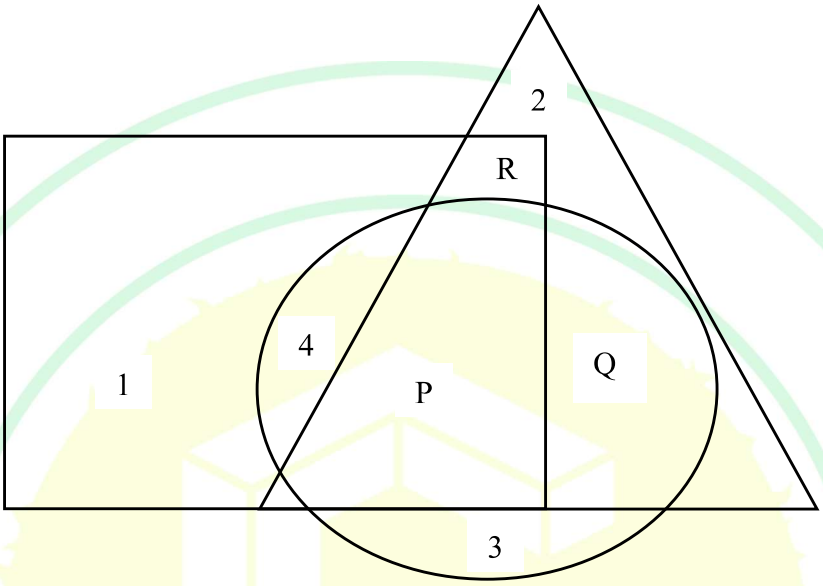
General Aptitude

Q.1 – Q.5 Carry ONE mark Each

Q.1	Courage : Bravery :: Yearning : _____ Select the most appropriate option to complete the analogy.
(A)	Longing
(B)	Yelling
(C)	Yawning
(D)	Glaring

Q.2	We _____ tennis in the lawn when it suddenly started to rain. Select the most appropriate option to complete the above sentence.
(A)	have been playing
(B)	had been playing
(C)	would have been playing
(D)	could be playing

Q.3	A 4 × 4 digital image has pixel intensities (U) as shown in the figure. The number of pixels with $U \leq 4$ is:
	<table><tr><td>0</td><td>1</td><td>0</td><td>2</td></tr><tr><td>4</td><td>7</td><td>3</td><td>3</td></tr><tr><td>5</td><td>5</td><td>4</td><td>4</td></tr><tr><td>6</td><td>7</td><td>3</td><td>2</td></tr></table>
(A)	3
(B)	8
(C)	11
(D)	9

Q.4	In the given figure, the numbers associated with the rectangle, triangle, and ellipse are 1, 2, and 3, respectively. Which one among the given options is the most appropriate combination of P, Q, and R ?
	
(A)	P = 6; Q = 5; R = 3
(B)	P = 5; Q = 6; R = 3
(C)	P = 3; Q = 6; R = 6
(D)	P = 5; Q = 3; R = 6

Q.5	A rectangle has a length L and a width W, where L > W. If the width, W, is increased by 10%, which one of the following statements is correct for all values of L and W?
(A)	Perimeter increases by 10%.
(B)	Length of the diagonals increases by 10%.
(C)	Area increases by 10%.
(D)	The rectangle becomes a square.

Q.6 – Q.10 Carry TWO marks Each

Q.6

Column-I has statements made by Shanthala; and, Column-II has responses given by Kanishk.

Column-I		Column-II	
P.	This house is in a mess.	1.	Alright, I won't bring it up during our conversations.
Q.	I am not happy with the marks given to me.	2.	Well, you can easily look it up.
R.	Politics is a subject I avoid talking about.	3.	No problem, let me clear it up for you.
S.	I don't know what this word means.	4.	Don't worry, I will take it up with your teacher.

Identify the option that has the correct match between Column-I and Column-II.

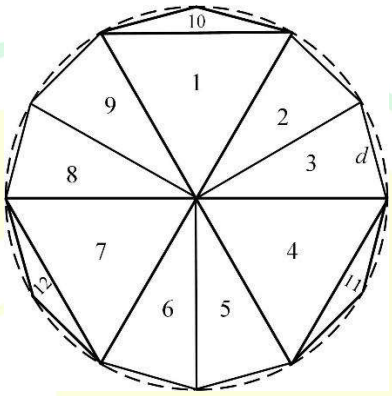
(A) P – 2; Q – 3; R – 1; S – 4

(B) P – 3; Q – 4; R – 1; S – 2

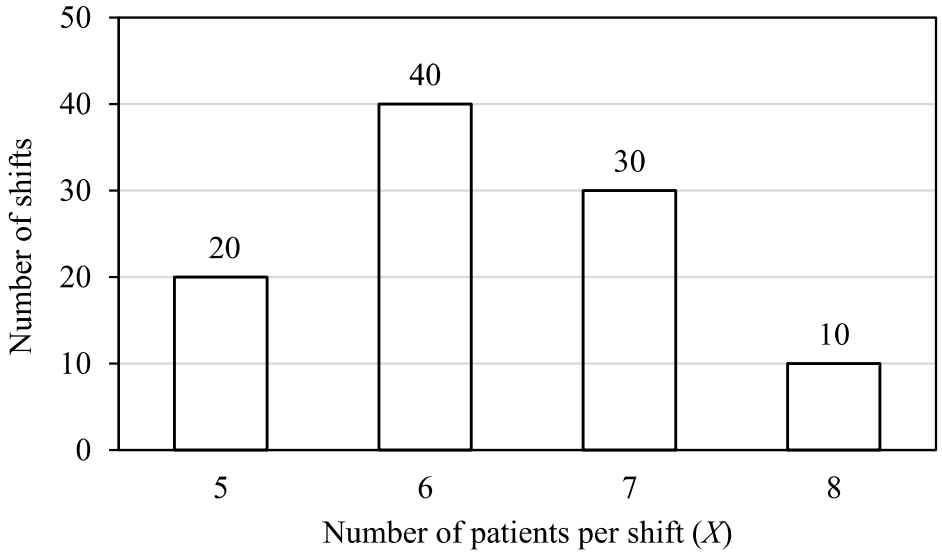
(C) P – 4; Q – 1; R – 2; S – 3

(D) P – 1; Q – 2; R – 4; S – 3

Q.7	Weight of a person can be expressed as a function of their age. The function usually varies from person to person. Suppose this function is identical for two brothers, and it monotonically increases till the age of 50 years and then it monotonically decreases. Let a_1 and a_2 (in years) denote the ages of the brothers and $a_1 < a_2$. Which one of the following statements is correct about their age on the day when they attain the same weight?
(A)	$a_1 < a_2 < 50$
(B)	$a_1 < 50 < a_2$
(C)	$50 < a_1 < a_2$
(D)	Either $a_1 = 50$ or $a_2 = 50$

Q.8	A regular dodecagon (12-sided regular polygon) is inscribed in a circle of radius r cm as shown in the figure. The side of the dodecagon is d cm. All the triangles (numbered 1 to 12) in the figure are used to form squares of side r cm and each numbered triangle is used only once to form a square. The number of squares that can be formed and the number of triangles required to form each square, respectively, are: Note: The figure shown is representative.
	
(A)	3; 4
(B)	4; 3
(C)	3; 3
(D)	3; 2

Q.9	If a real variable x satisfies $3^{x^2} = 27 \times 9^x$, then the value of $\frac{2^{x^2}}{(2^x)^2}$ is:
(A)	2^{-1}
(B)	2^0
(C)	2^3
(D)	2^{15}

Q.10	The number of patients per shift (X) consulting Dr. Gita in her past 100 shifts is shown in the figure. If the amount she earns is ₹ $1000(X - 0.2)$, what is the average amount (in ₹) she has earned per shift in the past 100 shifts? Note: The figure shown is representative.
	
(A)	6,100
(B)	6,300
(C)	6,000
(D)	6,500

Q.11 – Q.35 Carry ONE mark Each

Q.11	The eigenvalues of the matrix $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ are
(A)	$-\sqrt{-1}$ and $\sqrt{-1}$
(B)	-1 and 1
(C)	$1+\sqrt{-1}$ and $1-\sqrt{-1}$
(D)	$-1+\sqrt{-1}$ and $-1-\sqrt{-1}$
Q.12	If $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$ are the orthogonal unit vectors in Cartesian x-y-z coordinate system, the curl of the vector $-2y\mathbf{i}+x\mathbf{j}$ is
(A)	$3\mathbf{k}$
(B)	$-3\mathbf{k}$
(C)	$-\mathbf{k}$
(D)	$\mathbf{k}$

Q.13	If $F(s)$ denotes the Laplace transform of some function $f(t)$, then the Laplace transform of $e^{bt} f(t)$, where b is a real constant, is
(A)	$F(s-b)$
(B)	$F(s+b)$
(C)	$-F(s)$
(D)	$F(b-s)$
Q.14	Which one of the following equations is a linear differential equation?
(A)	$\frac{dy}{dx} + 2x = y^2$
(B)	$x^3 \frac{dy}{dx} + xy = x^2$
(C)	$x\frac{d^2y}{dx^2} + 2y\frac{dy}{dx} = 0$
(D)	$\left(\frac{dy}{dx}\right)^2 + 2x = y$

Q.15	A bag contains 5 red, 7 green and 3 blue balls. Two balls are drawn at random from the bag one-by-one. The probability of the second drawn ball being red is
(A)	$\frac{1}{5}$
(B)	$\frac{1}{3}$
(C)	$\frac{2}{5}$
(D)	$\frac{2}{3}$
Q.16	Exit-hole occurrence is common in
(A)	Electron Beam Welding
(B)	Submerged Arc Welding
(C)	Friction Welding
(D)	Friction Stir Welding

Q.17	An aircraft has two engines, each having a reliability R. The aircraft will crash only when both engines stop working. The reliability of the aircraft flying without crash is
(A)	R^2
(B)	$2R$
(C)	$2R-R^2$
(D)	R^2-2R
Q.18	The proper sequence of design of a product is
(A)	Conceptual design, Embodiment design, Detailed design
(B)	Conceptual design, Detailed design, Embodiment design
(C)	Embodiment design, Conceptual design, Detailed design
(D)	Embodiment design, Detailed design, Conceptual design

Q.19	In a work sampling, out of n observations, a worker was sitting idle in x observations. The standard deviation of the mean proportion of idle time is given by
(A)	$\sqrt{\frac{x^2}{n^3}}$
(B)	$\sqrt{\frac{x(n-x)}{n^3}}$
(C)	$\sqrt{\frac{x(n-x)}{n^2}}$
(D)	$\frac{x}{n}$
Q.20	Atomic packing factor of a body centered cubic structure is closest to
(A)	0.34
(B)	0.52
(C)	0.68
(D)	0.74

Q.21	Which one of the following statements is FALSE with respect to the injection molding of polymer composite?
(A)	Molten polymer along with the reinforcements is injected into a closed mold cavity.
(B)	Material deforms plastically to adopt the shape of the mold cavity.
(C)	Melt temperature, injection speed and screw speed are some important process parameters.
(D)	Commonly used reinforcements are particles, whiskers and short fibers.
Q.22	A through hole of 8 mm diameter is to be drilled in a 30 mm thick mild steel plate. Which one of the following processes is the most appropriate to achieve high dimensional accuracy with less processing time?
(A)	Conventional drilling using a carbide drill bit
(B)	Die sinking EDM using a copper electrode
(C)	ECM using a copper electrode
(D)	Plasma arc machining

Q.23	Which one of the following casting defects is caused due to the supply of the molten metal through two gates?
(A)	Cold shut
(B)	Shift
(C)	Pin hole
(D)	Rat tail

Q.24 Match the following with reference to the CNC machine and its minimum number of axes available in the machine.

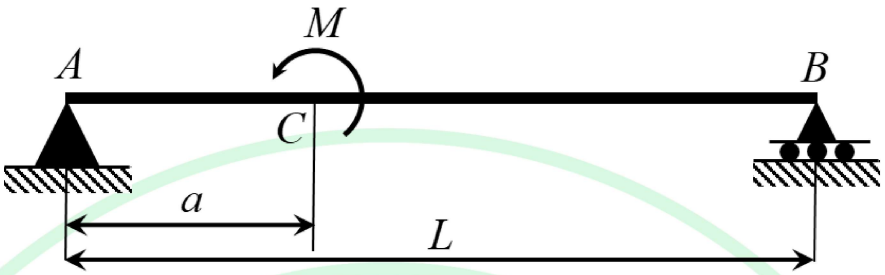
Type of CNC Machine		Minimum number of axes	
P	Turning center (CNC Lathe)	i	3
Q	Machining center (CNC Vertical milling)	ii	2
		iii	4

(A) P – i, Q – ii

(B) P – ii, Q – i

(C) P – i, Q – iii

(D) P – ii, Q – iii

Q.25	A simply supported beam AB of span L is shown in the figure. A moment M is applied at point C. The magnitude of the reaction force at point A is
	
(A)	$\frac{M}{L}$
(B)	$\frac{M}{a}$
(C)	$\frac{M}{L-a}$
(D)	$\frac{M}{L+a}$

Q.26	The relationship between the hoop stress σ_1 and the longitudinal stress σ_2 of a closed cylindrical thin-walled pressure vessel is
(A)	$\sigma_1 = 2\sigma_2$
(B)	$\sigma_1 = \sigma_2$
(C)	$\sigma_1 = \frac{\sigma_2}{2}$
(D)	$\sigma_1 = \frac{1}{3}\sigma_2$

Q.27 The starting simplex table of a linear programming problem is given below, where S_1, S_2, S_3 and S_4 are the slack variables. The objective of the problem is

Maximize $z = 6x_1 + 4x_2$

The leaving variable among the basic variables is

Basic	x_1	x_2	S_1	S_2	S_3	S_4	Solution
S_1	6	3	1	0	0	0	36
S_2	2	1	0	1	0	0	40
S_3	–1	3	0	0	1	0	2
S_4	0	3	0	0	0	1	3

(A) S_1

(B) S_2

(C) S_3

(D) S_4

Q.28	For an ideal Diesel cycle, the heat addition is an
(A)	isobaric process
(B)	isothermal process
(C)	isochoric process
(D)	isentropic process

Q.29	Three principal stresses at a point in a material are 300 MPa, 250 MPa and 100 MPa. If the yielding just starts at that point, the yield strength (in MPa) of the material as per Tresca criterion is_____. (*Answer in integer*)
Q.30	In an orthogonal straight turning process, the feed is 0.1 mm/rev and the depth of cut is 0.5 mm. In ASA system, the side cutting edge angle of the cutting tool is 0°. The width (in mm) of the chip is_____. (*Rounded off to one decimal place*)
Q.31	The pitch of the single-start lead screw of a lathe is 6 mm. It is used to cut double start thread of 3 mm pitch on a cylindrical work piece. During the thread cutting, the spindle rotates at 400 revolutions per minute (RPM). The speed (in RPM) of the lead screw is_____. (*Answer in integer*)

Q.32	Two options are available to meet the annual demand of batteries in a toy company. In option 1, batteries are manufactured in the plant having fixed cost of Rupees 2,00,000 and a variable cost of Rupees 70 per unit. Option 2 consists of buying batteries from the market at a price of Rupees 90 per unit. The annual demand (in number of batteries) at which the company should switch from buying to making the batteries in the plant is_____. (*Answer in integer*)
Q.33	A company estimates the demand of 2000 bulbs for the next year. The ordering cost is Rupees 300 per order and the annual carrying cost per bulb is Rupees 30. The economic order quantity (number of bulbs) is_____. (*Answer in integer*)
Q.34	While inspecting final assembly of automobile-gear-boxes, 15 features were considered critical-to-quality (CTQ). During last quarter, 40000 gear boxes were produced among which 1500 defects were found of the CTQ features. The defects per million opportunities (DPMO) is_____. (*Answer in integer*)
Q.35	The hole and the shaft dimensions (in mm) are given as Hole dimension $= 30^{+0.04}_{-0.02}$ Shaft dimension $= 30^{+0.06}_{+0.03}$ The maximum possible clearance (in mm) is_____. (*Rounded off to two decimal places*)

Q.36 – Q.65 Carry TWO marks Each

Q.36	The solution of the linear differential equation $$\frac{dy}{dx} + y = e^{x},$$ when $y(0) = 0$, is
(A)	$y = \frac{1}{2}e^{x} - \frac{1}{2}e^{-x}$
(B)	$y = \frac{1}{2}e^{x} + \frac{1}{2}e^{-x}$
(C)	$y = e^{x} - e^{-x}$
(D)	$y = e^{x} + e^{-x}$
Q.37	Which one of the following functions is analytic, given $i = \sqrt{-1}$?
(A)	$e^{x}(\cos y + i \sin y)$
(B)	$e^{x}(\cos y - i \sin y)$
(C)	$e^{x}(-\cos y + i \sin y)$
(D)	$e^{-x}(\cos y + i \sin y)$

Q.38 Match the following with reference to the machining process and its feature.

Process		Feature	
P	EDM	1	Loss of dimensional accuracy due to under cutting
Q	LBM	2	Cutting edible items
R	CHM	3	Machining of a deep square blind hole on a mild steel plate
S	WJM	4	High speed profile cutting on a thin mild steel plate

(A) P – 3, Q – 4, R – 1, S – 2

(B) P – 4, Q – 3, R – 2, S – 1

(C) P – 4, Q – 2, R – 1, S – 3

(D) P – 1, Q – 2, R – 3, S – 4

Q.39 Match the operation/phenomenon in a grinding process with the corresponding definition listed in the table.

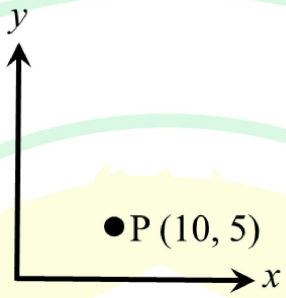
Operation/phenomenon		Definition	
P	Loading	1	Regenerating the sharpness of the grinding wheel
Q	Glazing	2	Filling of grinding chips in the space between the abrasive grits
R	Dressing	3	Restoring the geometry/shape of the grinding wheel
S	Truing	4	Condition of dull grinding wheel with worn-out grains

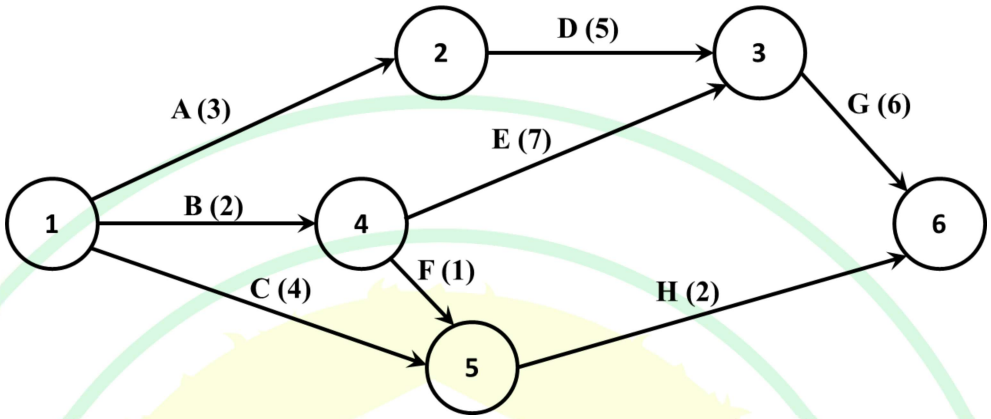
(A) P – 4, Q – 1, R – 3, S – 2

(B) P – 2, Q – 3, R – 1, S – 4

(C) P – 2, Q – 4, R – 1, S – 3

(D) P – 4, Q – 3, R – 1, S – 2

Q.40	A CNC vertical milling is used for cutting a straight line slot in x-y plane. Cutter is located at point P. The slope $\left(\frac{dy}{dx}\right)$ of the straight line created by the cutter is 1.25. Feed rate of x-axis is 120 mm/min. The new position of the cutter after 20 seconds is
	 All coordinates are in mm.
(A)	(50, 55)
(B)	(60, 50)
(C)	(60, 48)
(D)	(100, 80)

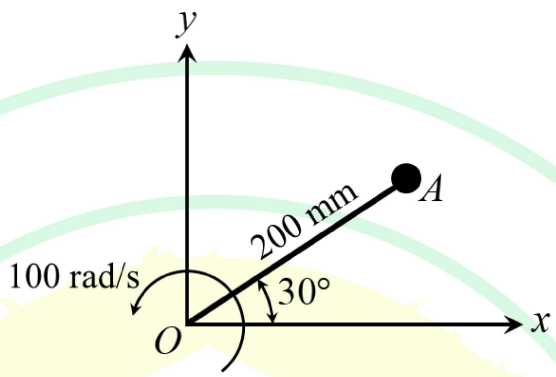
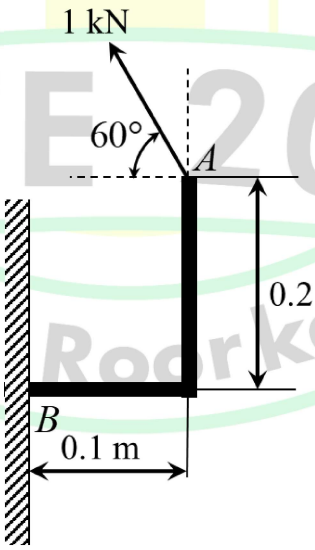
Q.41	The network diagram of eight activities (A to H) along with their time durations (in days, given in bracket) of a project is shown in the figure. The critical path of the project is
	
(A)	1–2–3–6
(B)	1–4–3–6
(C)	1–5–6
(D)	1–4–5–6

Q.42	The benefit(s) of product standardization is/are
(A)	Need of less number of drawings
(B)	Reduction in unit cost
(C)	Reduction in inventory cost
(D)	Greater product variety

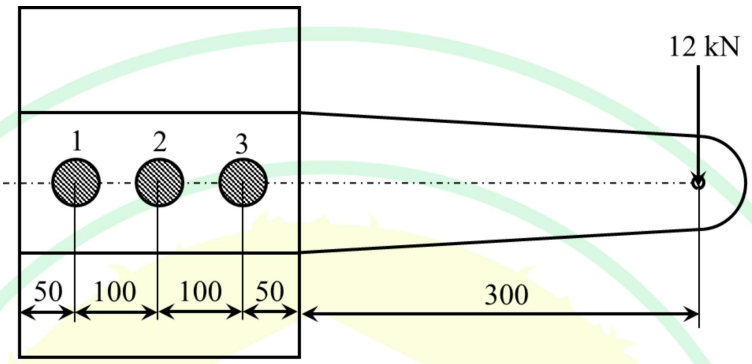
Q.43	The value of the integral $\int_{1}^{3}\left(x^2-2x\right)\mathrm{d}x$ obtained by using Simpson's 1/3 rule with 4 subintervals is equal to $\frac{n}{3}$. The value of n is_____. (*Answer in integer*)
Q.44	If $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$ are the orthogonal unit vectors in Cartesian x-y-z coordinate system, the rate of change of the function $f(x,y,z)=x^2+2y^2+z$ at point (1, 1, 1) in the direction of $3\mathbf{i}+4\mathbf{k}$ is_____. (*Answer in integer*)
Q.45	In a wire drawing of a perfectly-plastic material with flow stress of 300 MPa, the back tension is zero and front tension is 200 MPa. Assuming ideal deformation with zero friction, the percentage reduction of the cross-sectional area of the wire is_____. (*Rounded off to one decimal place*)
Q.46	In a cold rolling process without front and back tensions, the required minimum coefficient of friction is 0.04. Assume large rolls. If the draft is doubled and roll diameters are halved, then the required minimum coefficient of friction is_____. (*Rounded off to two decimal places*)

Q.47	In a direct current arc welding, the voltage V (in volt) is related to the arc length l (in cm) as $$V = (30 + 30l).$$ The open circuit voltage is 80 volts. The maximum possible arc length (in cm) is_____. (*Rounded off to two decimal places*)
Q.48	A worker is allowed half an hour personal time in a normal 8-hour shift. If the normal time for manufacturing a product is 5 minutes, the standard time (in second) is_____. (*Answer in integer*)
Q.49	A product has to be manufactured in a single-line layout by carrying out the six tasks in a sequence. The time (in minute) of the six sequential tasks are 37, 8, 19, 34, 36 and 17. These tasks cannot be further sub-divided. For minimizing the cycle time, the number of stations to be used is_____. (*Answer in integer*)
Q.50	A through hole of 10 mm diameter is to be drilled in a mild steel plate of 30 mm thickness. The selected spindle speed and feed for drilling hole are 600 revolutions per minute (RPM) and 0.3 mm/rev, respectively. Take initial approach and breakthrough distances as 3 mm each. The total time (in minute) for drilling one hole is_____. (*Rounded off to two decimal places*)

Q.51	In the iron-carbon equilibrium phase diagram, the eutectoid reaction occurs at 723 °C with the eutectoid composition of 0.83 weight % carbon. Ferrite and cementite phases are considered to contain 0.022 weight % carbon and 6.67 weight % carbon, respectively. If a steel specimen with 0.7 weight % carbon is cooled from 950 °C to below 723 °C, the fraction of eutectoid ferrite is_____. (*Rounded off to two decimal places*)
Q.52	During orthogonal cutting with a tool of 10° rake angle, the cutting and thrust forces are 900 N and 275 N, respectively. The coefficient of friction on the rake surface of the tool is_____. (*Rounded off to two decimal places*)
Q.53	In casting a cube of 80 mm side, the volumetric shrinkages due to solidification and solid contraction are 4.5% and 2%, respectively. Assume uniform cooling in all directions. The side (in mm) of the cubical pattern for getting the required size casting is_____. (*Rounded off to two decimal places*)
Q.54	The solidification of a casting starts at 10 AM. However, the solidification of the molten metal at the center-line of the mold starts at 10:03 AM and ends at 10:10 AM. The casting is considered solidified completely when the solidification is completed at the center-line of the mold. The center-line feeding resistance (CFR) in percentage is_____. (*Answer in integer*)

Q.55	A link *OA* of length 200 mm is rotating counter clockwise about *O* in *x*-*y* plane with a constant angular velocity of 100 rad/s, as shown in the figure. The absolute value of the *x*-component of the linear velocity (in m/s) of point *A* at the instant shown in the figure is_____. (*Rounded off to one decimal place*)
	
Q.56	A force of 1000 N is acting at point *A* on a bracket fixed at point *B* as shown in the figure. The magnitude of the moment of the force about *B* (in N·m) is_____. (*Rounded off to one decimal place*)
	

Q.57 A steel plate is fastened to a channel using three identical bolts as shown in the figure. The bolts are made of carbon steel of permissible yield strength in shear as 400 N/mm^2. The plate is subjected to a force of 12 kN. Neglect the weight of the plate. The magnitude of the resultant shear force (in N) on bolt 2 is_____. (*Answer in integer*)



All dimensions are in mm.

Q.58 The annual profit of a company depends on its annual marketing expenditure. The information of preceding 3 years' annual profit and marketing expenditure is given in the table. Based on linear regression, the estimated profit (in units) of the 4th year at a marketing expenditure of 5 units is_____. (*Rounded off to two decimal places*)

Year	Expenditure for marketing (units)	Annual profit (units)
1	3	22
2	4	27
3	6	36

Q.59 Three plants P_1, P_2 and P_3 produce 6, 1 and 9 thousand liters of fruit juice, respectively. The produced fruit juice is transported to three distribution centers D_1, D_2 and D_3 with requirement of 7, 5 and 4 thousand liters of juice, respectively. The transportation cost (in hundreds of Rupees) from each plant to each distribution center is given in the table. The total transportation cost (in hundreds of Rupees) in initial basic feasible solution using Vogel's approximation method is_____. (*Answer in integer*)

	D_1	D_2	D_3	Supply
P_1	2	3	11	6
P_2	1	0	6	1
P_3	5	8	15	9
Demand	7	5	4	

Q.60 A company purchases items in bulk for getting quantity discount in the item's price. The price break-up is given in the table. The annual demand for the item is 5000 units. The ordering cost is Rupees 400 per order. The annual inventory carrying cost is 30 percent of the purchase price per unit. The optimal order size (in units) is_____. (*Answer in integer*)

Quantity of item (Q in units)	**Unit price of item (Rupees)**
$0 \le Q < 1200$	10
$1200 \le Q < 2000$	8
$2000 \le Q$	7

Q.61 The zero line of the Vernier scale lies between divisions 20 and 21 of the main scale. The 4th Vernier scale division exactly coincides with a main scale division. The 5 divisions of the Vernier scale are equal to 4 divisions of the main scale. If one main scale division is 1 mm, the measured value (in mm) is _____. (*Rounded off to one decimal place*)

Q.62 A broaching machine makes key slots with a mean dimension of 10.56 mm and a standard deviation of 0.05 mm. The upper control limit for mean of sample size 5 calculated using X-bar ($\overline{X}$) chart is _____. (*Rounded off to two decimal places*)

Q.63 The table shows the data of running a machine for five years. The original machine cost is Rupees 70,000. In order to minimize the average total cost per year for running the machine, the machine should be replaced after_____ years. (*Answer in integer*)

	1st year	2nd year	3rd year	4th year	5th year
Resale value (Rupees)	40000	30000	25000	22000	20000
Maintenance cost (Rupees)	19100	20300	23500	30500	40000

Q.64	Water flows through a smooth circular pipe of diameter 10 cm and length 10 m. The pressure drop across the length of the pipe is 0.2 Pa. Kinematic viscosity and density of water are 1×10^{-6} m^2/s and 1000 kg/m^3, respectively. Assuming laminar and fully developed flow throughout the pipe, the velocity of water (in mm/s) at the center of the pipe is _____. (*Rounded off to one decimal place*)
Q.65	The left-hand side of a 20 cm thick wall is maintained at 25 °C. The right-hand side of the wall is exposed to hot air at 50 °C. There is no heat generation inside the wall and its thermal conductivity is 100 W/m·K. The convective heat transfer coefficient is 50 $W/m^2\cdot K$. Under steady state condition, the temperature (in °C) of the right-hand side surface of the wall is_____. (*Rounded off to one decimal place*)