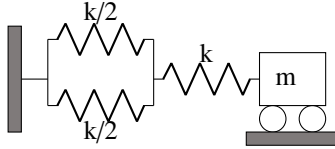


52) The natural frequency of the system shown below is



- a)  $\sqrt{\frac{k}{2m}}$       b)  $\sqrt{\frac{k}{m}}$       c)  $\sqrt{\frac{2k}{m}}$       d)  $\sqrt{\frac{3k}{m}}$

53) The equation of motion for a harmonic oscillator is given by:

$$\frac{d^2x}{dt^2} + 2\zeta\omega_n \frac{dx}{dt} + \omega_n^2 x = 0$$

and the initial condition at  $t = 0$  are  $x(0) = X$ ,  $\frac{dx}{dt}(0) = 0$ . The amplitude of  $x(t)$  after  $n$  complete cycles is

- a)  $Xe^{-2n\pi\left(\frac{\zeta}{\sqrt{1-\zeta^2}}\right)}$       c)  $Xe^{-2n\pi\left(\frac{\sqrt{1-\zeta^2}}{\zeta}\right)}$   
 b)  $Xe^{2n\pi\left(\frac{\zeta}{\sqrt{1-\zeta^2}}\right)}$       d)  $X$

54) 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

55) In electrodischarge machining (EDM), if the thermal conductivity of tool 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

- a) high and high      c) high and low  
 b) low and low      d) low and high

56) 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 m/min, 0.2 mm/rev and 2 mm respectively. The main cutting force in N is

- a) 40                      b) 80                      c) 400                      d) 800

57) A direct current welding machine with a linear power source characteristic provides open circuit voltage of 80 V and short circuit current of 800 A. During welding with the machine, the measured arc current is 500 A corresponding to an arc length of 5.0 mm and the measured arc current is 460 A corresponding to an arc length of 7.0 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)

- a)  $E = 20 + 2L$       b)  $E = 20 + 8L$       c)  $E = 80 + 2L$       d)  $E = 80 + 8L$

0.050

58) A hole is specified as  $40^{+0.000}_{-0.050}$  mm. The mating shaft has a clearance fit with minimum clearance of 0.01 mm. The tolerance on the shaft is 0.04 mm. The maximum clearance in mm between the hole and the shaft is

- a) 0.04                      b) 0.05                      c) 0.10                      d) 0.11

59) 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

- a) 1.56                      b) 1.25                      c) 0.80                      d) 0.64

60) 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. The properties of the metallic sheets are given as:

ambient temperature = 293 K

melting temperature = 1793 K

latent heat of fusion = 300 kJ/kg

density = 7000 kg/m<sup>3</sup>

specific heat 800 J/kgK

Assume: (i) contact resistance along sheet-sheet interface is 500 micro-ohm 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

- a) 50.37                      b) 60.37                      c) 70.37                      d) 80.37

61) 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 per 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

- a) 40                      b) 30                      c) 20                      d) 0

62) In open-die forging, a disc of diameter 200 mm and height 60 mm is compressed without any barreling effect. The final diameter of the disc is 400 mm. The true strain is

- a) 1.986                      b) 1.686                      c) 1.386                      d) 0.602

63) The thickness of a metallic sheet is reduced from an initial value of 16 mm to a final value of 10 mm in one single pass rolling with a pair of cylindrical rollers each of diameter of 400 mm. The bite angle in degree will be

- a) 5.936                      b) 7.936                      c) 8.936                      d) 9.936

64) Match the correct combination for following metal working processes

**Processes**

**Associated state of stress**

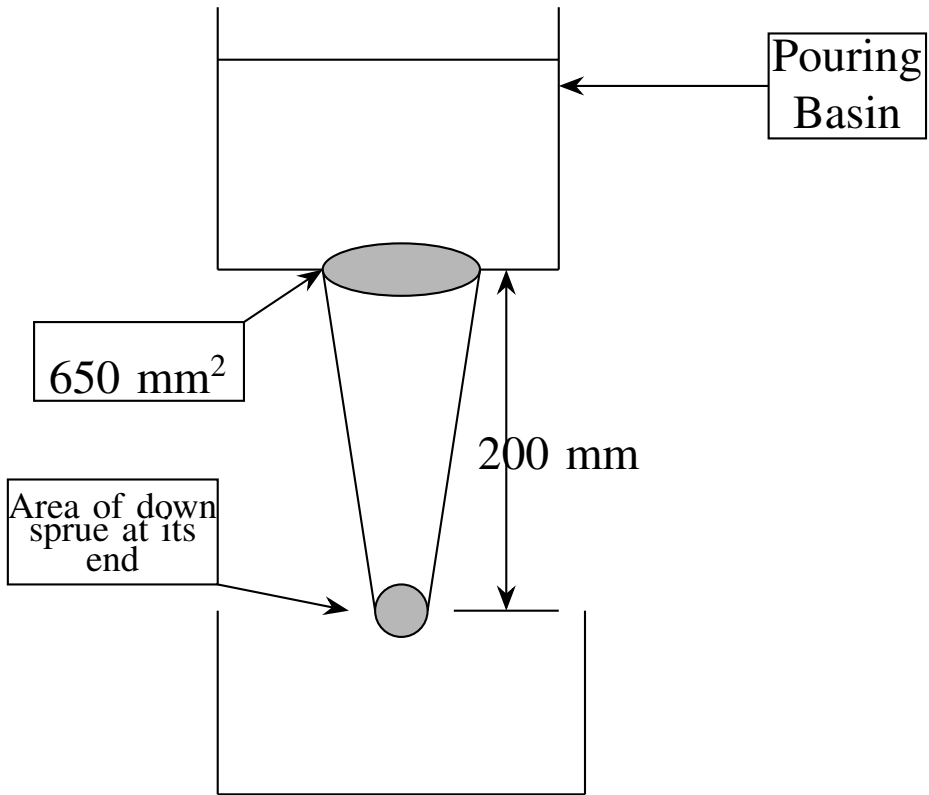
- |                     |                             |
|---------------------|-----------------------------|
| (A) Blanking        | (1) Tension                 |
| (B) Stretch Forming | (2) Compression             |
| (C) Coining         | (3) Shear                   |
| (D) Deep Drawing    | (4) Tension and Compression |
|                     | (5) Tension and Shear       |

- |                               |                               |
|-------------------------------|-------------------------------|
| a) A – 2, B – 1, C – 3, D – 4 | c) A – 5, B – 4, C – 3, D – 1 |
| b) A – 3, B – 4, C – 1, D – 5 | d) A – 3, B – 1, C – 2, D – 4 |

65) A 200 mm long down sprue has an area 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 molten metal flow rate is  $6.5 \times 10^5 \text{ mm}^3/\text{s}$ . Considering the end of down sprue to be open to atmosphere and an acceleration due to gravity of  $10^4 \text{ mm/s}^2$ , the area of the down sprue in  $\text{mm}^2$  at its end (avoiding aspirat effect) should be

- a) 650.0                      b) 350.0                      c) 290.7                      d) 190.0

66) 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 0.4 t, the new blanking force in kN is



- a) 3.0                      b) 4.5                      c) 5.0                      d) 8.0

67) Match the most suitable manufacturing processes for the following parts

**Parts**

- (A) Computer chip  
(B) Metal forming dies and molds  
(C) Turbine blade  
(D) Glass

**Manufacturing Processes**

- (1) Electrochemical Machining  
(2) Ultrasonic Machining  
(3) Electrodisharge Machining  
(4) Photochemical Machining

- a) A - 4, B - 3, C - 1, D - 2  
b) A - 4, B - 3, C - 2, D - 1

- c) A - 3, B - 1, C - 4, D - 2  
d) A - 1, B - 2, C - 4, D - 3

68) The maximum level of inventory of an item is 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(INRS.) of the plan, neglecting material cost, is

a) 800

b) 2800

c) 4800

d) 6800