gasoline
  - the air standard efficiency of diesel cycle is higher than the Otto cycle, at a fixed compression ratio
  - the compression ratio of a diesel engine is higher than that of an SI engine
  - self ignition temperature of diesel is higher than that of gasoline
22. In Rankine cycle, regeneration results in higher efficiency because
- pressure inside the boiler increases
  - heat is added before steam enters the low pressure turbine
  - average temperature of heat addition in the boiler increases
  - total work delivered by the turbine increases
23. Considering the variation of static pressure and absolute velocity in an impulse steam turbine, across one row of moving blades
- both pressure and velocity decrease
  - pressure decreases but velocity increases
  - pressure remains constant, while velocity increases
  - pressure remains constant, while velocity decreases
24. An industrial heat pump operates between the temperatures of 27°C and -13°C. The rates of heat addition and heat rejection are 750 W and 1000 W, respectively. The COP for the heat pump is
- 7.5
  - 6.5
  - 4.0
  - 3.0
25. For air with a relative humidity of 80%
- the dry bulb temperature is less than the wet bulb temperature
  - the dew point temperature is less than wet bulb temperature
  - the dew point and wet bulb temperature are equal
  - the dry bulb and dew point temperatures are equal
26. During heat treatment of steel, the hardness of various structures in increasing order is
- martensite, fine pearlite, coarse pearlite, spheroidite
  - fine pearlite, decreases but velocity increases
  - martensite, coarse pearlite, fine pearlite, spheroidite
  - spheroidite, coarse pearlite, fine pearlite, martensite
27. Hardness of green sand mould increases with
- increase in moisture content beyond 6 percent
  - increase in permeability
  - decrease in permeability
  - increases in both moisture content and permeability
28. In Oxyacetylene gas welding, temperature at the inner cone of the flame is around
- 3500°C
  - 3200°C

- c. 2900°C  
d. 2550°C
29. Cold working of steel is defined as working  
a. at its recrystallisation temperature  
b. above its recrystallisation temperature.  
c. below its recrystallisation temperature  
d. at two thirds of the melting temperature of the metal
30. Quality screw threads are produced by  
a. thread milling  
b. thread chasing.  
c. thread cutting with single point tool  
d. thread casting
31. As tool and work are not in contact in EDM process  
a. no relative motion occurs between them  
b. no water of tool occurs  
c. no power is consumed during metal cutting  
d. no force between tool and work occurs
32. The dimensional limits on a shaft of 25h 7 are  
a. 25.000,25.021 mm  
b. 25.000,24.979 mm  
c. 25.000,25.007 mm  
d. 25.000,24.993 mm
33. The symbol used for Transport in work study is  
a.  $\rightarrow$   
b. T  
c.  $\square$   
d.  $\nabla$
36. The solution of the differential equation  $\frac{dy}{dx} + y' = 0$  is  
a.  $y = \frac{1}{x+c}$   
b.  $y = \frac{-x^3}{3} + c$   
c.  $ce^x$   
d. unsolvable as equation is non-linear
37. The vector field is  $\vec{F} = x\hat{i} - y\hat{j}$  (where  $\hat{i}$  and  $\hat{j}$  are unit vector) is  
a. divergence free, but not irrotational is  
b. irrotational, but not divergence free  
c. divergence free and irrotational  
d. neither divergence free nor irrotational
38. Laplace transform of the function  $\sin \omega t$  is  
a.  $\frac{s}{s^2 + \omega^2}$   
b.  $\frac{\omega}{s^2 + \omega^2}$   
c.  $\frac{s}{s^2 - \omega^2}$   
d.  $\frac{\omega}{s^2 - \omega^2}$
39. A box contains 5 black and 5 red balls. Two balls are randomly picked one after another from the box, without replacement. The probability for both balls being red is  
a. 1/90  
b. 1/2  
c. 19/90  
d. 2/9
40. A truss consists of horizontal members (AC, CD, DB and EF) and vertical members (CE and DE) having length  $l$ . The members AE, DE and BF are inclined at  $45^\circ$  to the horizontal. For the uniformly distributed load "p" per unit length on the members EF of the truss shown in figure given below, the force in the member CD is



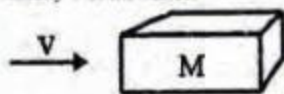
- a.  $\frac{pl}{2}$

### TWO MARKS QUESTIONS

34. Consider the system of simultaneous equations  
 $x + 2y + z = 6$   
 $2x + y + 2z = 6$   
 $x + y + z = 5$   
 This system has  
 a. unique solution  
 b. infinite number of solutions  
 c. no solution  
 d. exactly two solutions
35. The area enclosed between the parabola  $y = x^2$  and the straight line  $y = x$  is  
 a. 1/8  
 b. 1/6

- b.  $pl$   
 c. 0  
 d.  $\frac{2pl}{3}$

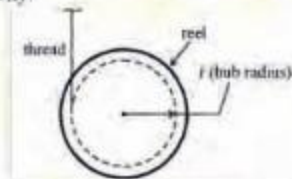
41. A bullet of mass "m" travels at a very high velocity v (as shown in the figure) and gets embedded inside the block of mass "M" initially at rest on a rough horizontal floor. The block with the bullet is seen to move a distance "s" along the floor. Assuming  $\mu$  to be the coefficient of kinetic friction between the block and the floor and "g" the acceleration due to gravity what is the velocity v of the bullet?



- a.  $\frac{M+m}{m} \sqrt{2\mu gs}$   
 b.  $\frac{M-m}{m} \sqrt{2\mu gs}$   
 c.  $\frac{\mu(M+m)}{m} \sqrt{2gs}$   
 d.  $\frac{M}{m} \sqrt{2\mu gs}$

**Date for Q. 42-43 are given below. Solve the problems and choose correct answers.**

A reel of mass "Mass" and radius of gyration "k" is rolling down smoothly from rest with one end of the thread wound on it held in the ceiling as depicted in the figure. Consider the thickness of the thread and its mass negligible in comparison with the radius "r" of the hub and the reel mass "m". Symbol "g" represents the acceleration due to gravity.



42. The linear acceleration of the reel is

- a.  $\frac{gk^2}{(r^2+k^2)}$   
 b.  $\frac{gk^3}{(r^2+k^2)}$

- c.  $\frac{grk}{(r^2+k^2)}$   
 d.  $\frac{mgr^2}{(r^2+k^2)}$

43. The tension in the thread is

- a.  $\frac{mgr^2}{(r^2+k^2)}$   
 b.  $\frac{mgrk}{(r^2+k^2)}$   
 c.  $\frac{mgk^2}{(r^2+k^2)}$   
 d.  $\frac{mg}{(r^2+k^2)}$

44. A simply supported laterally loaded beam was found to deflect more than a specified value. Which of the following measures will reduce deflection?

- a. Increase the area moment of inertia  
 b. Increase the span of the beam  
 c. Select a different material having lesser modulus of elasticity  
 d. Magnitude of the load to be increased

45. A shaft subjected to torsion experiences a pure shear stress on the surface. The maximum principal stress on the surface which is at  $45^\circ$  to the axis will have a value

- a.  $\tau \cos 45^\circ$   
 b.  $2\tau \cos 45^\circ$   
 c.  $2\tau \cos 45^\circ$   
 d.  $2\tau \sin 45^\circ \cos 45^\circ$

**Data for Q. 46 are given below. Solve the problems and choose correct answers.**

The state of stress at a point "P" in a two dimensional loading is such that the Mohr's circle is point located at 175 MPa on the positive normal stress axis.

46. Determine the maximum and minimum principal stresses respectively from the Mohr's circle

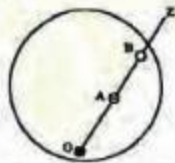
- a. + 175 MPa, - 175 MPa  
 b. + 175 MPa, +175 MPa  
 c. 0, - 175 MPa  
 d. 0, 0

47. Determine the directions of maximum and minimum principal stresses at the point "P" from the Mohr's circle

- a.  $0, 90^\circ$   
 b.  $90^\circ, 0$   
 c.  $45^\circ, 135^\circ$   
 d. all directions
48. For a certain engine having an average speed of 1200 rpm, a flywheel approximated as a solid disc, is required for keeping the fluctuation of speed within 2% about the average speed. The fluctuation of kinetic energy per cycle is found to be 2kJ. What is the least possible mass of the flywheel if its diameter is not to exceed 1m?
- a. 40 kg  
 b. 51 kg  
 c. 62 kg  
 d. 73kg
49. A flexible rotor-shaft system comprises of a 10kg rotor disc placed in the middle of a mass-less shaft of diameter 30mm and length 500 mm between bearings (shaft is being taken mass-less as the equivalent mass of the shaft is included in the rotor mass) mounted at the ends. The bearings are assumed to simulate simply supported boundary conditions. The shaft is made of steel for which the value of  $E$  is  $2.1 \times 10^{11}$  Pa. What is the critical speed of rotation of the shaft?
- a. 60 Hz  
 b. 90 Hz  
 c. 135Hz  
 d. 180Hz

**Data for Q. 50-51 are given below. Solve the problems and choose correct answers.**

The circular disc shown in its plan view in the figure rotates in a plane parallel to the horizontal plane about the point  $O$  at a uniform angular velocity  $\omega$ . Two other points  $A$  and  $B$  are located on the line  $OZ$  at distances  $r$  and  $rB$  from  $O$  respectively.

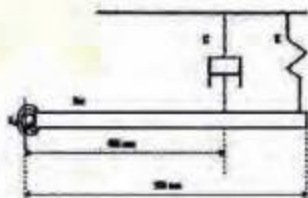


50. The velocity of point  $B$  with respect to point  $A$  is a vector of magnitude
- a. 0

- b.  $\omega (r_B - r_A)$  and direction opposite to the direction of motion of point  $B$   
 c.  $\omega (r_B - r_A)$  and direction same as the direction of motion of point  $B$   
 d.  $\omega (r_B - r_A)$  and direction being from  $O$  to  $Z$ .
51. The acceleration of point  $B$  with respect to point  $A$  is a vector of magnitude
- a. 0  
 b.  $\omega (r_B - r_A)$  and direction same as the direction of motion of point  $B$   
 c.  $\omega (r_B - r_A)$  and direction opposite to be direction of motion of point  $B$   
 d.  $\omega (r_B - r_A)$  and direction being from  $Z$  to  $O$ .

**Date for Q. 52-53 are given below. Solve the problems and choose correct answers.**

A uniform rigid slender bar of mass 10kg, hinged at the left end is suspended with the help of spring and damper arrangement as shown in the figure where  $K=2\text{ kN/m}$ ,  $C=500\text{ Ns/m}$  and the stiffness of the torsional spring  $K_\theta$  is  $1\text{ kN/m/rad}$ . Ignore the hinge dimensions.



52. The un-damped 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
53. The damping coefficient in the vibration equation is given by
- a. 500 Nms/rad  
 b. 500 N/(m/s)  
 c. 80 Nms/rad  
 d. 80 N/(m/s)
54. 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

- $\frac{4T}{ld}$
- $\frac{16T}{ld^2}$
- $\frac{8T}{ld^2}$
- $\frac{16T}{\pi d^3}$

55. In a band brake the ratio of tight side band tension to the tension on the slack side is 3, if the angle of overlap of band on the drum is  $180^\circ$  the coefficient of friction required between drum and the bank is
- 0.20
  - 0.25
  - 0.30
  - 0.35

Data for Q. 56-57 are given below. Solve the problems and choose correct answers.

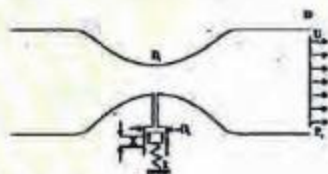
The overall gear ratio in a 2 stage speed reduction gear box (with all spur gears) is 12. The input and output shafts of the gear box are collinear. The countershaft which is parallel to the input and output shafts has a gear ( $Z_2$  teeth) and pinion ( $Z_3 = 15$  teeth) to mesh with pinion ( $Z_1 = 16$  teeth) on the input shaft and gear ( $Z_4$  teeth) on the output shaft respectively. It was decided to use a gear ratio of 4 with 3 module in the first stage and 4 module in the second stage.

56.  $Z_2$  and  $Z_4$  are
- 64 and 45
  - 45 and 64
  - 48 and 60
  - 60 and 48
57. The centre distance in the second stage is
- 90 mm
  - 120 mm
  - 160 mm
  - 240 mm
58. A water container is kept on a weighing balance. Water from a tap is falling vertically into the container with a volume flow rate of  $Q$ ; the velocity of the water when it hits the water surface is  $U$ . At a particular instant of time the total mass of the container and water is  $U$ . At a particular instant of time the total mass of the container and water is  $m$ . The force

registered by the weighing balance at this instant of time as

- $mg + \rho QU$
- $mg + 2\rho QU$
- $mg + 2QU^2 / 2$
- $\rho QU^2 / 2$

59. Air flows through a venturi and into atmosphere. Air density is  $\rho$ ; atmospheric pressure is  $P_0$ ; throat diameter is  $D$  exit diameter is  $D_1$ ; and exit velocity is  $U$ . The throat is connected to a cylinder containing a frictionless piston attached to a spring. The spring constant is  $k$ . The bottom surface of the piston is exposed to atmosphere. Due to the flow, the piston moves by distance  $x$ . Assuming incompressible frictionless flow,  $x$  is



- $(\rho U^2 / 2k) \pi D_1^2$
- $(\rho U^2 / 8k) \left( \frac{D^2}{D_1^2} - 1 \right) \pi D_1^2$
- $(\rho U^2 / 2k) \left( \frac{D^2}{D_1^2} - 1 \right) \pi D_1^2$
- $(\rho U^2 / 8k) \left( \frac{D^4}{D_1^4} - 1 \right) \pi D_1^2$

60. A centrifugal pump running at 500 rpm and at its maximum efficiency is delivering a head of 30m at a flow rate of 60 liters per minute. If the rpm is changed to 1000, then the head  $H$  in meters and flow rate  $Q$  in liters per minute at maximum efficiency are estimated to be
- $H = 60, Q = 120$
  - $H = 120, Q = 120$
  - $H = 60, Q = 480$
  - $H = 120, Q = 30$
61. Match the following
- P. Curtis  
Q. Rateau  
R. Kaplan  
S. Francis
- Reaction steam turbine
  - Gas turbine

3. Velocity compounding
4. Pressure compounding
5. Impulse water turbine
6. Axial turbine
7. Mixed flow turbine
8. Centrifugal pump
  - a. P-2, Q-1, R-1, S-6
  - b. P-3, Q-1, R-5, S-7
  - c. P-1, Q-3, R-1, S-5
  - d. P-3, Q-4, R-7, S-6

Data for Q. 62-63 are given below. Solve the problems and choose correct answers

A syringe with a frictionless plunger contains water and has at its end a 100mm long needle of 1 mm diameter. The internal diameter of the syringe is 10 mm. Water density is  $1000 \text{ kg/m}^3$ . The plunger is pushed in at  $10 \text{ mm/s}$  and the water comes out as a jet



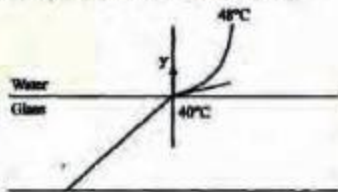
62. Assuming ideal flow, the force  $F$  in newtons required on the plunger to push out the water is
  - a. 0
  - b. 0.04
  - c. 0.13
  - d. 1.15
63. Neglect losses in the cylinder and assume fully developed laminar viscous flow throughout the needle; the Darcy friction factor is  $64/Re$ . Where  $Re$  is the Reynolds number. Given that the viscosity of water is  $1.0 \times 10^{-3} \text{ kg/s m}$ , the force  $F$  in newtons required on the plunger is
  - a. 0.13
  - b. 0.16
  - c. 0.3
  - d. 4.4
64. In a counter flow heat exchanger, for the hot fluid the heat capacity =  $2 \text{ kJ/kg K}$ , mass flow rate =  $5 \text{ kg/s}$ , inlet temperature  $150^\circ\text{C}$ , outlet temperature =  $100^\circ\text{C}$ . For the cold fluid, heat capacity =  $4 \text{ kJ/kg K}$ , mass flow rate =  $10 \text{ kg/s}$ , inlet temperature =  $20^\circ\text{C}$ . Neglecting heat transfer to the surroundings, the outlet temperature of the cold fluid is  $^\circ\text{C}$  is
  - a. 7.5
  - b. 32.5

- c. 45.5
- d. 70.0

65. Consider a laminar boundary layer over a heated flat plate. The free stream velocity is  $U_\infty$ . At some distance  $x$  from the leading edge the velocity boundary layer thickness is  $\delta_v$  and the thermal boundary layer thickness is  $\delta_T$ . If the Prandtl number is greater than 1, then
  - a.  $\delta_T > \delta_v$
  - b.  $\delta_T < \delta_v$
  - c.  $\delta_T \approx \delta_v \sim (U_\infty x)^{1/2}$
  - d.  $\delta_T \approx \delta_v \sim x^{1/3}$

Data for Q. 66-67 are given below. Solve the problems and choose correct answers.

Heat is being transferred by convection from water at  $48^\circ\text{C}$  to a glass plate whose surface that is exposed to the water is at  $40^\circ\text{C}$ . The thermal conductivity of water is  $0.6 \text{ W/mK}$  and the thermal conductivity of glass is  $1.2 \text{ W/mK}$ . The spatial gradient of temperature in the water at the water-glass interface is  $dT/dy = 1 \times 10^5 \text{ K/m}$ .



66. The value of the temperature gradient in the glass at the water-glass interface in  $\text{K/m}$  is
  - a.  $-2 \times 10^5$
  - b. 0.0
  - c.  $0.5 \times 10^4$
  - d.  $2 \times 10^4$
67. The heat transfer coefficient  $h$  in  $\text{W/m}^2 \text{ K}$  is
  - a. 0.0
  - b. 4.8
  - c. 6
  - d. 750
68. Considering the relationship  $TdS = dU + pdV$  between the entropy ( $S$ ), internal energy ( $U$ ), pressure ( $p$ ), temperature ( $T$ ) and volume ( $V$ ), which of the following statements is correct?
  - a. It is applicable only for a reversible process

- b. For an irreversible process,  $TdS > dU + pdV$
- c. It is valid only for an ideal gas
- d. It is equivalent to 1 law, for a reversible process
69. In a gas turbine, hot combustion products with the specific heats  $C_p = 0.98 \text{ kJ/kg K}$ , and  $C_v = 0.7538 \text{ kJ/kg K}$  enter the turbine at 20 bar, 1500 K exit at 1 bar. The isentropic efficiency of the turbine is 0.94. The work developed by the turbine per kg of gas flow is
- 689.64 kJ/kg
  - 794.66 kJ/kg
  - 1009.72 kJ/kg
  - 1312.00 kJ/kg
70. An automobile engine operates at a fuel air ratio of 0.05, volumetric efficiency of 90% and indicated thermal efficiency of 30%. Given that the calorific value of the fuel is 45 MJ/kg and the density of air at intake is 1 kg/m<sup>3</sup>, the indicated mean effective pressure for the engine is
- 6.075 bar
  - 6.75 bar
  - 67.5 bar
  - 243 bar

Data for Q. 71 & 72 are given below. Solve the problems and choose correct answers.

Nitrogen gas (molecular weight 28) is enclosed in a cylinder by a piston, at the initial condition of 2 bar, 298 K and 1 m<sup>3</sup>. In a particular process, the gas slowly expands under isothermal condition, until the volume becomes 2m<sup>3</sup>. Heat exchange occurs with the atmosphere at 298 K during this process.

71. For an engine operating on air standard Otto cycle, the clearance volume is 10% of the swept volume. The specific heat ratio of air is 1.4. The air standard cycle efficiency is
- 38.3%
  - 39.8%
  - 60.2%
  - 61.7%
72. The work interaction for the Nitrogen gas is
- 200kJ
  - 138.6kJ
  - 2kJ
  - 200kJ

73. The entropy changes for the Universe during the process in kJ/K is
- 0.4652
  - 0.0067
  - 0
  - 0.6711

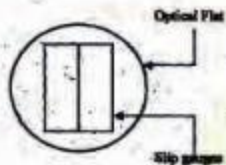
Data for Q. 74 & 75 are given below. Solve the problems and choose correct answers.

A refrigerator based on ideal vapour compression cycle operates between the temperature limits of -20°C and 40°C. The refrigerant enters the condenser as saturated vapour and leaves as saturated liquid. The enthalpy and entropy values for saturated liquid and vapour at these temperatures are given in the table below.

T (°C)	$h_f$ (kJ/kg)	$h_g$ (kJ/kg)	$s_f$ (kJ/kg K)	$s_g$ (kJ/kg K)
-20	20	180	0.07	0.7366
40	80	200	0.3	0.67

74. If refrigerant circulation rate is 0.025 kg/s, the refrigeration effect is equal to
- 2.1 kW
  - 2.5 kW
  - 3.0 kW
  - 4.0 kW
75. The COP of the refrigerator is
- 2.0
  - 2.33
  - 5.0
  - 6.0
76. Hardness of steel greatly improves with
- annealing
  - cyaniding
  - normalizing
  - tempering
77. With a solidification factor of  $0.97 \times 10^6 \text{ s/m}^2$ , the solidification time (in seconds) for a spherical casting of 200 mm diameter is
- 539
  - 1078
  - 4311
  - 3233
78. A shell of 100mm diameter and 100mm height with the corner radius of 0.4 mm is to be produced by cup drawing. The required blank diameter is
- 118 mm
  - 161 mm
  - 224 mm

- d. 312 mm
79. A brass billet is to be extruded from its initial diameter of 100mm to a final diameter of 50 mm. The working temperature of 700°C and the extrusion constant is 250 MPa. The force required for extrusion is
- 5.44 MN
  - 2.72 MN
  - 1.36 MN
  - 0.36 MN
80. A metal disc of 20 mm diameter is to be punched from a sheet of 2 mm thickness. The punch and the dia clearance is 3%. The required punch diameter is
- 19.88 mm
  - 19.84 mm
  - 20.06 mm
  - 20.12 mm
81. A batch of 10 cutting tools could produce 500 components while working at 50rpm with a tool feed of 0.25 mm/rev and depth of cut of 1mm. A similar batch of 10 tools of the same specification could produce 122 components while working at 80 rpm with a feed of 0.25 mm/rev and 1 mm depth of cut. How many components can be produced with one cutting tool at 60rpm?
- 29
  - 31
  - 37
  - 42
82. A threaded nut of M 16, ISO metric type, having 2 mm pitch with a pitch diameter of 14.701 mm is to be checked for its pitch diameter using two or three number of balls or rollers of the following sizes
- Rollers of 2mm  $\phi$
  - Rollers of 1.155 mm  $\phi$
  - Balls of 2 mm  $\phi$
  - Balls of 1.155mm  $\phi$
83. Two slip gauges of 10mm width measuring 1.000mm and 1.002mm are kept side by side in contact with each other lengthwise. An optical flat is kept resting on the slip gauges as shown in the figure. Monochromatic light of wavelength 0.005 8928 mm is used in the inspection. The total number of straight fringes that can be observed on both slip gauges is



- 2
  - 6
  - 8
  - 13
84. A part shown in the figure is machined to the sizes given below  
 $P = 35.00 \pm 0.08\text{mm}$ ,  $Q = 12.00 \pm 0.02\text{mm}$  and  $R = 13.00^{+0.04}_{-0.02}\text{mm}$



With 100% confidence, the resultant dimension W will have the specification

- $9.99 \pm 0.03\text{mm}$
  - $9.99 \pm 0.14\text{mm}$
  - $10.00 \pm 0.03\text{mm}$
  - $10.00 \pm 0.13\text{mm}$
85. Match the following

#### Work material

- P. Aluminum  
 Q. Die steel  
 R. Copper Wire  
 S. Titanium sheet

#### Type of joining

- Submerged Arc Welding
  - Soldering
  - Thermit Welding
  - Atomic Hydrogen Welding
  - Gas Tungsten Arc Welding
  - Laser Beam Welding
- P-2, Q-5, R-1, S-3
  - P-6, Q-3, R-4, S-4
  - P-1, Q-1, R-6, S-2
  - P-5, Q-4, R-2, S-6

Data for Q. 86-87 are given below. Solve the problems and choose correct answers.

A cylinder is turned on a lathe with orthogonal machining principle. Spindle rotates at 200 rpm. The axial feed rate is 0.25 mm per revolution.



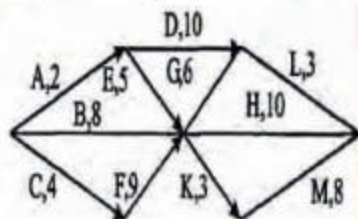
Depth of cut is 0.4 mm. The rake angle is  $10^\circ$ . In the analysis it is found that the shear angle is  $27.75^\circ$ .

86. The thickness of the produced chip is -  
 a. 0.511 mm  
 b. 0.528 mm  
 c. 0.818mm  
 d. 0.846mm
87. In the above problem, the coefficient of friction at the chip total interface obtained using Earnest and Merchant theory is  
 a. 0.18  
 b. 0.36  
 c. 0.71  
 d. 0.98
88. Two machines of the same production rate are available for use. On machine 1, the fixed cost is Rs. 100 and the variable cost is Rs. 2 per piece produced. The corresponding numbers for the machine 2 are Rs. 200 and Re. 1 respectively. For certain strategic reasons both the machines are to be used concurrently. The sale price of the first 800 units is Rs. 3.50 per unit and subsequently it is only Rs. 3.00. The breakeven production rate for each machine is  
 a. 75  
 b. 100  
 c. 150  
 d. 600
89. A residential school stipulates the study hours as 8.00 pm to 10.30 pm. Warden makes random checks on a certain student 11 occasions a day during the study hours over a period of 10 days and observes that he is studying on 71 occasions. Using 95% confidence interval, the estimated minimum hours of his study during that 10 day period is  
 a. 8.5 hours  
 b. 13.9 hours  
 c. 16.1 hours  
 d. 18.4 hours
90. The sales of cycles in a shop in four consecutive months are given as 70, 68, 82, 95. Exponentially smoothing average method with a smoothing factor of 0.4 is used in forecasting. The expected number of sales in the next month is  
 a. 59  
 b. 72

c. 86

d. 136

91. Market demand for springs is 8,00,000 per annum. A company purchases this spring in lots and sells them. The cost of making a purchase order is Rs. 1,200. The cost of storage of springs is Rs. 120 per stored piece per annum. The economic order quantity is  
 a. 400  
 b. 2,828  
 c. 4,000  
 d. 8,000
92. A manufacturer produces two types of products, 1 and 2, at production levels of  $x_1$  and  $x_2$  respectively. The profit is given by  $2x_1 + 5x_2$ . The production constraints are:  
 $x_1 + 3x_2 \leq 40$   
 $3x_1 + x_2 \leq 24$   
 $x_1 + x_2 \leq 10$   
 $x_1 > 0, x_2 > 0$   
 The maximum profit which can meet the constraints is  
 a. 29  
 b. 38  
 c. 44  
 d. 75
93. A Project consists of activities A to M shown in the net in the following figure with the duration of the activities marked in days



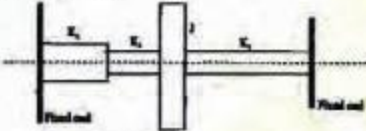
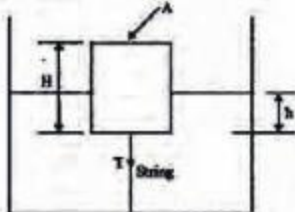
The project can be completed

- a. between 18, 19 days  
 b. between 20, 22 days  
 c. between 24, 26 days  
 d. between 60, 70 days

# MECHANICAL ENGINEERING

## ONE MARKS QUESTIONS

1.  $\lim_{x \rightarrow 0} \frac{\sin^2 x}{x}$  is equal to
- 0
  - $\infty$
  - 1
  - 1
2. The accuracy of Simpson's rule quadrature for a step size  $h$  is
- $O(h^2)$
  - $O(h^3)$
  - $O(h^4)$
  - $O(h^5)$
3. For the matrix  $\begin{bmatrix} 4 & 1 \\ 1 & 4 \end{bmatrix}$  the eigen value are
- 3 and -3
  - 3 and -5
  - 3 and 5
  - 5 and 0
4. If  $x = a(\theta + \sin \theta)$  and  $y = a(1 - \cos \theta)$ , then  $\frac{dy}{dx}$  will be equal to
- $\sin\left(\frac{\theta}{2}\right)$
  - $\cos\left(\frac{\theta}{2}\right)$
  - $\tan\left(\frac{\theta}{2}\right)$
  - $\cot\left(\frac{\theta}{2}\right)$
5. The angle between two unit-magnitude coplanar vectors  $P(0.866, 0.500, 0)$  and  $Q(0.259, 0.966, 0)$  will be
- $0^\circ$
  - $30^\circ$
  - $45^\circ$
  - $60^\circ$
6. The sum of the eigen values of the matrix given below is  $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$
- 5
  - 7
  - 9
  - 18
7. The second moment of a circular area about the diameter is given by ( $D$  is the diameter)
- $\frac{\pi D^4}{4}$
  - $\frac{\pi D^4}{16}$
  - $\frac{\pi D^4}{32}$
  - $\frac{\pi D^4}{64}$
8. A concentrated load of  $P$  acts on a simply supported beam of span  $L$  at a distance  $\frac{L}{3}$  from the left support. The bending moment at the point of application of the load is given by
- $\frac{PL}{3}$
  - $\frac{2PL}{3}$
  - $\frac{PL}{9}$
  - $\frac{2PL}{9}$
9. Two identical circular rods of same diameter and same length are subjected to same magnitude of axial tensile force. One of the rods is made out of mild steel having the modulus of elasticity of 206 GPa. The other rod is made out of cast iron having the modulus of elasticity of 100 GPa. Assume both the materials to be homogeneous and isotropic and the axial force causes the same amount of uniform stress in both the rods. The stresses developed are within the proportional limit of the respective materials. Which of the following observations is correct?
- Both rods elongate by the same amount
  - Mild steel rod elongates more than the cast iron
  - Cast iron rod elongates more than the mild steel rod

- d. As the stresses are equal strains are also equal in both the rods
10. The beams, one having square cross section and another circular cross-section, are subjected to the same amount of bending moment. If the cross sectional area as well as the material of both the beams are the same then
- maximum bending stress developed in both the beams is the same
  - the circular beam experience more bending stress than the square one
  - the square beam experiences more bending stress than the circular one
  - as the material is same both beams will experience same deformation
11. Consider the arrangement shown in the figure below where  $J$  is the combined polar mass moment of inertia of the disc and the shafts.  $K_1, K_2, K_3$  are the torsional stiffness of the respective shafts. The natural frequency of torsional oscillation of the disc is given by
- 
- $\sqrt{\frac{K_1 + K_2 + K_3}{J}}$
  - $\sqrt{\frac{K_1 K_2 + K_2 K_3 + K_3 K_1}{J(K_1 + K_2)}}$
  - $\sqrt{\frac{K_1 + K_2 + K_3}{J(K_1 K_2 + K_2 K_3 + K_3 K_1)}}$
  - $\sqrt{\frac{K_1 K_2 + K_2 K_3 + K_3 K_1}{J(K_1 + K_2)}}$
12. Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240 MPa. If the shaft diameter is doubled then the maximum shear stress developed corresponding to the same torque will be
- 120 MPa
  - 60 MPa
  - 30 MPa
  - 15 MPa
13. The mechanism used in a shaping machine is
- a closed 4-bar chain having 4 revolute pairs
  - a closed 6-bar chain having 6 revolute pairs
  - a closed 4-bar chain having 2 revolute and 2 sliding pairs
  - an inversion of the single slider-crank chain
14. The lengths of the links of a 4-bar linkage with revolute pairs only are  $p, q, r$  and  $s$  units. Given that  $p < q < r < s$ . Which of these links should be the fixed one, for obtaining a "double crank" mechanism?
- links of length  $p$
  - links of length  $q$
  - link of length  $r$
  - link of length  $s$
15. When a cylinder is located in a Vee-block, the number of degrees of freedom which are arrested is
- 2
  - 4
  - 7
  - 8
16. A wire rope is designated as  $6 \times 19$  standard hoisting. The numbers  $6 \times 9$  represent
- diameter in millimeter x length in meter
  - diameter in centimeter x length in meter
  - number of strands x number of wires in each strand
  - number of wires in each strand x number of strands
17. A cylindrical body of cross-sectional area  $A$ , height  $H$  and density  $\rho_1$ , is immersed to a depth  $h$  in a liquid of density  $\rho$ , and tied to the bottom with a string. The tension in the string is
- 
- $\rho g h A$
  - $(\rho_1 - \rho) g h A$
  - $(\rho - \rho_1) g h A$
  - $(\rho h - \rho_1 H) g A$