

The Graduate Aptitude Test in Engineering

GATE 2023 Question Paper

GATE is an entrance examination conducted in India that primarily tests the comprehensive understanding of undergraduate subjects in engineering and sciences for admission into technical postgraduate programs.

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General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

Q.1	"You are delaying the completion of the task. Send _____ contributions at the earliest."
(A)	you are
(B)	your
(C)	you're
(D)	yore

Q.2	References : _____ : : Guidelines : Implement (By word meaning)
(A)	Sight
(B)	Site
(C)	Cite
(D)	Plagiarise

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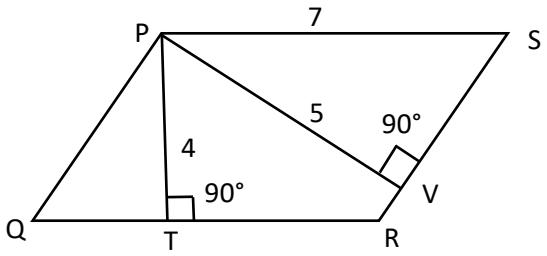
Q.3	In the given figure, PQRS is a parallelogram with PS = 7 cm, PT = 4 cm and PV = 5 cm. What is the length of RS in cm? (The diagram is representative.)
	
(A)	$\frac{20}{7}$
(B)	$\frac{28}{5}$
(C)	$\frac{9}{2}$
(D)	$\frac{35}{4}$

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Q.4	In 2022, June Huh was awarded the Fields medal, which is the highest prize in Mathematics. When he was younger, he was also a poet. He did not win any medals in the International Mathematics Olympiads. He dropped out of college. Based only on the above information, which one of the following statements can be logically inferred with *certainty*?
(A)	Every Fields medalist has won a medal in an International Mathematics Olympiad.
(B)	Everyone who has dropped out of college has won the Fields medal.
(C)	All Fields medalists are part-time poets.
(D)	Some Fields medalists have dropped out of college.

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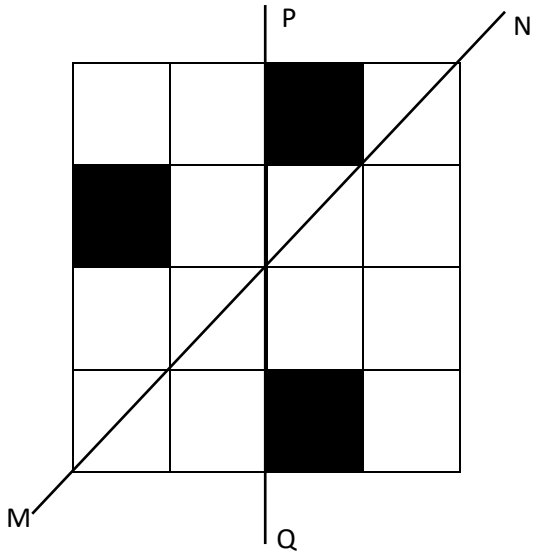
Q.5	A line of symmetry is defined as a line that divides a figure into two parts in a way such that each part is a mirror image of the other part about that line. The given figure consists of 16 unit squares arranged as shown. In addition to the three black squares, what is the minimum number of squares that must be coloured black, such that both PQ and MN form lines of symmetry? (The figure is representative)
	
(A)	3
(B)	4
(C)	5
(D)	6

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Q.6 – Q.10 Carry TWO marks Each

Q.6	Human beings are one among many creatures that inhabit an imagined world. In this imagined world, some creatures are cruel. If in this imagined world, it is given that the statement "Some human beings are not cruel creatures" is FALSE, then which of the following set of statement(s) can be logically inferred with *certainty*? (i) All human beings are cruel creatures. (ii) Some human beings are cruel creatures. (iii) Some creatures that are cruel are human beings. (iv) No human beings are cruel creatures.
(A)	only (i)
(B)	only (iii) and (iv)
(C)	only (i) and (ii)
(D)	(i), (ii) and (iii)

Q.7	To construct a wall, sand and cement are mixed in the ratio of 3:1. The cost of sand and that of cement are in the ratio of 1:2. If the total cost of sand and cement to construct the wall is 1000 rupees, then what is the cost (in rupees) of cement used?
(A)	400
(B)	600
(C)	800
(D)	200

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Q.8	The World Bank has declared that it does not plan to offer new financing to Sri Lanka, which is battling its worst economic crisis in decades, until the country has an adequate macroeconomic policy framework in place. In a statement, the World Bank said Sri Lanka needed to adopt structural reforms that focus on economic stabilisation and tackle the root causes of its crisis. The latter has starved it of foreign exchange and led to shortages of food, fuel, and medicines. The bank is repurposing resources under existing loans to help alleviate shortages of essential items such as medicine, cooking gas, fertiliser, meals for children, and cash for vulnerable households. Based only on the above passage, which one of the following statements can be inferred with *certainty*?
(A)	According to the World Bank, the root cause of Sri Lanka's economic crisis is that it does not have enough foreign exchange.
(B)	The World Bank has stated that it will advise the Sri Lankan government about how to tackle the root causes of its economic crisis.
(C)	According to the World Bank, Sri Lanka does not yet have an adequate macroeconomic policy framework.
(D)	The World Bank has stated that it will provide Sri Lanka with additional funds for essentials such as food, fuel, and medicines.

Q.9	The coefficient of x^4 in the polynomial $(x-1)^3(x-2)^3$ is equal to _____.
(A)	33
(B)	-3
(C)	30
(D)	21

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Q.10	Which one of the following shapes can be used to tile (completely cover by repeating) a flat plane, extending to infinity in all directions, without leaving any empty spaces in between them? The copies of the shape used to tile are identical and are not allowed to overlap.
(A)	circle
(B)	regular octagon
(C)	regular pentagon
(D)	rhombus

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Q.11 – Q.35 Carry ONE mark Each

Q.11	Given matrices $A = \begin{bmatrix} 1 & -1 & 4 \\ 3 & 2 & -1 \\ 2 & 1 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & B_{32} & B_{33} \end{bmatrix}$; B is skew-symmetric matrix of A. B_{13} is
(A)	-3
(B)	-2
(C)	2
(D)	3
Q.12	The non-linear differential equation from the following options is
(A)	$\frac{d^2y}{dx^2} + \frac{dy}{dx} + 10y = 0$
(B)	$\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + 10y = 0$
(C)	$\frac{d^2y}{dx^2} + \frac{dy}{dx} + 10x = 0$
(D)	$\frac{d^2y}{dx^2} + \frac{dy}{dx} + 10xy = 0$

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Q.13	The power series expansion of a function is given as $$\frac{1}{x}\ln(1+x) = 1 + bx + cx^2 + \cdots$$ for $0 < x \leq 1$. The values of constants b and c, respectively, are
(A)	$-\frac{1}{2}$ and $\frac{1}{3}$
(B)	$\frac{1}{2}$ and $-\frac{1}{3}$
(C)	-1 and $\frac{1}{2}$
(D)	1 and $-\frac{1}{2}$

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Q.14	Three unbiased coins are tossed. Provided that at least two outcomes are tails, the probability of having all three outcomes as tails is
(A)	$\frac{1}{8}$
(B)	$\frac{1}{4}$
(C)	$\frac{1}{3}$
(D)	$\frac{1}{2}$
Q.15	Two plane parallel surfaces exchange heat by thermal radiation. A radiation shield is placed in between at equal distance from the two surfaces to reduce heat transfer. All surfaces are black with infinite length and width. The ratio of heat transfer rate between surfaces with and without radiation shield is
(A)	$\frac{1}{2}$
(B)	$\frac{1}{4}$
(C)	$\frac{1}{6}$
(D)	$\frac{1}{8}$

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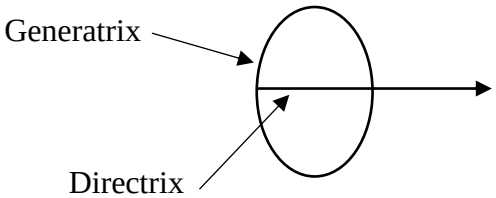
Q.16	As per the ANSI marking system, a grinding wheel with alumina as abrasive is designated as **51 A 36 K 5 V 23** Here, **K** indicates that
(A)	abrasive used in the wheel is aluminum oxide
(B)	hardness of the wheel is medium
(C)	bonding material of the wheel is shellac
(D)	structure of the wheel is dense
Q.17	The combination of Directrix and Generatrix in a machining operation is shown in figure. The surface produced is
	
(A)	cylindrical
(B)	planar
(C)	helical
(D)	parabolic

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Q.18	In NC machine, the function of interpolator is to
(A)	compute and maintain the tool feed rate
(B)	compute and maintain the velocity of the slide
(C)	generate warning signal based on the error
(D)	generate reference signals prescribing the shape of the produced part
Q.19	Vacuum in the machining zone is an essential requirement for
(A)	Electric Discharge Machining
(B)	Chemical Machining
(C)	Electro Chemical Machining
(D)	Electron Beam Machining

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Q.20	The qualitative method of forecasting amongst the given options is
(A)	Linear Regression
(B)	Weighted Moving Average
(C)	Delphi
(D)	Exponential Smoothing
Q.21	Transformation matrix to translate a point P from (10, 15) to (15, 25) is
(A)	$\begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{bmatrix}$
(B)	$\begin{bmatrix} 1 & 0 & 10 \\ 0 & 1 & 5 \\ 0 & 0 & 1 \end{bmatrix}$
(C)	$\begin{bmatrix} 5 & 0 & 0 \\ 0 & 10 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
(D)	$\begin{bmatrix} 10 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

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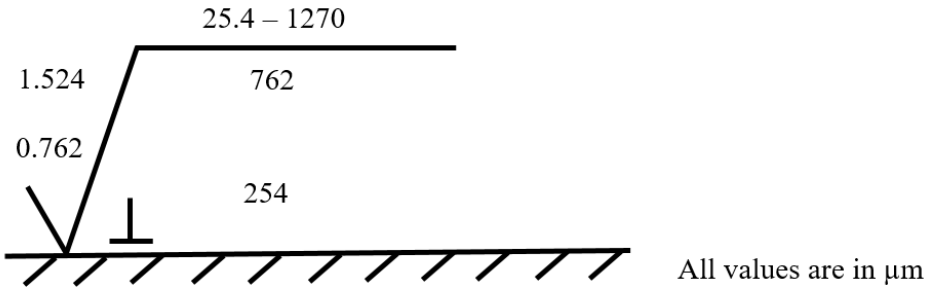
Q.22	A copper rod of 200 mm diameter and 400 mm length is extruded to the final diameter of 100 mm. The extrusion ratio is
(A)	1
(B)	2
(C)	4
(D)	8
Q.23	A symbol for surface texture parameters is shown in figure. The difference between maximum and minimum values of surface roughness (R_a) is
	
(A)	0.499 µm
(B)	0.508 µm
(C)	0.762 µm
(D)	1.524 µm

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Q.24	A thin cylinder has length L, diameter d, and thickness t. It is made of a material with modulus of elasticity E and Poisson's ratio μ. When the cylinder is subjected to an internal pressure P, the change in length is
(A)	$\frac{PdL}{2tE}\left(\frac{1}{2}-\mu\right)$
(B)	$\frac{PdL}{2tE}(2-\mu)$
(C)	$\frac{PdL}{2tE}(1-2\mu)$
(D)	$\frac{PdL}{4tE}\left(\frac{1}{2}-\mu\right)$
Q.25	Creep of mild steel at elevated temperature involves
(A)	elastic deformation under constant load
(B)	elastic deformation under dynamic load
(C)	plastic deformation under constant load
(D)	plastic deformation under dynamic load

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Q.26	Number of minimum control points required to generate a quadratic B-Spline curve is
(A)	2
(B)	4
(C)	8
(D)	16
Q.27	The Euler's method is used to solve $$\frac{dy}{dx} = x^3 y - 4, \quad y(0) = 1$$ The step size is 0.1. The approximate value of $y(0.1)$ is _____ (*round off to* 2 *decimal places*).
Q.28	A solid circular disk of 0.025 m thickness is used as flywheel. The density of the disk material is 7800 kg/m^3 and the mass moment of inertia of the disk about its center is 4.36 kg-m^2. The radius, in m, of the disk is _____(*round off to* 2 *decimal places*).
Q.29	The standard time for completing a job on a machine is 10 minutes. Number of machines available is 5, each machine is available for 300 hours/month, and average machine utilization is 80 %. The maximum number of jobs that can be produced in a month is _____ (*in integer*).

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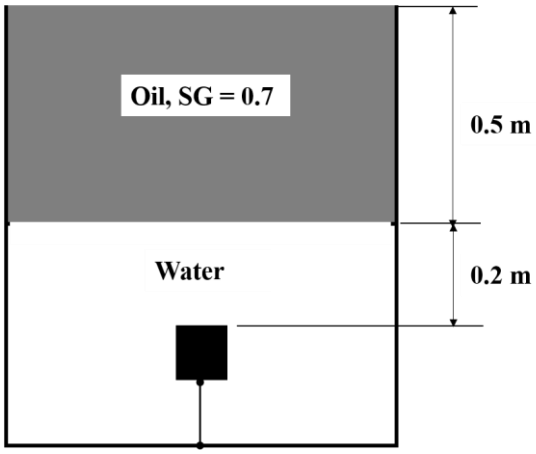
Q.30 Travel details of two persons P and Q travelling from city X to city Y are given as

Person	Mode of travel	Monetary worth of functions (travel time and comfort), in Rupees	Ticket cost, in Rupees
P	Aircraft	8000	4000
Q	Train	2000	2000

The positive difference in value of travel between the two modes is _____ (*in integer*).

Q.31 A wooden cubical block of side 0.1 m has specific gravity (SG) of 0.75. It is held submerged in a pool of oil and water by a massless rigid wire as shown in figure. The density of water is 1000 kg/m^3 and acceleration due to gravity is 9.8 m/s^2. The tension, in N, in the wire is _____ (*round off to* 2 *decimal places*).



Q.32 Under steady state conditions, superheated steam enters the turbine with enthalpy, h_1 = 3200 kJ/kg and wet steam leaves the turbine at pressure $p_2 = 0.1$ bar. The heat loss is 100 kJ/kg and work output is 1000 kJ/kg. Kinetic and potential energies for inflow and outflow are neglected. At pressure 0.1 bar, the enthalpy of saturated liquid is 200 kJ/kg and the enthalpy of vaporization is 2400 kJ/kg. The dryness fraction of the steam at the exit of the turbine is _____ (*round off to* 2 *decimal places*).

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Q.33	The total number of nonconformities is 420 from 30 samples. The size of each sample is 100. The lower control limit for the control chart for number of nonconformities is _____ (*round off to* 2 *decimal places*).
Q.34	Two metal sheets are joined using resistance spot welding. A welding current of 4500 A is applied for 0.2 s. The effective contact resistance at the sheet interface is 400×10^{-6} Ω. The thermal efficiency of the welding process is 50 %. The amount of heat, in J, used for producing a spot weld is _____(*in integer*).
Q.35	A metal rod of diameter 14 mm is subjected to a tensile test. After the test, its cross-sectional diameter at the fractured end is 12 mm. The ductility, in % , is _____ (*round off to* 2 *decimal places*).

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Q.36 – Q.65 Carry TWO marks Each

Q.36	Given, $z\,(x, y) = e^{x-2y}$, where $x(t) = e^{t}$ and $y(t) = e^{-t}$. All the variables are real. The total differential $\frac{dz}{dt}$ is
(A)	$-z(x + 2y)$
(B)	$-z(x - 2y)$
(C)	$z(x + 2y)$
(D)	$z(x - 2y)$
Q.37	Two cards are drawn one after the other from a regular deck of 52 playing cards without replacement. The probability that the drawn cards are of different suits is
(A)	$\frac{39}{51}$
(B)	$\frac{13}{52}$
(C)	$\frac{2}{52}$
(D)	$\frac{2}{51}$

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Q.38 Match the machine elements with their functions.

Machine element		Function	
P	Collet	**1**	Indexing
Q	Dividing head	**2**	Thread cutting
R	Lead screw	**3**	Holding the tool in place

(A) P – 3, Q – 2, R – 1

(B) P – 3, Q – 1, R – 2

(C) P – 2, Q – 1, R – 3

(D) P – 1, Q – 3, R – 2

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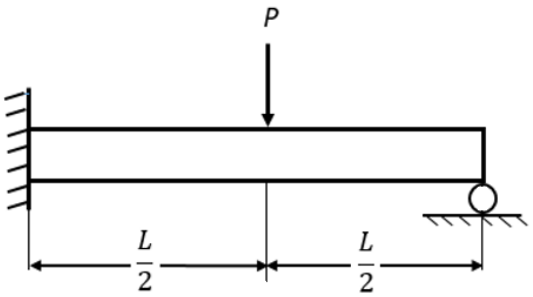
Q.39	A massless beam is fixed at one end and supported on a roller at other end. A point force P is applied at the midpoint of the beam as shown in figure. The reaction at the roller support is
	
(A)	$\frac{5P}{16}$
(B)	$\frac{2P}{3}$
(C)	$\frac{4P}{9}$
(D)	$\frac{9P}{25}$

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Q.40 Six jobs (1, 2, 3, 4, 5, 6) undergo drilling, followed by reaming operation. The time required for each operation is given as

Job	Drilling (min)	Reaming (min)
1	30	45
2	30	15
3	60	40
4	20	25
5	35	28
6	45	70

The sequence of processing the jobs, using the Johnson's rule, is

(A) 4 – 1 – 6 – 3 – 5 – 2

(B) 4 – 6 – 1 – 5 – 3 – 2

(C) 2 – 1 – 6 – 3 – 5 – 4

(D) 2 – 1 – 3 – 6 – 5 – 4

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Q.41 Match the engineering materials at room temperature with the given crystal structures.

Engineering material		Crystal structure	
P	Si	**1**	FCC
Q	Fe	**2**	HCP
R	Al	**3**	Diamond Cubic
S	Zn	**4**	BCC

(A) P – 3, Q – 4, R – 1, S – 2

(B) P – 2, Q – 1, R – 4, S – 3

(C) P – 2, Q – 4, R – 1, S – 3

(D) P – 3, Q – 1, R – 4, S – 2

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Q.42 Match the recording techniques used in method study with the most appropriate application areas.

Recording technique		Application area	
P	Outline process chart	**1**	Factory layout – movement of workers
Q	String diagram	**2**	Gang work
R	Multiple activity chart	**3**	Complete manufacturing sequence of a product
S	Two-handed process chart	**4**	Manual assembly of nuts and bolts

(A) P – 3, Q – 4, R – 2, S – 1

(B) P – 3, Q – 1, R – 2, S – 4

(C) P – 2, Q – 4, R – 3, S – 1

(D) P – 2, Q – 1, R – 3, S – 4

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Q.43 Match the products to be manufactured with the given metal working processes.

Product		Process	
P	Beverage can	**1**	Forging
Q	Seamless pipe	**2**	Skew Rolling
R	Connecting rod	**3**	Extrusion
S	Steel balls for bearing	**4**	Deep Drawing

(A) P – 3, Q – 4, R – 1, S – 2

(B) P – 2, Q – 4, R – 1, S – 3

(C) P – 4, Q – 3, R – 2, S – 1

(D) P – 4, Q – 3, R – 1, S – 2

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Q.44	The dual of a LPP is $$Minimize\ w = 4w_1 + 6w_2 + 5w_3 - w_4$$ subject to, $$\begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \end{bmatrix} \geq \begin{bmatrix} 3 \\ -2 \end{bmatrix}$$ $$\text{and} \quad w_i \geq 0 \quad \text{for} \quad i = 1, 2, 3, 4$$ The objective function of the primal is
(A)	$Maximize\ z = -3x_1 + 2x_2$
(B)	$Maximize\ z = x_1 + x_3$
(C)	$Maximize\ z = x_3 - x_4$
(D)	$Maximize\ z = 3x_1 - 2x_2$

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Q.45

There are four locations (P, Q, R, S) and four factors to be considered for setting up a facility. The scores (on a scale of 0 to 10, with 10 being the maximum) for the given locations and the weight assigned to each factor are given as

Factor	Weight	P	Q	R	S
Availability of raw material	0.4	6	8	5	4
Availability of skilled labor	0.3	7	4	10	6
Infrastructure	0.2	8	3	10	8
Proximity to market	0.1	10	8	7	5

The best location for setting up the facility is

(A) P

(B) Q

(C) R

(D) S

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Q.46	As per the Fe-C phase diagram, the microstructure of plain carbon steel with 0.4 wt.% carbon at room temperature contains
(A)	proeutectoid ferrite and pearlite
(B)	proeutectoid cementite and pearlite
(C)	ferrite and austenite
(D)	austenite and cementite
Q.47	The most appropriate process for manufacturing of plastic chair is
(A)	injection molding
(B)	extrusion
(C)	calendering
(D)	blow molding
Q.48	The following equation is solved using Newton-Raphson method $x^5 - 15 = 0$ with initial value $x_0 = 1.0$. The value of first approximation x_1 is _____(*round off to* 2 *decimal places*).

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Q.49 For the matrix $\begin{bmatrix} 4 & 2 \\ 3 & 3 \end{bmatrix}$, eigenvalue corresponding to the eigenvector $\begin{bmatrix} 2 \\ -3 \end{bmatrix}$ is _____(*in integer*).

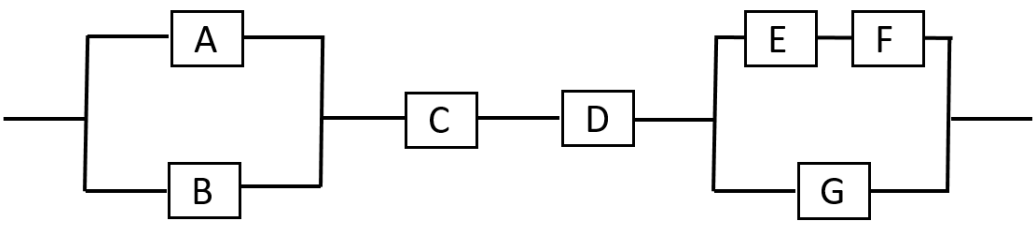
Q.50 The work sampling study, with 100 observations, revealed 25 % idle time of a worker. The number of observations required for ±10 % accuracy and 95.45 % confidence level is _____ (*in integer*).

Q.51 The information of two products P and Q is given as

Product	**Annual demand (units)**	**Ordering cost per order (Rupees)**	**Holding cost per unit per year (Rupees)**
P	2500	60	30
Q	3600	80	40

The value of $\frac{\text{Economic Order Quantity of product P}}{\text{Economic Order Quantity of product Q}}$ is _____ (*round off to* 2 *decimal places*).

Q.52 A system shown in figure has seven components with reliabilities $R_A = 0.96$, $R_B = 0.92$, $R_C = 0.94$, $R_D = 0.89$, $R_E = 0.95$, $R_F = 0.88$, and $R_G = 0.90$. The reliability of the system is _____ (*round off to* 2 *decimal places*).



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Q.53 Details of activities of a project are given as

Activity	A	B	C	D	E	F	G	H	I	J
Time (days)	8	10	8	7	16	15	18	14	9	4
Predecessors	-	-	-	A	A	B, D	C	C	F, G	E, I, H

The time required, in days, to complete the project along the critical path is _____ (*in integer*).

Q.54 A system has 10 essential components. Each component has an exponential time-to-failure distribution with constant failure rate of 0.04 per 4000 hours. The mean-time-to-failure, in hours, of the system is _____ (*in integer*).

Q.55 A CNC water jet cutting machine is used to cut a straight slot between the points (2, 1) and (10, 10) on the XY plane (dimensions are in mm). If the feed rate is 1.5 mm/s, the time, in s, required to machine the slot following the shortest path, is _____ (*round off to* 2 *decimal places*).

Q.56 In an orthogonal cutting with a tool of rake angle 0°, the value of the cutting force is two times of the thrust force. The coefficient of friction is _____ (*round off to* 1 *decimal place*).

Q.57 The solidification of a cubical casting of side 100 mm takes place with volumetric solidification shrinkage and solid contraction of 10 % each. The shape of the casting is retained on cooling to room temperature. The side of the cubical cast, in mm, at room temperature is _____ (*round off to* 2 *decimal places*).

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Q.58	A straight turning operation is carried out at the feed rate of 100 mm/min using a single point cutting tool with signature 8 – 8 – 5 – 5 – 7 – 25 – 0 (ASA). The spindle speed is 1600 rpm. The roughness, in μm, of the machined surface in terms of peak-to-valley height is _____ (*round off to* 2 *decimal places*).
Q.59	An arc welding operation is performed at 25 V and 200 A at welding speed of 2 mm/s. The heat used for melting is 80 % of the total heat generated. The unit melting energy of the metal to be joined is 10 J/mm^3. The volume of the weld metal produced per unit time, in mm^3/s, is _____ (*in integer*).
Q.60	Water flows through a pipe of diameter 0.02 m. The Reynolds number of the flow is 1000. The pipe is heated from outside with a uniform heat flux. The flow and heat transfer in the pipe are steady and fully developed. The thermal conductivity of water is 0.66 W/(m-K). The convective heat transfer coefficient, in W/(m^2-K), is _____ (*round off to* 2 *decimal places*).
Q.61	In an ideal air-standard Brayton cycle, air enters the compressor at 100 kPa and 300 K. Thermal efficiency of the cycle is 50 %. The heat added to air is 1000 kJ/kg. Air has constant specific heat $c_p = 1.0$ kJ/(kg-K) and $\gamma = 1.4$. Air temperature, in K, at the turbine inlet is _____ (*round off to* 2 *decimal places*).
Q.62	A key of width and height of 6 mm each is used to fix a gear on a shaft of 20 mm diameter. The shaft is used to transmit 10 kW power at 600 rpm to the gear. Permissible shear stress in the key is 80 N/mm^2, while compressive stress in the key is neglected. The minimum length of the key, in mm, is _____ (*round off to* 2 *decimal places*).

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Q.63	A cylindrical casting has 10 cm diameter and a mass of 12.56 kg. The material density is 7.85×10^{-3} kg/cm^3. The value of exponent 'n' is 2 and solidification time is 12 min. The Chvorinov's constant, in min/cm^2, is _____ (*round off to* 2 *decimal places*).
Q.64	A pair of spur gears is designed to transmit 20 kW power at a pitch line velocity of 10 m/s. Diameter of the driving gear is 0.5 m. The tangential force, in N, between the driver and the driven gear is _____(*in integer*).
Q.65	Two products, P and Q , are sold in the ratio of 10:1. The fixed cost is Rs. 1,40,000. The selling price of P is Rs. 10/unit and Q is Rs. 40/unit. The variable costs of P and Q are Rs. 5/unit and Rs. 20/unit, respectively. The break-even point in terms of revenue, in Rs., is _____(*in integer*).

END OF QUESTION PAPER

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