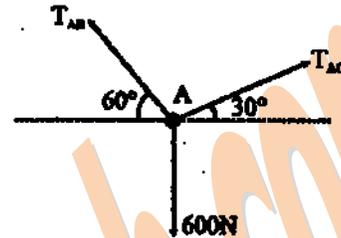


# MECHANICAL ENGINEERING

## ONE MARKS QUESTIONS

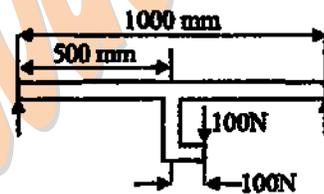
- The minimum value of function  $y = x^2$  in the interval  $[1, 5]$  is
  - 0
  - 1
  - 25
  - undefined
- If a square matrix  $A$  is real and symmetric, then the eigenvalues
  - are always real
  - are always real and positive
  - are always real and non-negative
  - occur in complex conjugate pairs
- If  $\phi(x, y)$  and  $\psi(x, y)$  are functions with continuous second derivatives, then  $\phi(x, y) + i\psi(x, y)$  can be expressed as an analytic function of  $x + iy(i - \sqrt{-1})$ , when
  - $\frac{\partial \phi}{\partial x} = \frac{\partial \psi}{\partial y}, \frac{\partial \phi}{\partial y} = \frac{\partial \psi}{\partial x}$
  - $\frac{\partial \phi}{\partial y} = -\frac{\partial \psi}{\partial x}, \frac{\partial \phi}{\partial x} = \frac{\partial \psi}{\partial y}$
  - $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = \frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} = 1$
  - $\frac{\partial \phi}{\partial x} + \frac{\partial \phi}{\partial y} = \frac{\partial \psi}{\partial x} + \frac{\partial \psi}{\partial y} = 0$
- The partial differential equation  $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + \left(\frac{\partial \phi}{\partial x}\right) + \left(\frac{\partial \phi}{\partial y}\right) = 0$  has
  - degree 1 order 2
  - degree 1 order 1
  - degree 2 order 1
  - degree 2 order 2
- If a system is in equilibrium and the position of the system depends upon many independent variables, the principle of virtual work states that the partial derivatives of its total potential energy with respect to each of the independent variable must be
  - 1.0
  - 0
  - 1.0
  - $\infty$

- If point A is in equilibrium under the action of the applied forces, the values of tensions  $T_{AB}$  and  $T_{AC}$  are respectively.



- 520 N and 300 N
- 300 N and 520 N
- 450 N and 150 N
- 150 N and 450 N

- In a simply-supported beam loaded as shown below, the maximum bending moment in Nm is



- 25
- 30
- 35
- 60

- A steel rod of length  $L$  and diameter  $D$ , fixed at both ends, is uniformly heated to a temperature rise of  $\Delta T$ . The Young's modulus is  $E$  and the coefficient of linear expansion is  $\alpha$ . The thermal stress in the rod is
  - 0
  - $\alpha T$
  - $E\alpha\Delta T$
  - $E\alpha\Delta TL$
- For an under damped harmonic oscillator, resonance
  - occurs when excitation frequency is greater than undamped natural frequency
  - occurs when excitation frequency is less than undamped natural frequency
  - occurs when excitation frequency is equal to undamped natural frequency

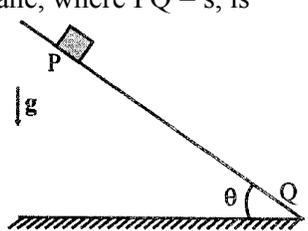
- d. never occurs
10. A ball bearing operating at a load  $F$  has 8000 hours of life. The life of the bearing, in hours, when the load is doubled to  $2F$  is
- 8000
  - 6000
  - 4000
  - 1000
11. Consider an incompressible laminar boundary layer flow over a flat plate of length  $L$ , aligned with the direction of an oncoming uniform free stream, If  $F$  is the ratio of the drag force on the front half of the plate to the drag force the rear half, then
- $F < 1/2$
  - $F = 1/2$
  - $F = 1$
  - $F > 1$
12. In a steady flow through a nozzle, the flow velocity on the nozzle axis is given by  $v = u_0(1 + 3x/L)i$ , where  $x$  is the distance along the axis of the nozzle from its inlet plane and  $L$  is the length of the nozzle, The time required for a fluid particle on the axis to travel from the inlet to the exit plane of the nozzle is
- $\frac{L}{u_0}$
  - $\frac{L}{3u_0} \ln 4$
  - $\frac{L}{4u_0}$
  - $\frac{L}{2.5u_0}$
13. Consider steady laminar incompressible axi-symmetric fully developed viscous flow through a straight circular pipe of constant cross-sectional area at a Reynolds number of 5. The ratio of inertia force to viscous force on a fluid particle is
- 5
  - 1/5
  - 0
  - $\infty$
14. Which of the following relationships is valid only for reversible processes undergone by a closed system of simple compressible substance (neglect changes in kinetic and potential energy)?
- $\delta Q = dU + \delta W$
  - $T dS = dU + p dV$
  - $T dS = dU + \delta W$
  - $\delta Q = dU + p dV$
15. Water has a critical specific volume of  $0.003155 \text{ m}^3/\text{kg}$ . A closed and rigid steel tank of volume  $0.025 \text{ m}^3$  contains a mixture of water and steam at  $0.1 \text{ MPa}$ . The mass of the mixture is  $10 \text{ kg}$ . The tank is now slowly heated. The liquid level inside the tank
- will rise
  - will fall
  - will remain constant
  - may rise or fall depending on the amount of heat transferred
16. If a particular Fe-C alloy contains less than  $0.83\%$  carbon, it is called
- High speed steel
  - hypereutectoid steel
  - hypereutectoid steel
  - cast iron
17. Which of the following engineering materials is the most suitable candidate for hot chamber die casting?
- low carbon steel
  - titanium
  - copper
  - tin
18. Which one of the following is a solid state joining process?
- gas tungsten arc welding
  - resistance spot welding
  - friction welding
  - submerged arc welding
19. In orthogonal turning of a low carbon steel bar of diameter  $150 \text{ mm}$  with uncoated carbide tool, the cutting velocity is  $90 \text{ m/min}$ . The feed is  $0.24 \text{ mm/rev}$  and the depth of cut is  $2 \text{ mm}$ . The chip thickness obtained is  $0.48 \text{ mm}$ . If the orthogonal rake angle is zero and the principal cutting edge angle is  $90^\circ$ , the shear angle in degree is
- 20.56
  - 26.56
  - 30.56
  - 36.56
20. Which type of motor is NOT used in axis or spindle drives of CNC machine tools?
- induction motor
  - dc servo motor
  - stepper motor

- d. linear servo motor
21. Volume of a cube of side 'l' and volume of a sphere of radius 'r' are equal. Both the cube and the sphere are solid and of same material. They are being cast. The ratio of the solidification time of the cube to the same of sphere is
- $\left(\frac{4\pi}{6}\right)^3 \left(\frac{r}{l}\right)^6$
  - $\left(\frac{4\pi}{6}\right) \left(\frac{r}{l}\right)^2$
  - $\left(\frac{4\pi}{6}\right)^2 \left(\frac{r}{l}\right)^3$
  - $\left(\frac{4\pi}{6}\right)^2 \left(\frac{r}{l}\right)^4$

### TWO MARKS QUESTIONS

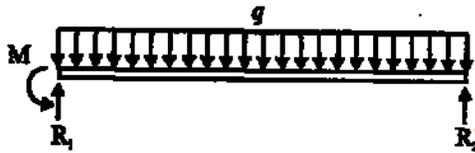
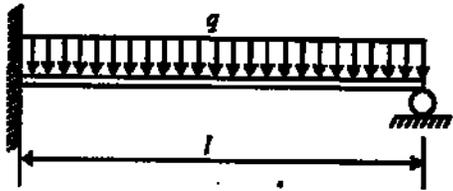
22. If,  $y = x + \sqrt{x + \sqrt{x + \sqrt{x + \dots \infty}}}$ , then  $y(2) =$
- 4 or 1
  - 4 only
  - 1 only
  - undefined
23. The area of a triangle formed by the tips of vectors  $\vec{a}, \vec{b}$  and  $\vec{c}$  is
- $\frac{1}{2}(\vec{a} - \vec{b}) \cdot (\vec{a} - \vec{c})$
  - $\frac{1}{2}|(\vec{a} - \vec{b}) \times (\vec{a} - \vec{c})|$
  - $\frac{1}{2}|\vec{a} \times \vec{b} \times \vec{c}|$
  - $\frac{1}{2}(\vec{a} \times \vec{b}) \cdot \vec{c}$
24. The solution of  $\frac{dy}{dx} = y^2$  with initial value  $y(0) = 1$  bounded in the interval
- $-\infty \leq x \leq 8$
  - $-\infty \leq x \leq 1$
  - $x < 1, x > 1$
  - $-2 \leq x \leq 2$
25. If  $F(s)$  is the Laplace transform of function  $f(t)$ , then Laplace transform of  $\int_0^t f(\tau) d\tau$  is
- $\frac{1}{s} F(s)$
  - $\frac{1}{s} F(s) - f(0)$
  - $sF(s) - f(0)$

d.  $\int F(s) ds$

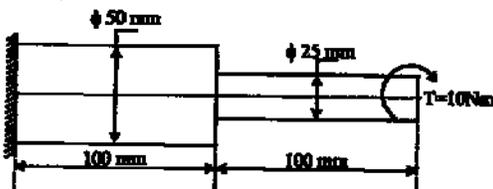
26. A calculator has accuracy up to 8 digits after decimal place. The value of  $\int_0^{2\pi} \sin x dx$  when evaluated using this calculator by trapezoidal method with 8 equal intervals, to 5 significant digits is
- 0.00000
  - 1.0000
  - 0.00500
  - 0.00025
27. Let X and Y be two independent random variables, Which one of the relations between expectation (E), variabce (Var) and covariance (Cov) given below is FALSE?
- $E(XY) = E(X) E(Y)$
  - $\text{Cov}(X, Y) = 0$
  - $\text{Var}(X + Y) = \text{Var}(X) + \text{Var}(Y)$
  - $E(X^2 Y^2) = (E(X))^2 (E(Y))^2$
28.  $\lim_{x \rightarrow 0} \frac{e^x - \left(1 + x + \frac{x^2}{2}\right)}{x^3} =$
- 0
  - 1/6
  - 1/3
  - 1
29. The number of linearly independent eigenvectors of  $\begin{bmatrix} 2 & 1 \\ 0 & 2 \end{bmatrix}$  is
- 0
  - 1
  - 2
  - infinite
30. A block of mass M is released from point P on a rough inclined plane with inclination angle  $\theta$ , shown in the figure below. The coefficient of friction is  $\mu$ . If  $\mu < \tan \theta$ , then the time taken by the block to reach another point Q on the inclined plane, where  $PQ = s$ , is
- 
- $\sqrt{\frac{2s}{g \cos \theta (\tan \theta - \mu)}}$

- b.  $\sqrt{\frac{2s}{g \cos \theta (\tan \theta + \mu)}}$
- c.  $\sqrt{\frac{2s}{g \sin \theta (\tan \theta - \mu)}}$
- d.  $\sqrt{\frac{2s}{g \sin \theta (\tan \theta + \mu)}}$

31. A uniformly loaded propped cantilever beam and its free body diagram is shown below. The reactions are



- a.  $R_1 = \frac{5ql}{8}, R_2 = \frac{3ql}{8}, M = \frac{ql^2}{8}$
  - b.  $R_1 = \frac{3ql}{8}, R_2 = \frac{5ql}{8}, M = \frac{ql^2}{8}$
  - c.  $R_1 = \frac{5ql}{8}, R_2 = \frac{3ql}{8}, M = 0$
  - d.  $R_1 = \frac{3ql}{8}, R_2 = \frac{5ql}{8}, M = 0$
32. A  $200 \times 100 \times 50$  mm steel block is subjected to a hydrostatic pressure of 15 MPa. The Young's modulus and Poisson's ratio of the material are 200 GPa and 0.3 respectively. The change in the volume of the block in  $\text{mm}^3$  is
- a. 85
  - b. 90
  - c. 100
  - d. 110
33. A stepped steel shaft shown below is subjected to 10 Nm torque. If the modulus of rigidity is 80 GPa, the strain energy in the shaft in N mm is



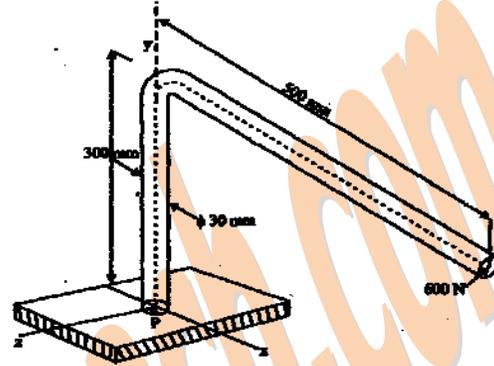
- a. 4.12
- b. 3.46

- c. 1.73
- d. 0.86

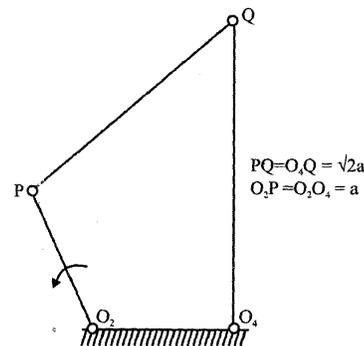
**Statement for Linked Answer**

**Questions 34 & 35:**

A machine frame shown in the figure below is subjected to a horizontal force of 600 N parallel to z-direction.

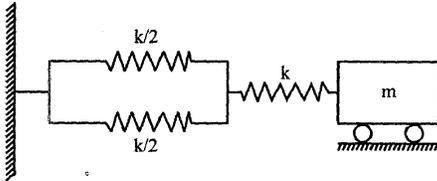


34. The normal and shear stresses in MPa at point P are respectively
- a. 67.9 and 56.6
  - b. 56.6 and 67.9
  - c. 67.9 and 0.0
  - d. 0.0 and 56.6
35. The maximum principal stress in MPa and the orientation of the corresponding principal plane in degrees are respectively
- a. -32.0 and -29.52
  - b. 100.0 and 60.48
  - c. -32.0 and 60.48
  - d. 100.0 and -29.52
36. The input link  $O_2P$  of a four bar linkage is rotated at 2 rad/s in counter clockwise direction as shown below, The angular velocity of the coupler PQ in rad/s, at an instant when  $\angle O_4O_2P = 180^\circ$ , is



- a. 4
- b.  $2\sqrt{2}$
- c. 1

- d.  $1\sqrt{2}$
37. The speed of an engine varies from 210 rad/s to 190 rad/s. During cycle the change in kinetic energy is found to be 400 Nm. The inertia of the flywheel in  $\text{kgm}^2$  is
- 0.10
  - 0.20
  - 0.30
  - 0.40
38. The natural frequency of the system shown below is

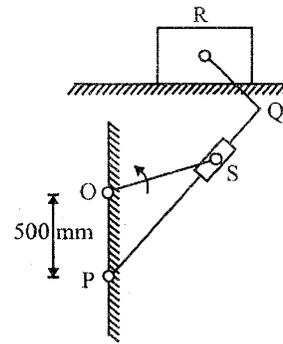


- $\sqrt{\frac{k}{2m}}$
  - $\sqrt{\frac{k}{m}}$
  - $\sqrt{\frac{2k}{m}}$
  - $\sqrt{\frac{3k}{m}}$
39. The equation of motion of a harmonic oscillator is given by  $\frac{d^2x}{dt^2} + 2\xi\omega_n \frac{dx}{dt} + \omega_n^2 x = 0$  and the initial conditions at  $t = 0$  are  $x(0) = X$ ,  $\frac{dx}{dt}(0) = 0$ . The amplitude of  $x(t)$  after  $n$  complete cycles is

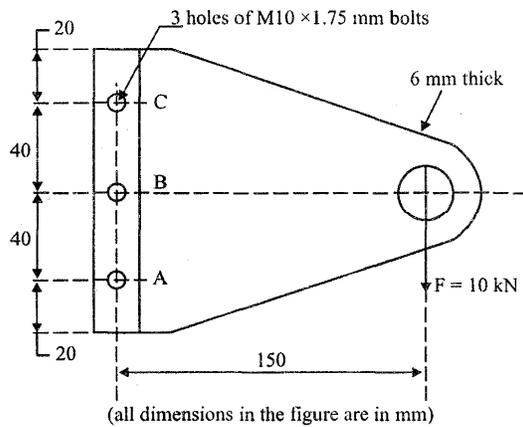
- $Xe^{-2n\pi\left(\frac{\xi}{\sqrt{1-\xi^2}}\right)}$
- $Xe^{2n\pi\left(\frac{\xi}{\sqrt{1-\xi^2}}\right)}$
- $Xe^{-2n\pi\left(\frac{\sqrt{1-\xi^2}}{\xi}\right)}$
- $X$

**Statement for Linked Answer Questions 40-41:**

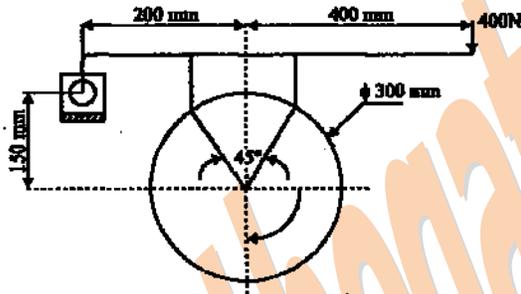
A quick return mechanism is shown below. The crank OS is driven at 2 rev/s in counter clockwise direction.



40. If the quick return ratio is 1: 2, then the length of the crank in mm is
- 250
  - $250\sqrt{3}$
  - 500
  - $500\sqrt{3}$
41. The angular speed of PQ in rev/s when the block R attains maximum speed during forward stroke (stroke with slower speed) is
- 1/3
  - 2/3
  - 2
  - 3
42. A thin spherical pressure vessel of 200 mm diameter and 1 mm thickness is subjected to an internal pressure varying from 4 to 8 MPa. Assume that the yield, ultimate, and endurance strength of material are 600, 800 and 400 MPa respectively. The factor of safety as per Goodman's relation is
- 2.0
  - 1.6
  - 1.4
  - 1.2
43. A natural feed journal bearing of diameter 50 mm and length 50 mm operating at 20 revolution/sec. carries a load of 2.0 kN. The lubricant used has a viscosity of 20 MPa/s. The radial clearance is 50  $\mu\text{m}$ . The sommerfield number for the bearings is
- 0.062
  - 0.125
  - 0.250
  - 0.785
44. A bolted joint is shown below. The maximum shear stress, in MPa, in the bolts at A and B, respectively are



- a. 242.6, 42.5  
 b. 42.5, 242.6  
 c. 42.5, 42.5  
 d. 242.6, 242.6
45. A block-brake shown below has a face width of 300mm and a mean coefficient of friction of 0.25. For an activating force of 400 N, the braking torque in Nm is



- a. 30  
 b. 40  
 c. 45  
 d. 60
46. The piston rod of diameter 20 mm and length 700 mm in a hydraulic cylinder is subjected to a compressive force of 10 kN due to the internal pressure. The end conditions for the rod may be assumed as guided at the piston end and hinged at the other end. The Young's modulus is 200 GPa. The factor of safety for the piston rod is
- a. 0.68  
 b. 2.75  
 c. 5.62  
 d. 11.0

### Statement for Linked Answer

#### Questions 47 to 49:

A gear set has a pinion with 20 teeth and a gear with 40 teeth. The pinion runs at 30rev/s and

transmits a power of 20 kW. The teeth are on the 20° full-depth system and have a module of 5mm. The length of the line of action is 19mm.

47. The center distance for the above gear set in mm is
- a. 140  
 b. 150  
 c. 160  
 d. 170
48. The contact ratio of the contacting tooth is
- a. 1.21  
 b. 1.25  
 c. 1.29  
 d. 1.33
49. The resultant force on the contacting gear tooth is N is
- a. 77.23  
 b. 212.20  
 c. 225.80  
 d. 289.43
50. The inlet angle of runner blades of a Francis turbine is 90°. The blades are so shaped that the tangential component of velocity at blade outlet is zero. The flow velocity remains constant throughout the blade passage and is equal to half of the blade velocity at runner inlet. The blade efficiency of the runner is
- a. 25%  
 b. 50%  
 c. 80%  
 d. 89%
51. A model of a hydraulic turbine is tested at a head of 1/4<sup>th</sup> of that under which the full scale turbine works. The diameter of the model is half of that of the full scale turbine. If N is the RPM of the full scale turbine, then the RPM of the model will be
- a. N/4  
 b. N/2  
 c. N  
 d. 2N
52. Which combination of the following statements about steady incompressible forced vortex flow is correct?  
 P: Shear stress is zero at all points in the flow.  
 Q: Vorticity is zero at all points in the flow.  
 R: Velocity is directly proportional to the radius from the centre of the vortex.

S: Total mechanical energy per unit mass is constant in the entire flow field.

- P and Q
- R and S
- P and R
- P and S

53. Match the items in columns I and II.

**Column I**

P: Centrifugal compressor

Q: Centrifugal pump

R: Pelton wheel

S: Kaplan turbine

**Column II**

1. Axial flow

2. Surging

3. Priming

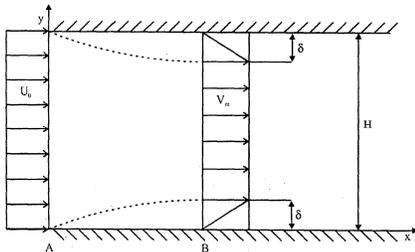
4. Pure impulse

- P-2, Q-3, R-4, S-1
- P-2, Q-3, R-1, S-4
- P-3, Q-4, R-1, S-2
- P-1, Q-2, R-3, S-4

**Statement for linked Answer Questions**

**54 & 55**

Consider a steady incompressible flow through a channel as shown below.



The velocity profile is uniform with a value of  $u_0$  at the inlet section A. The velocity profile at section B downstream is

$$u = \begin{cases} V_m \frac{y}{\delta}, & 0 \leq y \leq \delta \\ V_m, & \delta \leq y \leq H - \delta \\ V_m \frac{H - y}{\delta}, & H - \delta \leq y \leq H \end{cases}$$

54. The ratio  $V_m/u_0$  is

- $\frac{1}{1 - 2(\delta/H)}$
- 1
- $\frac{1}{1 - (\delta/H)}$
- $\frac{1}{1 + (\delta/H)}$

55. The ratio  $\frac{P_A - P_B}{\frac{1}{2}\rho u_0^2}$  (where  $P_A$  and  $P_B$  are the

pressures at section A and B, respectively, and  $\rho$  is the density of the fluid) is

- $\frac{1}{(1 - (\delta/H))^2} - 1$
- $\frac{1}{[1 - (\delta/H)]^2}$
- $\frac{1}{(1 - (2\delta/H))^2} - 1$
- $\frac{1}{1 + (\delta/H)}$

56. The temperature distribution within the thermal boundary layer over a heated isothermal flat plate is given by

$$\frac{T - T_w}{T_\infty - T_w} = \frac{3}{2} \left( \frac{y}{\delta_t} \right) - \frac{1}{2} \left( \frac{y}{\delta_t} \right)^3, \text{ where } T_w \text{ and } T_\infty \text{ are the temperatures of plate and free stream respectively, and } y \text{ is the normal distance measured from the plate. The local Nusselt number based on the thermal boundary layer thickness } \delta_t \text{ is given by}$$

- 1.33
- 1.50
- 2.0
- 4.64

57. In a counter flow heat exchanger, hot fluid enters at  $60^\circ\text{C}$  and cold fluid leaves at  $30^\circ\text{C}$ . Mass flow rate of the hot fluid is 1 kg/s and that of the cold fluid is 2 kg/s. Specific heat of the hot fluid is 10 kJ/kgK and that of the cold fluid is 5 kJ/kgK. The Log Mean Temperature Difference (LMTD) for the heat exchanger in  $^\circ\text{C}$  is

- 15
- 30
- 35
- 45

58. The average heat transfer coefficient on a thin hot vertical plate suspended in still air can be determined from observations of the change in plate temperature with time as it cools. Assume the plate temperature to be uniform at any instant of time and radiation heat exchange with the surroundings negligible. The ambient temperature is  $25^\circ\text{C}$ , the plate has a total surface area of  $0.1 \text{ m}^2$  and a mass of 4 kg. The specific heat of the plate material is 2.5 kJ/kgK. The convective heat transfer

coefficient in  $\text{W/m}^2\text{K}$ , at the instant when the plate temperature is  $225^\circ\text{C}$  and the change in plate temperature with time  $dT/dt = -0.02 \text{ K/s}$ , is

- 200
  - 20
  - 15
  - 10
59. A heat transformer is device that transfers a part of the heat, supplied to it at an intermediate temperature, to a high temperature reservoir while rejecting the remaining part to a low temperature heat sink. In such a heat transformer, 100 kJ of heat is supplied at 350 K. The maximum amount of heat in kJ that can be transferred to 400 K, when the rest is rejected to a heat sink at 300K is
- 12.50
  - 14.29
  - 33.33
  - 57.14

### Statement for linked Answer

#### Questions 60 & 61:

Consider steady one-dimensional heat flow in a plate of 20 mm thickness with a uniform heat generation of  $80 \text{ MW/m}^3$ . The left and right faces are kept at constant temperatures of  $160^\circ\text{C}$  and  $120^\circ\text{C}$  respectively. The plate has a constant thermal conductivity of  $200 \text{ W/mK}$ .

60. The location of maximum temperature within the plate from its left face is
- 15 mm
  - 10 mm
  - 5 mm
  - 0 mm
61. The maximum temperature within the plate is  $^\circ\text{C}$  is
- 160
  - 165
  - 200
  - 250
62. The stroke and bore of a four stroke spark ignition engine are 250mm and 200 mm respectively. The clearance volume is  $0.001 \text{ m}^3$ . If the specific heat ratio  $\gamma = 1.4$ , the air- standard cycle efficiency of the engine is
- 46.40%
  - 56.10%

- 58.20%
- 62.80%

63. Which combination of the following statements is correct?

The incorporation of reheater in a steam power plant:

P: always increases the thermal efficiency of the plant.

Q: always increases the dryness fraction of steam at condenser inlet.

R: always increases the mean temperature of heat addition.

S: always increases the specific work output.

- P and S
- Q and S
- P, R and S
- P, Q, R and S

64. Which combination of the following statements is correct?

P: A gas cools upon expansion only when its Joule - Thomson coefficient is positive in the temperature range of expansion.

Q: For a system undergoing a process, its entropy remains constant only when the process is reversible.

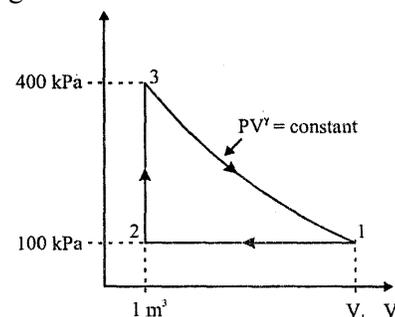
R: The work done by a closed system in an adiabatic is a point function.

S: A liquid expands upon freezing when the slope of its fusion curve on pressure-temperature diagram is negative.

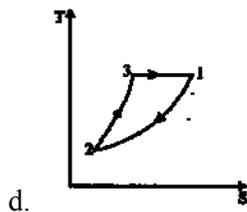
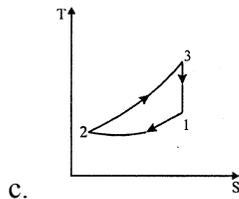
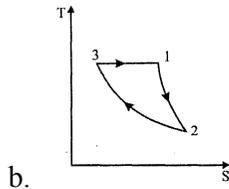
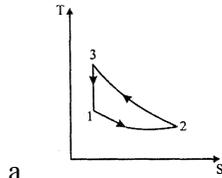
- R and S
- P and Q
- Q, R and S
- P, Q and R

### Common data for questions 65 & 66

A thermodynamic cycle with an ideal gas as working fluid is shown below



65. The above cycle is represented on T-S plane by



66. If the specific heats of the working fluid are constant and the value of specific heat ratio is 1.4, the thermal efficiency (%) of the cycle is
- 21
  - 40.9
  - 42.6
  - 59.7
67. A building has to be maintained at  $21^{\circ}\text{C}$  (dry bulb) and  $14.5^{\circ}\text{C}$  (wet bulb). The dew point temperature under these conditions is  $10.17^{\circ}\text{C}$ . The outside temperature is  $-23^{\circ}\text{C}$  (dry bulb) and the internal and external surface heat transfer coefficients are  $8 \text{ W/m}^2\text{K}$  and  $23 \text{ W/m}^2\text{K}$  respectively. If the building wall has a thermal conductivity of  $1.2 \text{ W/mK}$ , the minimum thickness (in m) of the wall required to prevent condensation is
- 0.471
  - 0.407
  - 0.321
  - 0.125
68. Atmospheric air at a flow rate of  $3 \text{ kg/s}$  (on dry basis) enters a cooling and dehumidifying coil with an enthalpy of  $85 \text{ kJ/kg}$  of dry air and a humidity ratio of  $19 \text{ grams/kg}$  of dry air. The air leaves the coil

with an enthalpy of  $43 \text{ kJ/kg}$  of dry air and a humidity ratio of  $8 \text{ grams/kg}$  of dry air. If the condensate water leaves the coil with an enthalpy of  $67 \text{ kJ/kg}$ , the required cooling capacity of the coil in kW is

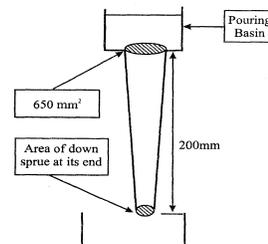
- 75.0
  - 123.8
  - 128.2
  - 159.0
69. In electro discharge machining (EDM), if the thermal conductivity of tools is high and the specific heat of work piece is low, then the tool wear rate and material removal rate are expected to be respectively
- high and high
  - low and low
  - high and low
  - low and high
70. In orthogonal turning of medium carbon steel, the specific machining energy is  $2.0 \text{ J/mm}^3$ . The cutting velocity, feed and depth of cut are  $120 \text{ m/min}$ ,  $0.2 \text{ mm/rev}$  and  $2 \text{ mm}$  respectively. The main cutting force in N is
- 40
  - 80
  - 400
  - 800
71. A direct current welding machine with a linear power source characteristic provides open circuit voltage of  $80 \text{ V}$  and short circuit current of  $800 \text{ A}$ . During welding with the machine, the measured arc current is  $500 \text{ A}$  corresponding to an arc length of  $5.0 \text{ mm}$  and the measured arc current is  $460 \text{ A}$  corresponding to an arc length of  $7.0 \text{ mm}$ . The linear voltage (E)-arc length (L)-characteristic of the welding arc can be given as (where E is in Volt and L is in mm)
- $E = 20 + 2L$
  - $E = 20 + 8L$
  - $E = 80 + 8L$
  - $E = 80 + 2L$
72. A hole is specified as  $40_{0.000}^{0.050} \text{ mm}$ . The mating shaft has a clearance fit with minimum clearance of  $0.01 \text{ mm}$ . The tolerance on the shaft is  $0.04 \text{ mm}$ . The maximum clearance in mm between the hole and the shaft is
- 0.04
  - 0.05

- c. 0.10  
d. 0.11
73. In orthogonal turning of low carbon steel pipe with principal cutting edge angle of  $90^\circ$ , the main cutting force is 1000 N and the feed force is 800 N. The shear angle is  $25^\circ$  and orthogonal rake angle is zero. Employing Merchant's theory, the ratio of friction force to normal force acting on the cutting tool is
- 1.56
  - 1.25
  - 0.80
  - 0.64
74. Two metallic sheets, each of 2.0 mm thickness, are welded in a lap joint configuration by resistance spot welding at a welding current of 10 kA and welding time of 10 millisecond. A spherical fusion zone extending up to the full thickness of each sheet is formed a properties of the metallic sheets are given as:  
ambient temperature = 293 K  
melting temperature = 1793 K  
density =  $7000 \text{ kg/m}^3$   
latent heat of fusion = 300 kJ/kg  
specific heat 800 J/kgK  
Assume: (i) contact resistance along sheet-interface is 500 micro-ohms and along electrode- sheet interface is zero; (ii) no conductive heat loss through the bulk sheet materials; and (iii) the complete weld fusion zone is at the melting temperature. The melting efficiency (in %) of the process is
- 50.37
  - 60.37
  - 70.37
  - 80.37
75. In open-die forging, a disc of diameter 200mm and height 60 mm is compressed without any barreling effect. The final diameter of the disc is 400 mm. The true strain is
- 1.986
  - 1.686
  - 1.386
  - 0.602
76. The thickness of a metallic sheet is reduced from an initial value of 16mm to a final value of 10mm in one single pass rolling with a pair of cylindrical rollers

each of diameter of 400 mm. The bite angle in degree will be

- 5.936
  - 7.936
  - 8.936
  - 9.936
77. Match the correct combination for following metal working processes.
- Processes**  
P - Blanking  
Q - Stretch Forming  
R - Coining  
S - Deep Drawing
- Associated state of stress**
- Tension
  - Compression
  - Shear
  - Tension and Compression
  - Tension and shear
- P-2, Q-1, R-3, S-4
  - P-3, Q-4, R-1, S-S
  - P-5, Q-3, R-3, S-1
  - P-3, Q-1, R-2, S-4

78. A 200 mm long down sprue has an are of cross-section of  $650 \text{ mm}^2$  where the pouring basin meets the down sprue (i.e. at the beginning of the down sprue). A constant head of molten metal is maintained by the pouring basin. The moltan metal flow rate is  $6.5 \times 10 \text{ mm}^3/\text{s}$ . Considering the end of down sprue to be open to atmspere and an acceleration due to gravity of  $10 \text{ mm/s}^2$ , the area of the down sprue in  $\text{mm}^2$  at its end (avoiding aspiration effect) should be



- 650.0
  - 350.0
  - 5.0
  - 190.0
79. The force requirement in a blanking operation of low carbon steel sheet is 5.0 kN. The thickness of the sheet is 't' and diameter of the blanked part is 'd'. For the same work material, if the diameter of the blanked part is increased to 1.5 d and

thickness is reduced to 0.4t, the new blanking force in kN is

- 3.0
- 4.5
- 290.7
- 8,0

80. Match the most suitable manufacturing processes for the following parts.

**Parts**

- P-Computer chip
- Q-Metal forming dies and molds
- R-Turbine blade
- S-Glass

**Manufacturing Processes**

- Electrochemical Machining
  - Ultrasonic Machining
  - Electro discharge Machining
  - Photochemical Machining
- P-4, Q-3, R-1, S-2
  - P-4, Q-3, R-2, S-1
  - P-3, Q-1 R-4, S-2
  - P-1 Q-2, R-4, S-3

**Statement for Linked Answer Question 81-82:**

A low carbon steel bar of 147mm diameter with a length of 630mm is being turned with uncoated carbide insert. The observed tool lives are 24 mm and 12 mm for cutting velocities of 90m/min and 120 m/min respectively. The feed and depth of cut are 0.2 mm/rev and 2 mm respectively. Use the unsharpened diameter to calculate the cutting velocity.

81. What tool life is 20 mm, the cutting velocity in m/min is

- 87
- 97
- 107
- 114

82. Neglect over-travel or approach of the tool. When tool life is 20 mm, the machining time in mm for a single pass is

- 5
- 10
- 15
- 20

83. Capacities of production of an item over 3 consecutive months in regular time are 100, 100 and 80 and in overtime are 20, 20 and 40. The demands over those 3 months are 90, 130 and 110. The cost of production in regular time and overtime

are respectively Rs. 20 per item and Rs. 24 per item. Inventory carrying cost is Rs. 2 per item month. The levels of starting and final inventory are nil. Backorder is not permitted. For minimum cost of plan, the level of planned production in overtime in the third month is

- 40
- 30
- 20
- 0

84. The maximum level of inventory of an item 100 and it is achieved with infinite replenishment rate. The inventory becomes zero over one and half month due to consumption at a uniform rate. This cycle continues throughout the year. Ordering cost is Rs. 100 per order and inventory carrying cost is Rs. 10 per item per month. Annual cost (in Rs.) of the plan, neglecting material cost, is

- 800
- 2800
- 4800
- 6800

85. In machine shop, pins of 15 mm diameter are produced at a rate of 1000 per month and the same is consumed at a rate of 500 per month. The production and consumption continue simultaneously till the maximum inventory is reached. Then inventory is allowed to reduce to zero due to consumption. The lot size of production is 1000. If backlog is not allowed, the maximum inventory level is

- 400
- 500
- 600
- 700

86. The net requirements of an item over 5 consecutive weeks are 50-0-15-20-20. The inventory carrying cost and ordering cost are Re. 1 per item per week and Rs. 100 per order respectively. Starting inventory is zero. Use "Least Unit Cost Technique" for developing the plan. The cost of the plan (in Rs.) is

- 200
- 250
- 225
- 260