

050/23

Question Booklet Alpha Code

A

Question Booklet Sl. No.

Total Number of Questions : 100

Time : 90 Minutes

Maximum Marks : 100

**INSTRUCTIONS TO CANDIDATES**

1. The Question Paper will be given in the form of a Question Booklet. There will be four versions of Question Booklets with Question Booklet Alpha Code viz. **A, B, C & D**.
2. The Question Booklet Alpha Code will be printed on the top left margin of the facing sheet of the Question Booklet.
3. The Question Booklet Alpha Code allotted to you will be noted in your seating position in the Examination Hall.
4. If you get a Question Booklet where the alpha code does not match to the allotted alpha code in the seating position, please draw the attention of the Invigilator **IMMEDIATELY**.
5. The Question Booklet Serial Number is printed on the top right margin of the facing sheet. If your Question Booklet is un-numbered, please get it replaced by new Question Booklet with same alpha code.
6. The Question Booklet will be sealed at the middle of the right margin. Candidate should not open the Question Booklet, until the indication is given to start answering.
7. Immediately after the commencement of the examination, the candidate should check that the Question Booklet supplied to him/her contains all the 100 questions in serial order. The Question Booklet does not have unprinted or torn or missing pages and if so he/she should bring it to the notice of the Invigilator and get it replaced by a complete booklet with same alpha code. This is most important.
8. A blank sheet of paper is attached to the Question Booklet. This may be used for rough work.
9. **Please read carefully all the instructions on the reverse of the Answer Sheet before marking your answers.**
10. Each question is provided with four choices **(A), (B), (C)** and **(D)** having one correct answer. Choose the correct answer and darken the bubble corresponding to the question number using Blue or Black Ball Point Pen in the OMR Answer Sheet.
11. **Each correct answer carries 1 mark and for each wrong answer 1/3 mark will be deducted. No negative mark for unattended questions.**
12. No candidate will be allowed to leave the examination hall till the end of the session and without handing over his/her Answer Sheet to the Invigilator. Candidates should ensure that the Invigilator has verified all the entries in the Register Number Coding Sheet and that the Invigilator has affixed his/her signature in the space provided.
13. Strict compliance of instructions is essential. Any malpractice or attempt to commit any kind of malpractice in the Examination will result in the disqualification of the candidate.

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1. Which of the following statements is true with regard to Atomic Packing Factor (APF) ?
  - A) APF of FCC is equal to APF of HCP
  - B) APF of SC is greater than APF of BCC
  - C) APF of BCC is greater than APF of HCP
  - D) APF of BCC is equal to APF of FCC
  
2. Which of the following pairs is matched correctly ?
  - A) Surface defect – Presence of extra partial planes
  - B) Point defect – Precipitates
  - C) Line defect – Grain boundary
  - D) Volume defect – Slag and porosity
  
3. Which of the following is true for Burger's vector in edge dislocation ?
  - A) Perpendicular to the dislocation line
  - B) Parallel to the dislocation line
  - C) Inclined to the dislocation line
  - D) None of these
  
4. A typical metallic sheet of 10 mm thickness and cross-sectional area of 0.25 m<sup>2</sup> is used as a steady state diffusion membrane in a hydrogen purifier. Find the mass of hydrogen purified in kg per second, if the difference in hydrogen concentration across the sheet is 1 kg/m<sup>3</sup> and the diffusion coefficient is 1 × 10<sup>-8</sup> m<sup>2</sup>/s.
  - A) 4 × 10<sup>-6</sup>
  - B) 2.5 × 10<sup>-7</sup>
  - C) 5 × 10<sup>-7</sup>
  - D) 3 × 10<sup>-6</sup>
  
5. Which of the following are true for austenite ?
  - i. It is a solid solution of iron, carbon and chromium
  - ii. It has FCC crystal structure
  - iii. It is stable at room temperature
  - iv. Pure austenite is stable in the temperature range of 912 – 1394°C
  - A) i and ii
  - B) ii and iii
  - C) i and iv
  - D) ii and iv
  
6. Which of the following statements agree with the Hume-Rothery Rules for solid solubility ?
  - A) The size difference between solvent and solute atoms must be less than 15%
  - B) Crystal structure of both the materials must be different
  - C) There should be large difference in electronegativity of the materials
  - D) The valency of the atoms of the materials must be different
  
7. In eutectic reaction, which of the following is true ?
  - A) Liquid + δ-ferrite ↔ Austenite
  - B) Austenite ↔ α-Ferrite + Cementite
  - C) Liquid ↔ Austenite + Cementite
  - D) Ferrite ↔ Austenite + Cementite

8. The case hardening technique suitable for steels with very low carbon content
- |                            |                        |
|----------------------------|------------------------|
| A) Cyaniding               | B) Induction hardening |
| C) Electron beam hardening | D) Flame hardening     |
9. Martensite is a
- |   |
|---|
| A) Stable phase with body centred tetragonal unit cell      |
| B) Meta stable phase with body centred tetragonal unit cell |
| C) Meta stable phase with body centred cubic unit cell      |
| D) Stable phase with body centred cubic unit cell           |
10. Name the type of cast iron in which carbon is present in the form of free graphite flakes.
- |                    |                        |
|--------------------|------------------------|
| A) White cast iron | B) Malleable cast iron |
| C) Grey cast iron  | D) Chilled cast iron   |
11. Due to its biocompatibility and properties very close to human bone, which of these alloys are extensively used as bone implants ?
- |                       |                     |
|-----------------------|---------------------|
| A) Copper alloys      | B) Aluminium alloys |
| C) Micro alloy steels | D) Titanium alloys  |
12. Jominy end quench test is used to determine the
- |                                |                              |
|--------------------------------|------------------------------|
| A) Hardness of a material      | B) Ductility of a material   |
| C) Hardenability of a material | D) Brittleness of a material |
13. Which of the following statements are true for Mohr's circle in a plane stress condition ?
- Maximum shear is at the top and bottom of the circle
  - The maximum shear stress is equal to the radius of the circle
  - The principal stresses are located at the horizontal axis where shear is zero
  - The maximum shear stress is equal to twice the radius of the circle
- |               |                  |
|---------------|------------------|
| A) i and iv   | B) i, ii and iii |
| C) iii and iv | D) All the above |
14. A metallic cube of side 5 cm is triaxially loaded with 50 kN and 75 kN tensile loads and 100 kN compressive load in the x, y and z directions, respectively. If the Poisson's ratio is 0.25 and the Young's modulus is E N/mm<sup>2</sup>, the volumetric strain will be
- |             |            |
|-------------|------------|
| A) $-330/E$ | B) $300/E$ |
| C) $410/E$  | D) $330/E$ |

15. For a cantilever beam of length  $L$  with uniformly distributed load  $w$ /unit length and a point load of  $W$  at the free end, the bending moment at a distance  $x$  from the free end is given by  
 A)  $wx^2/8 + Wx^2$       B)  $wx^2/2 - Wx$       C)  $wx^2/4 + Wx$       D)  $wx^2/2 + Wx$
16. A metallic rod of uniform diameter and length  $L$  with coefficient of thermal expansion  $\alpha$  and Young's modulus  $E$  is constrained between two rigid walls. If the temperature rise is  $\Delta T$ , the thermal stress developed in the rod is  
 A)  $E\alpha\Delta T$       B)  $E\alpha/\Delta T$       C)  $\alpha\Delta T$       D)  $E\alpha\Delta T^2$
17. A uniform circular solid shaft with diameter 2 cm is subjected to a torque of 40 Nm. The shear stress in  $N/mm^2$  at the periphery of the shaft is equal to  
 A)  $80\pi$       B)  $400\pi$       C)  $80/\pi$       D)  $160/\pi$
18. Which of the following relationships hold good among modulus of elasticity  $E$ , modulus of rigidity  $G$  and bulk modulus  $K$  ?  
 A)  $K = 9EG/(3E + G)$       B)  $E = 9KG/(3K + G)$   
 C)  $E = 6KG/(3K + G)$       D)  $G = 9KE/(2K + G)$
19. A rectangular block of height  $H$ , length  $L$  and depth  $D$  is rigidly fixed at the bottom (length  $L \times$  depth  $D$  face). When a tangential force  $P$  acts at the top face of the block parallel to the length  $L$ , the linear deformation at the top is  $\Delta L$ . What will be the shear strain of the block ?  
 A)  $\Delta L/H$       B)  $\Delta L/L$       C)  $\Delta L/D$       D) None of these
20. A square bar of 40 mm size is subjected to a sudden tensile load of 80 kN. The instantaneous stress in MPa induced in the bar will be  
 A) 50      B) 100      C) 200      D) 150
21. What will be the section modulus of a rectangular beam with a breadth of 6 cm and depth of 2 cm ?  
 A)  $4 \text{ cm}^3$       B)  $12 \text{ cm}^3$       C)  $8 \text{ cm}^3$       D)  $1 \text{ cm}^3$
22. For the shear force  $S$  and bending moment  $M$  of a beam, which of the following is correct ?  
 A)  $M = \frac{dS}{dx}$       B)  $S = \frac{dM}{dx}$       C)  $M = \frac{d^2S}{dx^2}$       D)  $S = \frac{d^2M}{dx^2}$
23. What will be the deflection in m at the centre of a simply supported beam of span 2 m, when a point load of 36 kN is applied at the centre (where  $E$  in kPa and  $I$  in  $m^4$ ) ?  
 A)  $6E/I$       B)  $12E/I$       C)  $6/EI$       D)  $12/EI$

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24. The Euler's theory of columns is valid when the
- i. Slenderness ratio is greater than or equal to  $\sqrt{\frac{\pi^2 E}{\sigma_c}}$
  - ii. Crushing stress is  $\geq$  buckling stress
  - iii. The column is short
  - iv. Crushing stress is  $<$  buckling stress
- A) i and ii                      B) i and iv                      C) i, ii and iii                      D) iii and iv
25. Change in enthalpy in a closed system is equal to heat transferred, if the reversible process takes place at constant
- A) temperature                      B) internal energy                      C) entropy                      D) pressure
26. An engine operates between temperatures limits of 900 K and  $T_2$  and another engine operates between  $T_2$  and 400 K. For both engines to be equally efficient,  $T_2$  should be equal to
- A) 650 K                      B) 600 K                      C) 625 K                      D) 700 K
27. The throttling of certain gases may be used for getting the refrigerating effect. The value of Joule coefficient ( $\mu$ ) for such a process is
- A)  $\mu = 0$                       B)  $\mu = 1$                       C)  $\mu > 1$                       D)  $\mu < 0$
28. The thermodynamic property which is evaluated with the help of Maxwells equations from the data of other measurable properties of a system is
- A) entropy                      B) enthalpy                      C) specific heat                      D) latent heat
29. Which one of the following gases will have the maximum value of characteristic gas constant ?
- A) oxygen                      B) nitrogen                      C) carbon dioxide                      D) sulfur dioxide
30. For a heat engine operating on Carnot cycle, the work output is 25% of the heat rejected to the sink. The thermal efficiency for the engine would be
- A) 10%                      B) 50%                      C) 30%                      D) 20%
31. In Carnot cycle, the addition of heat takes at
- A) constant pressure
  - B) constant volume
  - C) constant temperature
  - D) partly at constant pressure and partly at constant volume

A

32. Which of the following is a correct statement ?
- A) a reversible adiabatic process is an isentropic process
  - B) an isentropic process is an adiabatic process
  - C) an irreversible adiabatic process is a constant entropy process
  - D) entropy decreases during an irreversible adiabatic process
33. For the same compression ratio and heat supplied, the air standard efficiency of an Otto cycle compared to that of a Diesel cycle is
- A) less
  - B) equal
  - C) more
  - D) unpredictable
34. Which parameter can be considered to remain constant if the value of exponent  $n$  in the polytropic equation  $p v^n = \text{Constant}$  takes a unit value ?
- A) enthalpy
  - B) internal energy
  - C) entropy
  - D) pressure or volume
35. As differentials, heat and work would be described mathematically as
- A) exact
  - B) discontinuity
  - C) inexact
  - D) point function
36. The mean effective pressure of an Otto cycle is
- A) Independent of pressure ratio
  - B) Inversely proportional to pressure ratio
  - C) Proportional to the square root of pressure ratio
  - D) Directly proportional to pressure ratio
37. For a given set of operating pressure limits of a Rankine cycle, the highest efficiency occurs for
- A) superheated cycle
  - B) saturated cycle
  - C) reheat cycle
  - D) regenerative cycle
38. The steam engine part which guides motion of the piston rod and prevents it from bending is called
- A) crankshaft
  - B) cross head
  - C) valve rod
  - D) eccentric
39. In an impulse reaction turbine, the heat drops in the fixed and moving blades are 20 kJ/kg and 40 kJ/kg respectively. The degree of reaction for this stage will be
- A) 1/2
  - B) 2/3
  - C) 1/3
  - D) None of the above
40. For subsonic flow through a nozzle, the following changes occur in velocity and pressure along the flow direction
- A) pressure decreases, velocity increases
  - B) pressure increases, velocity decreases
  - C) increase in both pressure and velocity
  - D) velocity increases and pressure remains constant

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41. The volumetric efficiency of a well-designed SI engine lies in the range  
A) 40 – 50%                      B) 51 – 60%                      C) 61 – 70%                      D) 71 – 90%
42. In two-stage reciprocating air compressor, the suction and delivery pressures are 1 and 4 bar respectively. For maximum efficiency, the intercooler pressure is  
A) 3 bar                              B) 2.5 bar                              C) 2 bar                              D) 1.5 bar
43. If an axial flow compressor is designed for a constant velocity through all stages, then the area of annulus of the succeeding stage will  
A) remain the same    B) progressively decrease  
C) progressively increase    D) depend upon number of stage
44. Increasing the number of reheating stages in a gas turbine to infinity makes the expansion tending  
A) isothermal    B) isobaric  
C) adiabatic    D) reversible adiabatic
45. A refrigerator working on a reversed Carnot cycle has a COP of 4.5. If it works as a heat pump and consumes 1 kW, the heating effect will be  
A) 1 kW                              B) 4.5 kW                              C) 5 kW                              D) 5.5 kW
46. In aqua ammonia and Li-Br water absorption refrigeration systems, the refrigerants are  
A) water and water    B) water and Li-Br  
C) ammonia and Li-Br    D) ammonia and water
47. During chemical dehumidification process of air  
A) dry bulb temperature and specific humidity decrease  
B) dry bulb temperature decreases and specific humidity increases  
C) dry bulb temperature increases and specific humidity decreases  
D) dry bulb temperature and specific humidity increase
48. An increase in fin effectiveness is caused by high values of  
1. convective coefficient  
2. thermal conductivity  
3. cross sectional area  
4. circumference  
Identify the correct statement.  
A) 1 and 3    B) 2 and 3  
C) 3 and 4    D) 2 and 4



49. The ratio of hydrodynamic to thermal boundary layer thickness varies as  
 A) root of Prandtl number                      B) one-third of Prandtl number  
 C) two-third power of Stanton number        D) four-fifth power of Nusselt number
50. In a counter flow heat exchanger, cold fluid enters at 30°C and leaves at 50°C, whereas the hot fluid enters at 150°C and leaves at 130°C. The mean temperature difference for this case is  
 A) 20°C    B) 80°C  
 C) 100°C     D) indeterminate
51. For a completely submerged body with center of gravity 'G' and center of buoyancy 'B', the condition of stability will be pressure  
 A) G is located above B                        B) G is located below B  
 C) G and B are coincident                    D) None of the above
52. Consider the turbulent flow of a fluid through a circular pipe of diameter, D. Identify the correct pair of statements.  
 1. Fluid is well mixed  
 2. Fluid is un mixed  
 3. Reynolds number less than 2300  
 4. Reynolds number greater than 2300.  
 A) 1, 4    B) 1, 3    C) 2, 3    D) 2, 4
53. A flow field which has only convective acceleration is  
 A) A steady uniform flow                      B) An unsteady uniform flow  
 C) A steady non uniform flow                D) All of the above
54. As per common design practices, the three types of hydraulic turbines in descending order of flow rates are  
 A) Pelton, Francis, Kaplan                      B) Francis, Kaplan, Pelton  
 C) Pelton, Kaplan, Francis                      D) Kaplan, Francis, Pelton
55. A draft tube is not required for a  
 A) Francis turbine                                B) Kaplan turbine  
 C) Pelton wheel turbine                        D) None of the above
56. A pitot-static tube measures  
 A) Dynamic pressure  
 B) Difference in static and dynamic pressure  
 C) Static pressure  
 D) Atmospheric pressure

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57. Surface tension is due to

- A) Adhesion
- B) Gravity and adhesion
- C) Stagnation pressure
- D) Cohesion

58. The pressure gradient in the horizontal direction (x-direction) in a static fluid is represented by

- A)  $\frac{\partial p}{\partial x} = 0$
- B)  $\frac{\partial p}{\partial x} = g$
- C)  $\frac{\partial p}{\partial x} = -g$
- D)  $\frac{\partial p}{\partial x} = \rho g$

59. The Newton's law of viscosity relates

- A) The shear stress and rate of shear strain
- B) The stress and strain in a fluid
- C) The viscosity and density of fluid
- D) The shear stress, gravity and viscosity

60. For steady incompressible three-dimensional flow, the continuity equation is given as

- A)  $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$
- B)  $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$
- C)  $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = \frac{\partial p}{\partial t}$
- D) None of the above

61. Moody's chart is used to determine the

- A) Reynolds number
- B) Nusselt number
- C) Friction factor
- D) Surface tension

62. Specific speed of a centrifugal pump is

- A)  $N\sqrt{QH^{\frac{3}{4}}}$
- B)  $N^2\sqrt{QH^{\frac{3}{4}}}$
- C)  $N\sqrt{QH^{\frac{1}{4}}}$
- D)  $\frac{N\sqrt{Q}}{H^{\frac{3}{4}}}$

63. Oldham's coupling is an inversion of

- A) Four bar chain
- B) Slider-crank chain
- C) Double slider crank chain
- D) Five link chain



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69. The outside diameter of a hollow shaft is double the inside diameter. The ratio of the torque carrying capacity to that of a solid shaft of the same material and of the same outside diameter is

- A) 1/16                      B) 1/2                      C) 15/16                      D) 3/4

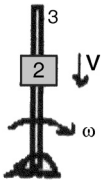
70. The tearing efficiency of a riveted joint is 80 percent, then the ratio of the rivet hole diameter to the pitch is equal to

- A) 0.25                      B) 0.2                      C) 0.3                      D) 0.4

71. The principal stresses of a two dimensional state of stress are  $\sigma_1$  and  $\sigma_2$ ,  $\sigma_1$  is greater than  $\sigma_2$  and both are tensile, then which one of the following would be the correct criterion for failure according to maximum shear stress theory ?

- A)  $\sigma_1/2 = \pm\sigma_y/2$                       B)  $\sigma_1 = 2\sigma_y$   
C)  $\sigma_2/2 = \pm\sigma_y/2$                       D)  $(\sigma_1 - \sigma_2)/2 = \pm\sigma_y/2$

72. The slider 2 moves inwards with a velocity of  $v$  along a link 3 which is rotating clockwise with an angular velocity  $\omega$ . The magnitude and direction of the Coriolis acceleration is



- A)  $\overleftarrow{\omega v}$                       B)  $\overrightarrow{2\omega v}$                       C)  $\overrightarrow{\omega v}$                       D)  $\overleftarrow{2\omega v}$

73. A flywheel connected to a punching machine has to supply energy of 320 Nm which is running at a mean angular speed of 20 rad/s. If the total fluctuation of speed is not to exceed  $\pm 2\%$ , the mass moment of inertia of the flywheel in  $\text{kg} - \text{m}^2$  is

- A) 25                      B) 20                      C) 30                      D) 40

74. The swaying couple is maximum or minimum when the angle of inclination in degrees of the line of stroke is equal to

- A) 180 and 315                      B) 225 and 135  
C) 225 and 45                      D) 180 and 225

75. With the decrease of governor speed

- A) Radius of rotation decreases but the height of it increases  
B) Radius of rotation and height of it decreases  
C) Radius of rotation and the height of it increases  
D) Radius of rotation increases but the height of it increases

A

76. Given that  $T_1$  and  $T_2$  are the tensions on the tight and slack side of the belt respectively, the initial tension of the belt taking the account of centrifugal tension  $T_c$  is equal to
- A)  $(T_1 + T_2 + T_c)/2$                       B)  $(T_1 + T_2 + 2T_c)/2$   
 C)  $(T_1 + T_2 + T_c)/3$                       D)  $(T_1 + T_2 + 2T_c)/3$
77. In sand casting process, when the mold consists of more than two pieces, the additional parts are called
- A) Foundations              B) Cheeks              C) Necks              D) Copes
78. Cores are employed in castings to
- A) Make desired recess in castings              B) Save moulding sand  
 C) Strengthen the casting              D) None of the above
79. Which one of the following is the strongest among the following brazing joints ?
- A) Inclined              B) Lap              C) Butt              D) V-butt
80. Seam welding is a
- A) Single spot welding process              B) Arc welding process  
 C) A type of stud welding              D) Continuous spot welding process
81. Hot forging is used for producing
- A) Piston              B) Crankshaft              C) Carburettor              D) All the above
82. In ultrasonic machining process, the metal removal rate will be higher for materials with
- A) Higher toughness              B) Higher ductility  
 C) Lower toughness              D) Higher fracture strain
83. Among the conventional machining processes, maximum specific energy is consumed in
- A) Turning              B) Drilling              C) Planing              D) Grinding
84. Plain milling of mild steel plates produces
- A) Irregular shaped discontinuous chips  
 B) Regular shaped discontinuous chips  
 C) Continuous chips without built up edge  
 D) Jointed chips
85. The NC system which is applicable to a milling machine is called the
- A) Point to point system              B) Continuous path system  
 C) Zig-zag machining system              D) Contour system

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86. A main advantage of ECM over EDM is that
- A) it can cut harder material
  - B) it is more accurate and precise
  - C) it consumes less power
  - D) its tool wear is negligible
87. Which one of the following is the most accurate instrument ?
- A) Optical projector
  - B) Slip gauge
  - C) Screw gauge
  - D) Vernier caliper
88. For a CNC machining process, which of the following is not applicable ?
- A) Close tolerances required
  - B) Part geometry is complex
  - C) Design changes are frequent
  - D) No inspection is required
89. The type of layout suitable for simpler production scheduling, high volume of output and high labour efficiency is
- A) Fixed position layout
  - B) Product layout
  - C) Process layout
  - D) Combination layout
90. A SIMO chart is used for studying the relationship of
- A) Operator and machines
  - B) Operator and materials
  - C) Different limbs of an operator
  - D) Time and motion of operators
91. Break-even point gives the production level at which annual ?
- A) Contribution is equal to fixed cost
  - B) Fixed cost is equal to variable cost
  - C) Sales revenue is equal to variable cost
  - D) Sales revenue is equal to fixed cost
92. In production planning and control, loading means
- A) Maximum utilisation of the facility
  - B) Assigning jobs to work centres
  - C) Determining the time required for each operation
  - D) Giving work orders for initiating the work
93. The selective inventory technique ABC gives importance to
- A) Items which are rare
  - B) Items which are critical
  - C) Value of the items
  - D) Demand for the items
94. In operations research, Hungarian method is used to solve
- A) Queuing problems
  - B) Assignment problems
  - C) Transportation problems
  - D) Game theory

95. In the context of industrial psychology, the groups where the individuals are in face-to-face relationships with each other are called
- A) Primary groups
  - B) Secondary groups
  - C) Working groups
  - D) Quality circle
96. In a bath tub curve, the zone which represents the failures due to limitations inherent in the design and accidents caused by usage is
- A) Random failure zone
  - B) Secondary failure zone
  - C) Wear out failure zone
  - D) Infant mortality zone
97. Matrix organisation is created by
- A) Merging line and staff organisation
  - B) Merging project organisation with functional organisation
  - C) Merging project organisation with military organisation
  - D) Merging with functional organisation with committees
98. A type of company which is being managed by the Board of Directors is
- A) Joint Stock Company
  - B) Private Limited Company
  - C) Public Limited Company
  - D) Cooperative Organisation
99. The type of conveyor most suitable for moving granular materials
- A) Roller conveyor
  - B) Chain conveyor
  - C) Bucket conveyor
  - D) Fork truck
100. Which one of the following is not an element in the factor comparison method of job evaluation ?
- A) Physical effort
  - B) Skill
  - C) Responsibility
  - D) Employee worth
-

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Space for Rough Work