

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)

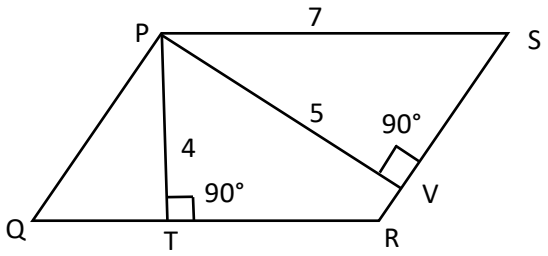
Q.1 – Q.5 Carry ONE mark Each

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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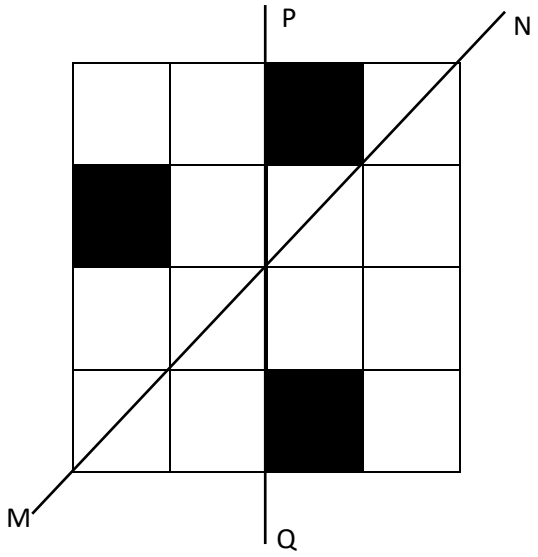
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Q.4	In 2022, June Huh was awarded the Fields medal, which is the highest prize in Mathematics. When he was younger, he was also a poet. He did not win any medals in the International Mathematics Olympiads. He dropped out of college. Based only on the 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	At one atmosphere pressure, α-Fe transforms to γ-Fe above 912 ^{o}C. Density of γ-Fe is more than that of α-Fe. Choose the correct statement.
(A)	Increasing the pressure above one atmosphere lowers the α-Fe to γ-Fe transformation temperature.
(B)	Increasing the pressure above one atmosphere raises the α-Fe to γ-Fe transformation temperature.
(C)	Molar volume of γ-Fe is higher than the molar volume of α-Fe.
(D)	Pressure change will not have any effect on the α-Fe to γ-Fe transformation temperature.
Q.12	Formation of an ideal solution leads to
(A)	increase in entropy
(B)	decrease in volume
(C)	increase in enthalpy
(D)	decrease in entropy

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Q.13	Order (O) and degree (D) of the differential equation $\left(\frac{dy}{dx}\right)^3 = \sqrt{\frac{d^2y}{dx^2} + 10}$ are
(A)	O = 2 and D = 1
(B)	O = 1 and D = 2
(C)	O = 6 and D = 1
(D)	O = 2 and D = 6
Q.14	At one atmosphere pressure, iron (*Fe*) and nickel (*Ni*) oxidize as $2Fe + O_2 \leftrightarrow 2FeO \qquad \Delta G^o = -527400 + 128\,T\ Joules$ $2Ni + O_2 \leftrightarrow 2NiO \qquad \Delta G^o = -471200 + 172\,T\ Joules$ Identify the correct statement. Given: Temperature, T is in *Kelvin*
(A)	*Fe* can reduce *NiO* at all temperatures
(B)	*Fe* can reduce *NiO* only above 1000 *K*
(C)	*Ni* can reduce *FeO* at all temperatures
(D)	*Ni* can reduce *FeO* only above 1000 *K*

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Q.15	For laminar fluid flow through a smooth circular tube, the relation between friction factor (f) and Reynolds number (Re) is
(A)	$f = \frac{16}{Re}$
(B)	$f = \frac{24}{Re}$
(C)	$f = \frac{16}{\sqrt{Re}}$
(D)	$f = \frac{24}{\sqrt{Re}}$
Q.16	Among the following options, a process for liquid-liquid separation is
(A)	Smelting
(B)	Roasting
(C)	Sintering
(D)	Calcination

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Q.17	The most effective concentration step for sulfide ores is
(A)	Froth flotation
(B)	Magnetic separation
(C)	Gravity separation
(D)	Electrostatic separation
Q.18	The gas distribution in a blast furnace is controlled by the shape of
(A)	Cohesive zone
(B)	Deadman zone
(C)	Raceway zone
(D)	Chemical reserve zone

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Q.19	Diamond has low
(A)	electrical conductivity
(B)	modulus of elasticity
(C)	hardness
(D)	thermal conductivity
Q.20	For self-diffusion in polycrystalline copper with a lattice diffusion coefficient D_L, grain boundary diffusion coefficient D_{GB}, and surface diffusion coefficient D_S, the correct relationship is
(A)	$D_S > D_{GB} > D_L$
(B)	$D_L > D_S > D_{GB}$
(C)	$D_{GB} > D_S > D_L$
(D)	$D_{GB} = D_S = D_L$

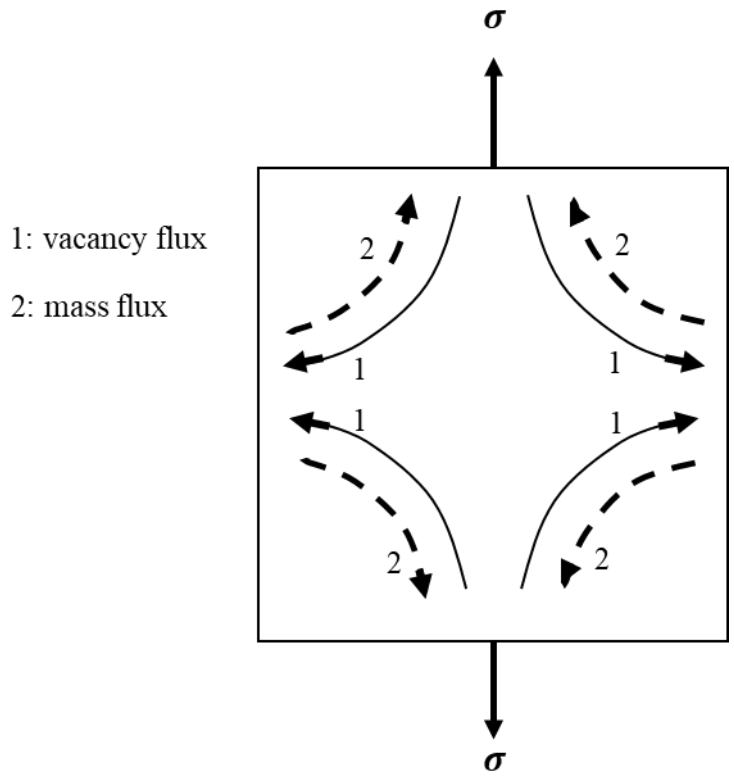
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Q.21	Magnitude of Burgers vector of the dislocation resulting from reaction of dislocations with Burgers vectors $\frac{a}{2}[101]$ and $\frac{a}{2}[0\bar{1}\bar{1}]$ is
(A)	$\frac{a}{\sqrt{2}}$
(B)	$\sqrt{2}\,a$
(C)	$\frac{a}{2}$
(D)	$2\,a$

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Q.22	The mechanism of creep for a single crystal as depicted in the schematic is 
(A)	Nabarro-Herring creep
(B)	Grain boundary sliding
(C)	Dislocation creep
(D)	Coble creep

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Q.23	The value of $\lim_{x\to 1}\frac{7x^7-20x^5+13x}{3x^3+x-4}$ is
(A)	$-\frac{38}{10}$
(B)	$-\frac{51}{10}$
(C)	$\frac{38}{10}$
(D)	undefined
Q.24	Match the defects in **Column I** with corresponding metal forming techniques in **Column II**.

	Column I	**Column II**
	(P) Cold shut	(1) Rolling
	(Q) Zipper breaks	(2) Sheet metal forming
	(R) Stretcher strains	(3) Drawing
	(S) Center burst	(4) Forging

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

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Q.25	In rolling, the point on the surface of contact between roll and sheet where surface velocity of the roll is equal to velocity of the sheet is referred as
(A)	no-slip point
(B)	no-stick point
(C)	maximum slip point
(D)	maximum stick point
Q.26	When cracks propagate in a brittle material, the following option(s) is/are correct
(A)	elastic strain energy decreases
(B)	surface energy increases
(C)	surface energy decreases
(D)	elastic strain energy increases

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Q.27	Which of the following is/are responsible for reducing the high cycle fatigue life of a component?
(A)	increasing the mean stress at constant amplitude
(B)	increasing the surface roughness
(C)	employing shot peening
(D)	absence of sharp corners in the component
Q.28	The non-destructive testing technique(s) for detecting internal defects in a steel component is/are
(A)	X-ray tomography
(B)	Ultrasonic technique
(C)	Gamma radiography
(D)	Dye penetrant technique

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Q.29	The condition(s) for high degree of mutual substitutional solid solubility for two metals is/are
(A)	metals should have same valence
(B)	metals should have same crystal structure
(C)	the difference in atomic size of metals should be less than 15%
(D)	the difference in electronegativity of metals should be large
Q.30	The sum of eigen values of the matrix $\begin{bmatrix} 4 & 3 & 2 \\ 0 & -1 & 2 \\ 0 & 0 & -3 \end{bmatrix}$ is_____ (*in integer*).
Q.31	The probability of setting an easy exam paper by three setters are $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$. If all three are setting one paper each, then the probability that at least one of the papers will be easy is _____ (*round off to 2 decimal places*).
Q.32	Maximum number of phases that can be in equilibrium for a 5-component system at constant temperature and pressure is _____ (*in integer*).

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Q.33	A liquid of density 900 $kg\ m^{-3}$ is flowing over a flat plate with a free stream velocity of 0.1 $m\ s^{-1}$. The laminar boundary layer thickness at a distance of 0.2 m from the leading edge of the plate is 0.007 m. The viscosity of the liquid in *centipoise* is _____ (*round off to 2 decimal places*). Given: 1 *centipoise* = $10^{-3}\ kg\ m^{-1}s^{-1}$
Q.34	The rate constant of a reaction at 400 K is three times the value at 300 K. The activation energy of the reaction in $kJ\ mol^{-1}$ is _____ (*round off to 1 decimal place*). Given: Universal gas constant, R = 8.314 $J\ mol^{-1}K^{-1}$
Q.35	The maximum value of function $f(x) = 4x^3 - 24x^2 + 36$ in the domain $[-1, 5]$ is _____ (*round off to nearest integer*).

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Q.36 – Q.65 Carry TWO marks

Q.36 Taking S as entropy, T as temperature, P as pressure, and V as volume, match **Column I** with **Column II**.

Column I	**Column II**
(A) Gibbs Free Energy	(1) depends on T, V and composition
(B) Helmholtz Free Energy	(2) depends on T, P and composition
(C) Enthalpy	(3) depends on S, P and composition
(D) Internal Energy	(4) depends on S, V and composition

(A) A – 2, B – 1, C – 3, D – 4

(B) A – 4, B – 3, C – 2, D – 1

(C) A – 3, B – 1, C – 4, D – 2

(D) A – 2, B – 1, C – 4, D – 3

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Q.37	Match the transport processes in **Column I** with the relationships in **Column II**.

	Column I	**Column II**
	(P) Molecular momentum transport	(1) Stefan-Boltzmann law
	(Q) Molecular mass transport	(2) Newton's law of viscosity
	(R) Molecular energy transport	(3) Fick's law
	(S) Radiation energy transport	(4) Fourier law

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

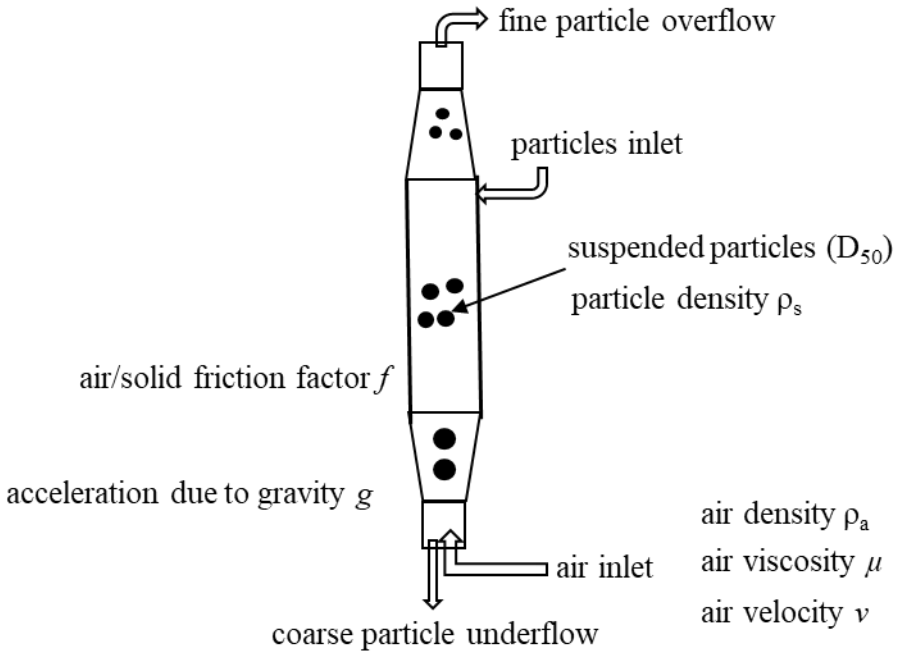
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Q.38	For supersonic O_2 jet in basic oxygen furnace steelmaking, choose the correct combination from the following:
	(1) Converging-diverging nozzle (2) Diverging-converging nozzle (3) O_2 velocity greater than sound velocity at nozzle throat (Mach number > 1) (4) O_2 velocity equal to sound velocity at nozzle throat (Mach number $= 1$) (5) Exit O_2 jet pressure $\geq$ atmospheric pressure (6) Exit O_2 jet pressure $<$ atmospheric pressure
(A)	(1), (4), (5)
(B)	(1), (3), (6)
(C)	(2), (3), (5)
(D)	(2), (4), (5)

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Q.39	Elutriator is used to separate particles based on their sizes in flowing air as shown in the figure.  Assuming spherical particles, the diameter (D_{50}) of the suspended particles which have 50% chance to report to overflow by turbulent air flow is expressed as
(A)	$D_{50} = \frac{3fv^2\rho_a}{4g(\rho_s - \rho_a)}$
(B)	$D_{50} = \left(\frac{18\mu v}{gf(\rho_s - \rho_a)}\right)^{0.5}$
(C)	$D_{50} = \left(\frac{9\mu v}{2g(\rho_s - \rho_a)}\right)^{2}$
(D)	$D_{50} = \frac{3fv\rho_a}{8g(\rho_s - \rho_a)}$

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Q.40	A fluid flow field is given by the velocity vector $\vec{V} = e^{xyz}(x\hat{\imath} + z\hat{k})$. The curl of velocity at (1, 2, 3) is
(A)	$e^6(9\hat{\imath} - 16\hat{\jmath} - 3\hat{k})$
(B)	$e^6(9\hat{\imath} - 3\hat{k})$
(C)	$e^6(9\hat{\imath} + 16\hat{\jmath} - 3\hat{k})$
(D)	$e^6(-16\hat{\imath} + 9\hat{\jmath} - 3\hat{k})$
Q.41	Given, $\bar{\varphi} = xy\,\hat{\imath} + yz\,\hat{\jmath} + xz\,\hat{k}$. S is a surface bounded by the planes $x = 0$, $y = 0$, $z = 0$, $x = 3$, $y = 2$, and $z = 1$. If $\hat{n}$ is the unit vector normal to S, then $\iint_S \bar{\varphi} . \hat{n}\, dS$ is
(A)	18
(B)	9
(C)	36
(D)	3

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Q.42	Match the processes in **Column I** with the corresponding applications in **Column II**.

Column I	**Column II**
(P) Fused salt electrolysis	(1) Ironmaking
(Q) Carbothermal reduction	(2) Aluminium extraction
(R) Oxidation-refining	(3) Copper extraction
(S) Matte converting	(4) Steelmaking

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

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Q.43 Match **Column I** with **Column II**.

Column I	**Column II**
(P) Gallium arsenide	(1) Superconductor
(Q) Barium titanate	(2) Soft magnetic material
(R) Iron - 4 wt.% silicon	(3) Semiconductor
(S) Yttrium-barium-copper oxide	(4) Piezoelectric material

(A) P – 3, Q – 4, R – 2, S – 1

(B) P – 2, Q – 4, R – 3, S – 1

(C) P – 3, Q – 2, R – 1, S – 4

(D) P – 4, Q – 2, R – 1, S – 3

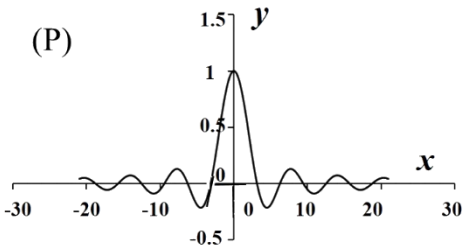
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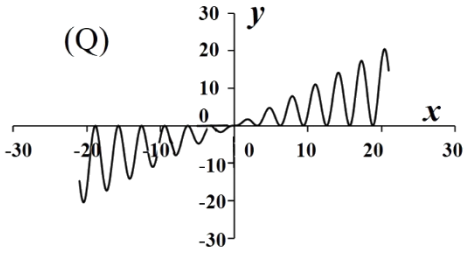
Q.44	Match the plots in **Section I** with the corresponding functions in **Section II**.

Section I

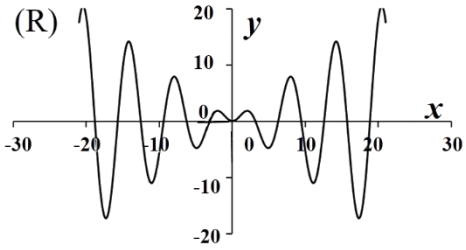
(P)



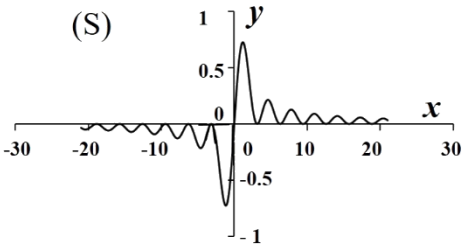
(Q)



(R)



(S)



Section II

(1) $y = \frac{sin^2 x}{x}$

(2) $y = x\ sin^2 x$

(3) $y = \frac{sinx}{x}$

(4) $y = x\ sinx$

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

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Q.45	Match the components in **Column I** with corresponding manufacturing processes in **Column II**.

Column I	**Column II**
(P) Crank shaft	(1) Sheet metal forming
(Q) Machine bed	(2) Forging
(R) Automobile brake pad	(3) Casting
(S) Beverage can	(4) Powder metallurgy

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

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Q.46	Match the welding techniques in **Column I** with the most appropriate applications in **Column II**.

Column I	**Column II**
(P) Submerged arc welding	(1) Thick sections
(Q) Electroslag welding	(2) Surfacing and repair
(R) Shielded metal arc welding	(3) Thin sheets
(S) Resistance spot welding	(4) Flat position

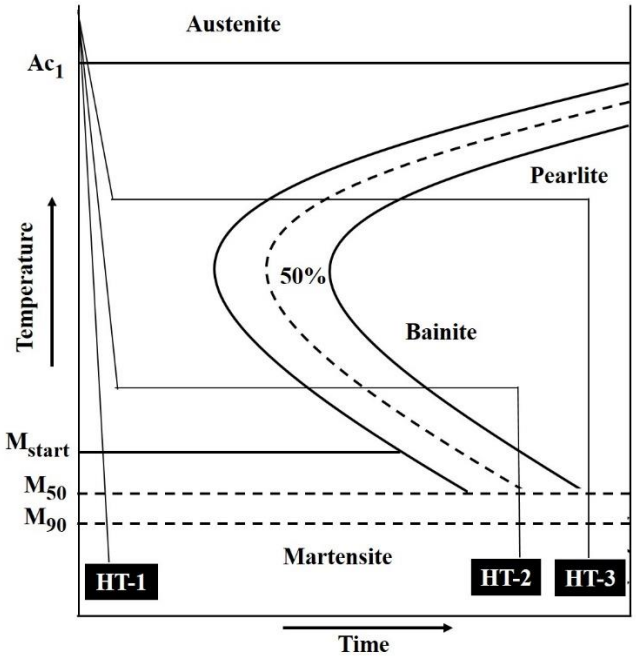
(A)	P – 4, Q – 1, R – 2, S – 3
(B)	P – 3, Q – 2, R – 1, S – 4
(C)	P – 1, Q – 3, R – 4, S – 2
(D)	P – 2, Q – 4, R – 3, S – 1
Q.47	Concerning the chemical potentials of components in a binary system at constant pressure, the correct statement(s) is/are
(A)	For single-phase equilibrium at a given temperature, chemical potentials of the components change with alloy composition.
(B)	For two-phase equilibrium at a given temperature, chemical potential of any component in both phases is same.
(C)	For two-phase equilibrium at a given temperature, chemical potentials of the components change with alloy composition.
(D)	For single-phase equilibrium of a given composition, chemical potentials of the components do not change with temperature.

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Q.48	Which of the following is/are the role(s) of coke in a blast furnace?
(A)	reducing agent
(B)	heat source
(C)	gas permeable medium
(D)	flux
Q.49	Identify the INCORRECT statement(s)
(A)	Calcination is typically exothermic and roasting is usually endothermic.
(B)	Coking of coal is carried out in a shaft furnace.
(C)	The aims of extractive metallurgy processing are separation, compound formation, metal production, and metal purification.
(D)	The secondary steelmaking offers steel cleanliness, composition adjustments, and temperature adjustments.

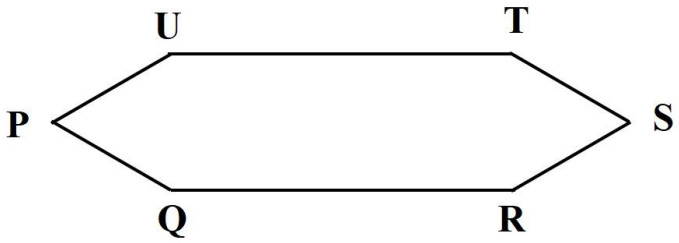
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Q.50	For the given schematic TTT diagram of an eutectoid steel, the following statement(s) is/are true for the heat treatment schedules HT-1, HT-2, and HT-3.
	
(A)	HT-3 leads to the formation of a pearlite microstructure
(B)	HT-1 leads to a predominantly martensite microstructure
(C)	HT-2 leads to a bainite microstructure
(D)	HT-3 leads to a mixture of pearlite and bainite microstructure

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Q.51	A dislocation loop **PQRSTU** is on the (111) plane of a cubic single crystal with Burgers vector $\frac{1}{6}[\bar{1}2\bar{1}]$. The dislocation segments $\overrightarrow{\mathbf{PU}}$ and $\overrightarrow{\mathbf{PQ}}$ are parallel to $[0\bar{1}1]$ and $[1\bar{1}0]$ directions, respectively.  The correct statement(s) is/are
(A)	Dislocation segment **PQ** is mixed in character.
(B)	Dislocation segment **UT** is screw in character.
(C)	Dislocation segment **PU** is mixed in character.
(D)	Dislocation segment **QR** is edge in character.

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Q.52	Compared to top gating, the effect(s) of bottom gating in sand mold casting is/are
(A)	reduced melt oxidation
(B)	reduced mold erosion
(C)	enhanced melt oxidation
(D)	enhanced mold erosion
Q.53	Choose the correct statement(s) in the context of fusion welding of austenitic stainless steel containing about 0.06 wt.% carbon.
(A)	Corrosion resistance of heat affected zone is poorer than base material.
(B)	Corrosion resistance of heat affected zone is superior than fusion zone.
(C)	Corrosion resistance of heat affected zone is same as fusion zone.
(D)	Corrosion resistance is same for fusion zone, heat affected zone, and base material.

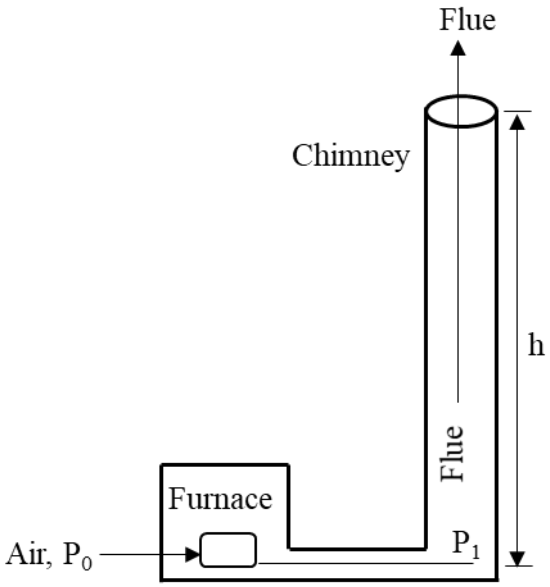
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Q.54	For the equation $\begin{vmatrix} x+3 & 3x+4 & 4x+5 \\ -2 & -3 & -4 \\ -3 & -4 & -5 \end{vmatrix} = 0$ the value of x is_____(*in integer*).
Q.55	Enthalpy of formation of an A−B regular solution containing 80 atomic percent A is 3.36 $kJ\ mol^{-1}$. The activity coefficient of A at 500 K for the solution containing 40 atomic percent A is _____(*round off to 1 decimal place*). Given: Universal gas constant, R = 8.314 $J\ mol^{-1}K^{-1}$
Q.56	A thin plate is loaded in plane stress condition with $\sigma_{xx} = 110\ MPa,\ \sigma_{yy} = -50\ MPa,\ \tau_{xy} = -70\ MPa$ The maximum principal stress in MPa is _____ (*round off to nearest integer*).

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Q.57 A chimney as shown in the figure requires to have natural draft (pressure difference between the furnace and the bottom of chimney, $P_0 - P_1$) of 1.0133×10^3 Pa.



Given: acceleration due to gravity, g = 9.81 $m\ s^{-2}$

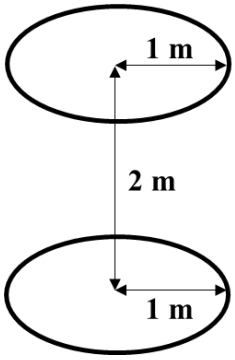
Assume densities of air and flue do not change along the chimney height. Neglect frictional energy loss and kinetic energy difference at the bottom and top of the chimney.

If the density difference between the air and flue is 0.5 kg m^{-3}, the minimum height (h) of the chimney in meters is_____ (*round off to nearest integer*).

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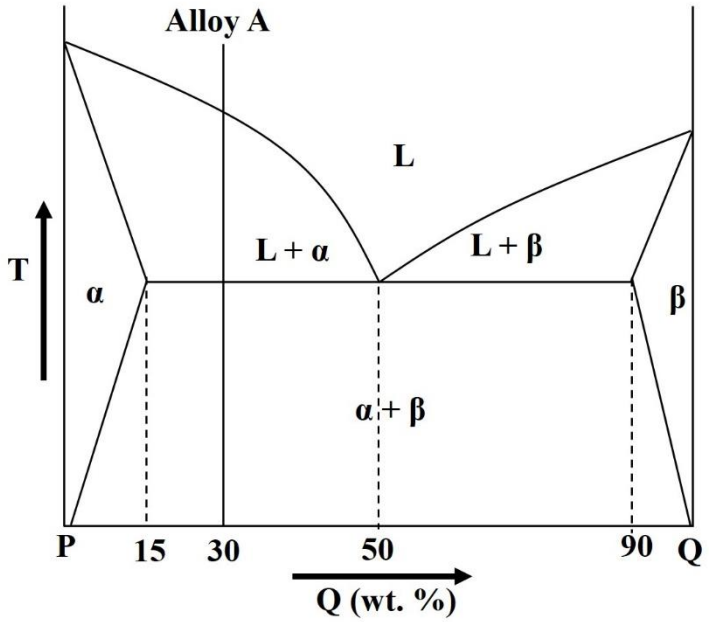
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Q.58	Two circular surfaces **A** and **B** with the values of emissivity **ε**, temperature **T**, and respective view factors are shown in the figure. Consider heat radiation only between surfaces **A** and **B**.  Surface **B** $\varepsilon = 0.8$, $\mathbf{T} = 500\ K$, $\mathbf{F_{BA}} = 0.172$ Surface **A** $\varepsilon = 0.7$, $\mathbf{T} = 800\ K$, $\mathbf{F_{AB}} = 0.172$ Given: Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8}\ Wm^{-2}K^{-4}$ Net heat flow rate by radiation from surface **A** in *kW* is_____ (*round off to 1 decimal place*).
Q.59	Copper ore assaying 10 wt.% Cu is fed to a concentration plant at the rate of 100 tons/h. If the grades of concentrate and tailing are 30 wt.% Cu and 1 wt.% Cu, respectively, the percentage recovery of copper in concentrate is _____ (*round off to nearest integer*). Given:1 ton = 1000 kg
Q.60	Diffraction pattern of a polycrystalline BCC metal is obtained using monochromatic X-rays of wavelength 0.25 *nm*. If the first peak occurs at Bragg angle (θ) of 30°, then the radius of the metal atom in *nm* is _____ (*round off to 2 decimal places*).

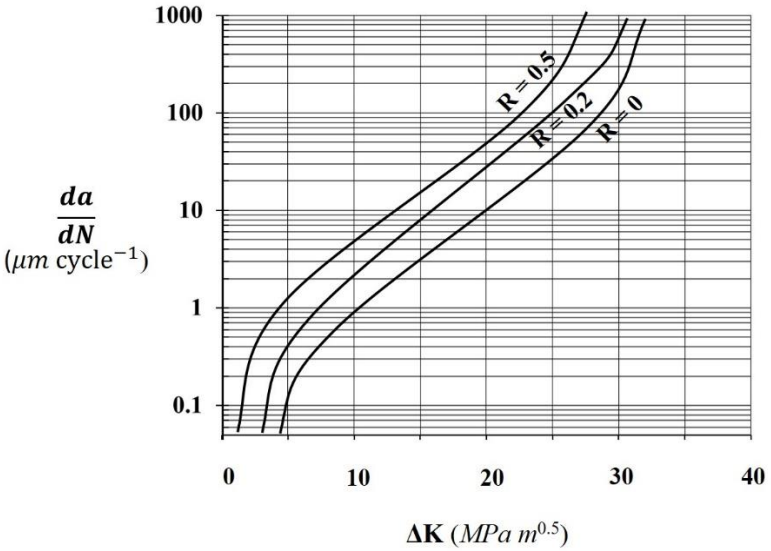
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Q.61	The alloy A (given in the phase diagram) is cooled slowly from the liquid state to just below the eutectic temperature. The ratio of weight fractions of pro-eutectic α to eutectic α is _____ (*round off to 1 decimal place*).
	
Q.62	In an aqueous solution of Fe^{2+} ions with concentration of 10^{-4} M at 298 *K* and atmospheric pressure, the reduction potential of Fe in volt is _____ (*round off to 2 decimal places*). Given: Standard reduction potential, $E^{\circ}_{Fe^{2+}/Fe} = -0.44\ V$ Faraday's constant, F = 96500 *C* per mole of electrons Universal gas constant, R = 8.314 $J\ mol^{-1}K^{-1}$
Q.63	Strain hardening behavior of an alloy is given by $\sigma = 1100\ \varepsilon^{0.3}$, where σ and ε are true stress and true strain, respectively. The alloy is cold drawn to an unknown amount of strain, followed by tensile testing. If the tensile test showed 10 % reduction in area at maximum load, then the unknown amount of strain from prior cold work is _____ (*round off to 2 decimal places*).

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Q.64	A specimen containing maximum initial surface crack of size 1.5 *mm* is subjected to cyclic loading with $\sigma_{max} = 300\ MPa$ and $\sigma_{min} = 0\ MPa$. Assuming specimen geometric factor of 1, and referring to the given figure, the crack growth rate in μm cycle^{-1} is _____ (*round off to nearest integer*).  Given: ***N*** = number of cycles ***a*** = crack length **R** = stress ratio **ΔK** = stress intensity range
Q.65	A 200 mm thick slab is rolled using 500 mm diameter rolls under cold rolling and hot rolling conditions, separately. The coefficient of friction is 0.04 in cold rolling and 0.4 in hot rolling. The ratio of maximum possible thickness reduction in cold rolling to that in hot rolling is _____ (*round off to 2 decimal places*).

END OF QUESTION PAPER

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