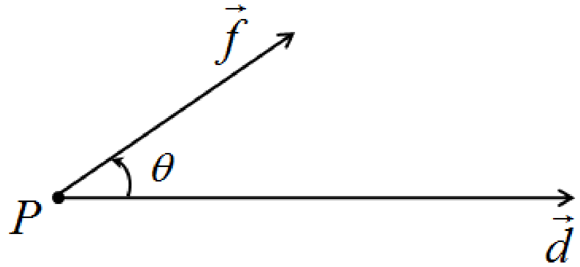
Q. 1 – Q. 25 carry one mark each.

Q.1 In numerical integration using Simpson's rule, the approximating function in the interval is a

(A) constant (B) straight line (C) cubic B-Spline (D) parabola

Q.2 If a constant force $\vec{f}$ applied on an object P, displaces it by a distance $\vec{d}$, inclined at an angle θ to the direction of force $\vec{f}$, then the work done by the force $\vec{f}$ is



(A) $\mathrm{div}(\vec{f} \times \vec{d})$ (B) $\left|\vec{f} \times (\mathrm{curl}\, \vec{d})\right|$ (C) $\left|\vec{f} \times \vec{d}\right|$ (D) $\vec{f} . \vec{d}$

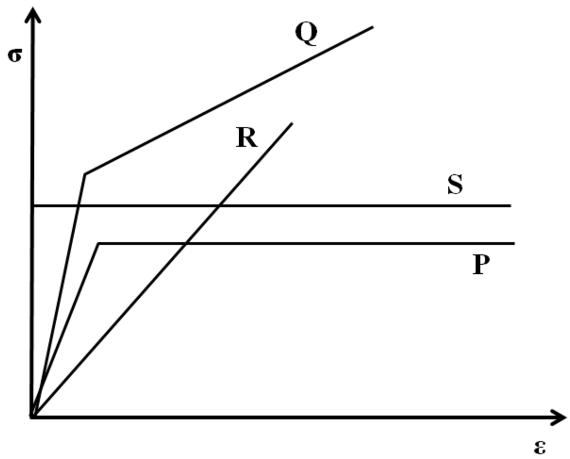
Q.3 A product is an assembly of 5 different components. The product can be sequentially assembled in two possible ways. If the 5 components are placed in a box and these are drawn at random from the box, then the probability of getting a correct sequence is

(A) $\frac{2}{5!}$ (B) $\frac{2}{5}$ (C) $\frac{2}{(5-2)!}$ (D) $\frac{2}{(5-3)!}$

Q.4 The function $f(x) = x^2 = x + x + x + \ldots x$ times, is defined

(A) at all real values of x
(B) only at positive integer values of x
(C) only at negative integer values of x
(D) only at rational values of x

Q.5 The room-temperature stress (σ)-strain (ε) curves of four materials P, Q, R, and S are shown in the figure below. The material that behaves as a rigid perfectly plastic material is



(A) P (B) Q (C) R (D) S

Q.6 The true stress at fracture of a tensile tested specimen, having an initial diameter of 13 mm, is 700 MPa. If the diameter of specimen at fracture is 10 mm, then the engineering stress, in MPa, at fracture is _________________.

Q.7 If the principal stress values are 120 MPa, –50 MPa and 10 MPa in a given state of stress, then maximum shear stress in the material, in MPa, is ___________________.

Q.8 Match the items in the first column to their functions in the second column.

P. Sprue	1. regulates flow of molten metal into mould cavity
Q. Riser	2. feeds molten metal from pouring basin to gate
R. Gate	3. acts as a reservoir for molten metal
S. Pouring basin	4. supplies molten metal to compensate for liquid shrinkage

(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-4, R-1, S-3
(C) P-4, Q-2, R-1, S-3
(D) P-2, Q-4, R-3, S-1

Q.9 In rolling of a flat strip, the relative velocity of strip with respect to the roller is

(A) positive at entry plane, negative at exit plane
(B) negative at entry plane, positive at exit plane
(C) positive throughout from entry to exit plane
(D) negative throughout from entry to exit plane

Q.10 The maximum reduction per pass during wire drawing of an aluminum alloy ignoring friction and redundant work is 77%. The strain hardening exponent of the material is ____________.

Q.11 Built-up edge formation decreases under the conditions listed below **EXCEPT**

(A) at low cutting speeds
(B) using large positive rake angle
(C) with sharper tool
(D) using cutting fluid

Q.12 During turning of mild steel work material, the maximum temperature is observed at

(A) primary deformation zone
(B) tool and chip interface
(C) tool-flank and work interface
(D) machined sub-surface

Q.13 Which one of the following statements related to grinding process is **INCORRECT**?

(A) Grinding wheels made of finer abrasive grains produce better surface finish.
(B) Abrasive grains tend to fracture frequently during the grinding process.
(C) Specific energy in grinding is higher than that in turning.
(D) Cutting speed in grinding process is much lower than that in face milling.

Q.14 For an assembly made of n components, the dimensions on each component i follow a normal distribution and have tolerance T_i. Overall dimension of the assembly is L_a with tolerance T_a. The relationship between T_a and T_i is

(A) $T_a = L_a\sqrt{\sum_{i=1}^{n} T_i^{\,2}}$
(B) $T_a = \sqrt{\sum_{i=1}^{n} T_i^{\,2}}$
(C) $T_a = \sqrt{L_a \sum_{i=1}^{n} T_i^{\,2}}$
(D) $T_a = L_a + \sqrt{\sum_{i=1}^{n} T_i^{\,2}}$

www.FirstRanker.com

Q.15 Which of the following **DO NOT** influence the material removal rate in Electrical Discharge Machining process?

(i) Hardness of work piece material
(ii) Melting temperature of work piece material
(iii) Hardness of tool material
(iv) Discharge current and frequency

(A) (i) and (ii) (B) (i) and (iii) (C) (iii) and (iv) (D) (i), (ii) and (iii)

Q.16 In Computer Aided Process Planning, determination of process sequence for manufacture of any part design without predefined standard plans is known as

(A) variant type process planning
(B) retrieval type process planning
(C) generative type process planning
(D) group technology based process planning

Q.17 The angle of a twist drill that determines its rake angle is

(A) lip relief angle (B) chisel edge angle (C) helix angle (D) point angle

Q.18 A line balancing problem is solved in the context of

(A) process layout
(B) fixed position layout
(C) product layout
(D) production schedule

Q.19 Solution to the balanced assignment problem is binary due to

(A) linear formulation
(B) non-empty feasible region
(C) approximation algorithms
(D) uni-modularity property

Q.20 Material Requirements Planning **DOES NOT** include

(A) material price
(B) bill of material
(C) inventory level
(D) production schedule

Q.21 Ishikawa diagram represents

(A) different types of quality defects
(B) quantitative relation between the extent of defect and a process parameter
(C) relation between defects and their causes
(D) prioritized quality defects

Q.22 As per the principles of motion economy, which one of the following is **NOT** a pivot for a classified movement of human body?

(A) Knee (B) Elbow (C) Torso (D) Wrist

Q.23 For air travel over a distance of 500 km, the ticket price is *Rs.* 4000. The comfort of the air travel can be monetized at *Rs.*3000, and the monetary value of time saved because of air travel is *Rs.*3000. The value of air travel is _____________.

Q.24 Which one of the following is **NOT** in the scope of Enterprise Resource Planning (ERP) system?

(A) General ledger entries
(B) Materials management system
(C) Order management system
(D) Employee promotion policy

www.FirstRanker.com

Q.25 If standard production is 20 units, a worker's actual output is 18 units, piece rate is *Rs*. 500 per unit, and over-achievement rate is *Rs*. 750 per unit, then the wage paid to the worker, in *Rs*., as per Taylor's differential price rate wage incentive plan, is ______________.

Q. 26 – Q. 55 carry two marks each.

Q.26 The solution to $6yy' - 25x = 0$ represents a

(A) family of circles
(B) family of ellipses
(C) family of parabolas
(D) family of hyperbolas

Q.27 The solution to $x^2y'' + xy' - y = 0$ is

(A) $y = c_1x^2 + c_2x^{-3}$
(B) $y = c_1 + c_2x^{-2}$
(C) $y = c_1x + \frac{c_2}{x}$
(D) $y = c_1x + c_2x^4$

Q.28 Match the linear transformation matrices listed in the first column to their interpretations in the second column.

P.	$\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$	1.	Stretch in the y-axis
Q.	$\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$	2.	Uniform stretch in x and y-axes
R.	$\begin{bmatrix} 1 & 0 \\ 0 & 3 \end{bmatrix}$	3.	Projection in x-axis
S.	$\begin{bmatrix} 4 & 0 \\ 0 & 4 \end{bmatrix}$	4.	Projection in y-axis

(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-3, R-4, S-1
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-1, R-2, S-3.

Q.29 The value of $\lim_{(x,y)\to(0,0)} \frac{x^2 - xy}{\sqrt{x} - \sqrt{y}}$ is

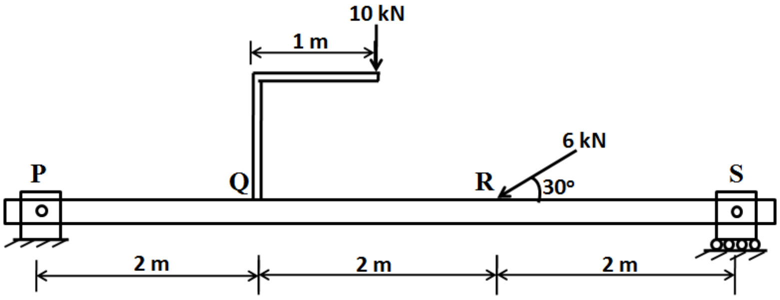
(A) 0
(B) $\frac{1}{2}$
(C) 1
(D) ∞

Q.30 The curve $y = x^4$ is

(A) concave up for all values of x
(B) concave down for all values of x
(C) concave up only for positive values of x
(D) concave up only for negative values of x

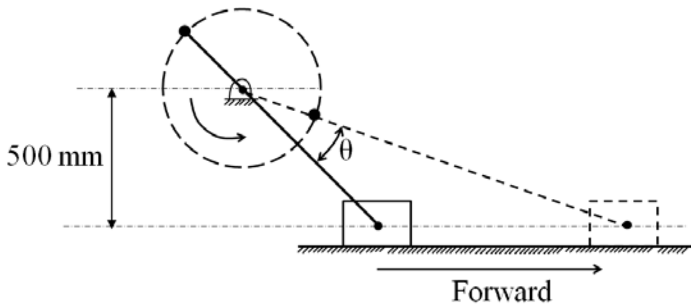
Q.31 A metallic bar of uniform cross-section with specific weight of 100 kN/m^3 is hung vertically down. The length and Young's modulus of the bar are 100 m and 200 GPa, respectively. The elongation of the bar, in mm, due to its own weight is ____________.

Q.32 A beam is loaded as shown in the figure.



The bending moment, in Nm, at point R is __________.

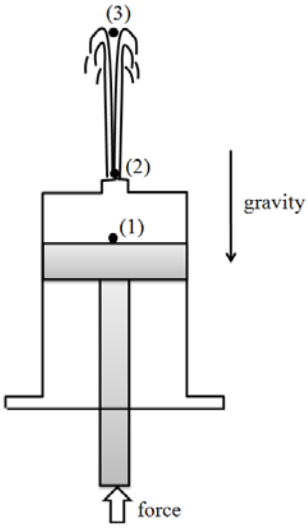
Q.33 In an off-set slider crank mechanism, shown in figure, the crank is rotated at a constant speed of 150 rpm. The value of the angle θ shown in the figure is 20^0. What is the ratio of forward to return stroke time? Can this mechanism be used in an application involving quick return?



(A) 3.33, No (B) 0.73, Yes (C) 1.25, Yes (D) 0.73, No

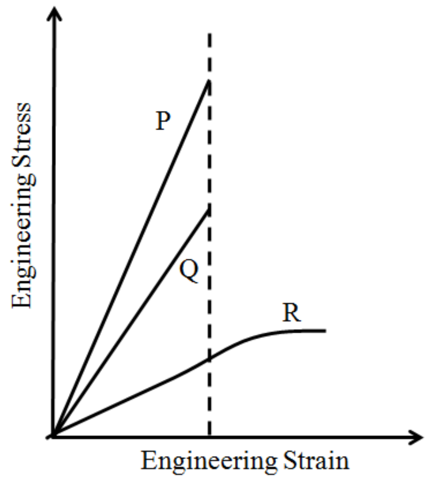
Q.34 In a 1 m thick wall, the temperature distribution at a given instant is $T(x) = c_0 + c_1x + c_2x^2$ where T is in ^oC and x is in m. The constants are: c_0 = 800 ^oC, c_1 = –250 $^oC/m$ and c_2 = –40 $^oC/m^2$. The thermal conductivity of the wall is 50 W/mK and wall area is 5 m^2. If there is a heat source generating uniform volumetric heating at the rate of 500 W/m^3 inside the wall, then the rate of change of energy storage in the wall, in kW, is ________.

Q.35 In a vertical piston-cylinder arrangement the force applied to the piston, pushes water through a nozzle as shown in the figure. The water flows out from the nozzle, and reaches the top of its trajectory. The kinetic and pressure energies at points (1), (2) and (3), respectively, are



(A) (small and large), (large and zero) and (zero and zero)
(B) (small and zero), (large and large) and (small and zero)
(C) (large and zero), (zero and large) and (large and zero)
(D) (large and small), (small and zero) and (small and large)

Q.36 Consider a glass-fiber reinforced polymer material. The stress-strain curves of the fiber, matrix and composite are plotted in the figure. Which one of the following statements is **TRUE**?



(A) Curve P represents the composite, Curve Q the matrix and Curve R the fiber.
(B) Curve Q represents the composite, Curve R the matrix and Curve P the fiber.
(C) Curve R represents the composite, Curve P the matrix and Curve Q the fiber.
(D) Curve P represents the composite, Curve R the matrix and Curve Q the fiber.

Q.37 A mould for injection moulding is designed for polymer **P** having shrinkage of 0.010 mm/mm. A critical dimension needed in the moulded part is 35 mm. If the same mould is now used to make a similar part but made of a different polymer **Q** with shrinkage of 0.025 mm/mm, then the critical dimension in the moulded part made of polymer **Q**, in mm, is _____________.

Q.38 Open die forging of a cylinder made of a rigid perfectly plastic material with yield strength of 200 MPa having a height of 25 mm and diameter of 25 mm is being carried out. The cylinder is subjected to a true compressive strain of 3.6 during the process. Assuming frictionless and homogeneous deformation, the energy expended, in kJ, is ______________________.

Q.39 In drilling operation, a twist-drill of 30 mm diameter with point angle of 118 degrees is used. If the CNC command issued to execute the drilling operation is G90 G01 Z?? F20. The datum is defined on the top surface of the work material and the approach distance is 3 mm. Then, to achieve a cylindrical hole depth of 40 mm, the Z coordinate to be provided in the CNC command, in mm, is _________________.

Q.40 In an orthogonal machining experiment carried out using a cutting tool with zero degree rake angle, the measured cutting force was 1700 N. If the friction angle at the rake face-chip interface is 26^{o}, then the thrust force value, in N, is __________________.

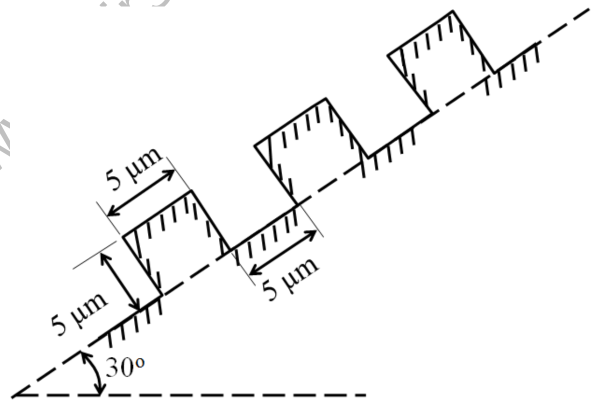
Q.41 In a slab milling operation, a cutter of 75 mm diameter with sufficient width is used to remove 5 mm thick material from a 200 mm long part in a single pass. The minimum length of travel, in mm, for the cutter to engage and completely cut the part surface is ____________.

Q.42 In a metal casting process, molten copper alloy is poured into a sand mould. The level of molten metal in the pouring basin is at a height of 300 mm from the runner having diameter of 10 mm. If the density and melting temperature of molten copper alloy are 9000 kg/m^3 and 1000^{o}C, respectively, then the rate of flow of molten metal into the mould neglecting friction and other losses, in cm^3/s, is _____________________.

Q.43 Two aluminum alloy plates each 10 mm thick and 1 m long are welded without crowning by multi-pass tungsten inert gas butt welding. The joint configuration is V-type with 60º angle and root gap is maintained at 5 mm. If electrode of 5 mm diameter with 500 mm length is used for welding, then the number of electrodes required is

(A) 7 (B) 9 (C) 11 (D) 13

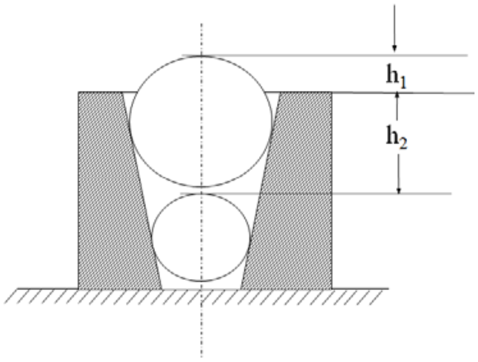
Q.44 A surface is prepared specially for an application with the profile as shown in the figure.



The theoretical R_a value for this surface, in µm, is ___________________.

www.FirstRanker.com

Q.45 During the measurement of internal taper of a part using standard balls of diameter 15 mm and 20 mm, the large ball is found to protrude by 5 mm (h_1) and the top of small ball is found to be 35 mm (h_2) below the top face of the gauge. The taper angle, in degree, is ________



Q.46 In a Flexible Manufacturing System, the Automated Guided Vehicles (AGV) move at a speed of 50 m/min, cover an average distance of 150 m to deliver and 100 m for return. If the time required for pick-up and drop is 30 s each, neglecting idle times, then the number of AGVs required to meet the demand of 50 deliveries per hour is ______________.

Q.47 A machine is bought for *Rs*. 25,00,000. The organization follows a declining balance method of depreciation with a depreciation charge of 25%. If the machine is sold at *Rs*.17,50,000 at the end of second year, then the profit on the book, in *Rs*., is ________________.

Q.48 A manufacturing line requires 7.2 minutes to make a product. The line has six workstations arranged as per the required sequence of operations. Total production required is 300 products in 7.5 hours. At steady state, the line efficiency, in %, is ____________.

Q.49 A single facility is to be located to meet the demand at coordinates (1, 2), (2, 3), (3, 5) and (4, 1). The demand at these points is 700, 100, 300 and 500 respectively. Using the rectilinear distance measure and weighted distance minimization criterion, the facility should be located

(A) anywhere on the line joining points (2, 2) and (3, 2)
(B) at the point (2, 3)
(C) anywhere on the line joining (2, 3) and (3, 3)
(D) at the point (3, 3)

Q.50 The value of (X_1 , X_2) for an optimal solution for

Minimize $Z = 6X_1 - 8X_2$

subject to: $5X_1 + 10X_2 \leq 30$

$4X_1 + 4X_2 \leq 20$

$X_1 \geq 0, X_2 \geq 0$

is

(A) (0, 0) (B) (1, 6) (C) (0, 3) (D) (3, 7)

Q.51 Arrival of machines for repair in a maintenance shop follows a Poisson distribution at a rate of one per 18 hours. The time to repair follows an exponential distribution with Mean Time To Repair (MTTR) of 14 hours. If the productivity loss is *Rs*.22,500 per hour, then the total expected loss of productivity due to machine breakdowns, in *Rs*., is

(A) 78,750 (B) 1,01,250 (C) 11,81,250 (D) 14,17,500

Q.52 In a manufacturing process, 24 samples each of size 50 items were inspected and a total of 52 defective items were observed. The lower and upper control limits set for the p-chart should, respectively, be

(A) (0.043, 0.12) (B) (–0.043, 0.086) (C) (–0.043, 0.10) (D) (0, 0.13)

Q.53 Data on five products to be processed on a single machine is given below:

Product	Release time	Processing time	Due date
P	0	3	10
Q	2	4	9
R	0	2	15
S	1	5	11
T	1	1	13

For the processing sequence R – P – S – T – Q, total tardiness is ____________.

Q.54 In a time study experiment, observed time is 15 minutes, operator rating is 90, personal need allowance is 4%, fatigue allowance is 3%, contingency allowance for work is 3% and contingency allowance for delay is 2%. The total work content, in minutes, is __________________.

Q.55 There are three alternatives to meet the demand of a product.

Alternative I: Manufacture using a process P
Alternative II: Manufacture using a process Q
Alternative III: Buy the product from a vendor

The costs associated with each alternative is given below:

Cost	Alternative I	Alternative II	Alternative III
Fixed cost	*Rs.* 100,000	*Rs.* 190,000	
Variable cost (per unit)	*Rs.* 75	*Rs.* 60	
Purchase price (per unit)			*Rs.* 87.50

Alternative I is cheaper compared to Alternative II when the demand is

(A) 8500 (B) above 8000
(C) 6500 (D) below 6000

END OF THE QUESTION PAPER