General Aptitude (GA)
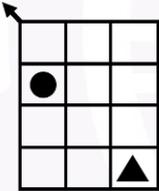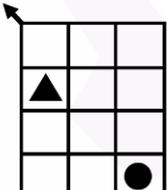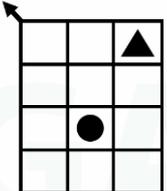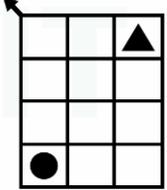
Q.1 – Q.5 Carry ONE mark Each

Q.1	'The team _____ more than 300 runs in 20 overs _____ rains. However, some players needed to improve their batting skills.'
	Choose the option with the correct sequence of words to fill the blanks.
(A)	score; despite
(B)	scoring; instead of
(C)	scored; despite
(D)	scoring; in spite of

Q.2	If a positive real x satisfies the following equation
	$$\log_2 x + \log_{\sqrt{2}} x = 48,$$
	then the value of x is _____
(A)	2^{16}
(B)	4^{16}
(C)	2^{14}
(D)	4^{14}

Q.3	The next figure (indicated by '?') in the sequence is
(A)	
(B)	
(C)	
(D)	

Q.4	'All the mangoes in the basket are good.'
	If the above statement is **false**, then which one of the following statements is necessarily true?
(A)	All the mangoes in the basket are not good.
(B)	No mango in the basket is good.
(C)	In the basket, some of the mangoes are good and some are not good.
(D)	There exists at least one mango in the basket that is not good.

Q.5	Consider the following statements about four numbers:
	(S1) The average of the four numbers is 25
	(S2) Each number is at most 40
	(S3) Each number is at least 20
	Choose the option that is necessarily correct.
(A)	(S1) and (S2) together imply (S3)
(B)	(S2) and (S3) together imply (S1)
(C)	(S1) and (S3) together imply (S2)
(D)	(S1) implies (S3)

Q.6 – Q.10 Carry TWO marks Each

Q.6	'People are crowding around ___ pit into which ___ elephant has fallen. I have never seen an elephant looking more bewildered ___ miserable. Here it is in a most undignified position, thrust into a pit and made to look up ___ a vast, curiosity-stricken crowd.'
	Choose the option with the correct sequence of words to fill the blanks.
(A)	an; a; at; and
(B)	a; an; and; at
(C)	and; a; an; at
(D)	at; a; an; and

| Q.7 | The table lists the unit selling price of five products P, Q, R, S, and T. On a particular day, 250 items were sold with the average selling price of Rs. 60. The following observations were made: |

(i)   The quantity of S sold was twice that of T.
(ii)   The quantity of R sold was thrice that of T.
(iii)   The quantity of Q sold was four times that of T.

Product	P	Q	R	S	T
Unit selling price (Rs.)	100	50	40	60	60

What is the quantity of product P sold on that day?

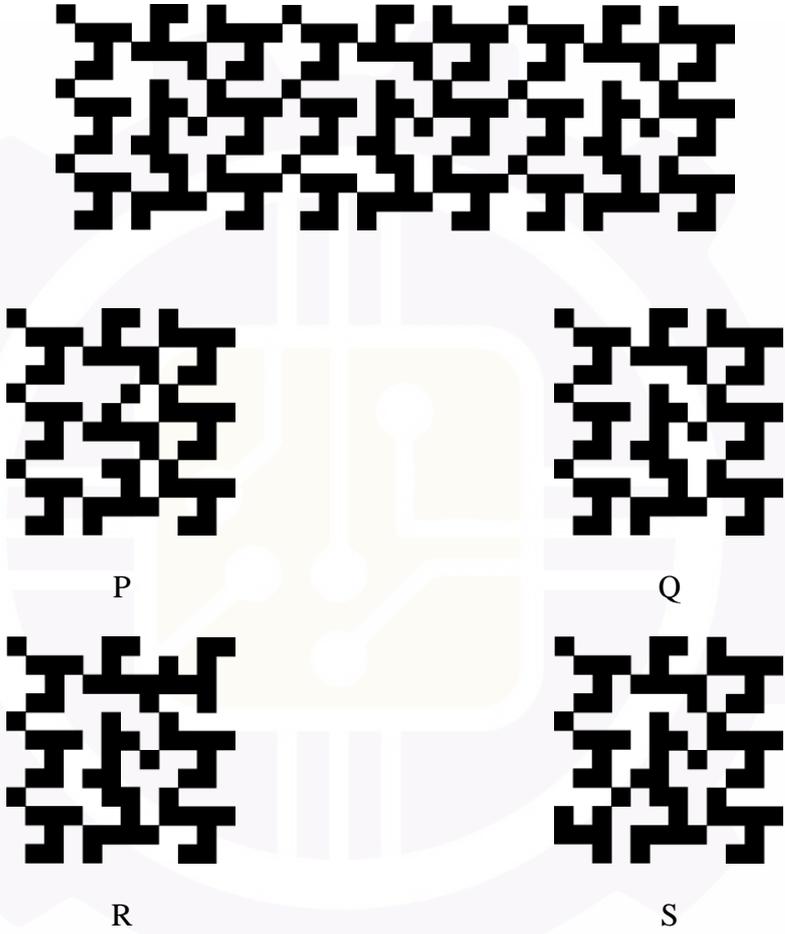| (A)	40
(B)	50
(C)	60
(D)	70

Q.8	Consider a string P of length l that is laid out as a straight-line segment. Another string K is laid out as a semicircular arc with string P as its diameter, as represented in Figure (i). When both the strings are shortened by a length x they can be re-arranged such that the shortened string K forms a full circle with the shortened string P as its diameter, as represented in Figure (ii). The value of x/l is _____

String K · After Shortening · Shortened String K

String P · Shortened String P

l

Figure (i)   Figure (ii)

(A)	π
(B)	$\dfrac{\pi-1}{2\pi}$
(C)	$\dfrac{\pi}{2(\pi-1)}$
(D)	$\dfrac{\pi}{\pi-1}$

Q.9	The Roman senator Meritorius, his brother, his son, and his daughter have varying oratory skill levels. They are seated in rows and columns as shown in the figure with exactly one person sitting in each box. It is known that
	(i) Meritorius' daughter and his brother are seated in the same column.
	(ii) His son is seated diagonally across the sibling of the worst orator.
	(iii) The best and worst orators are seated in the same row.
	Who is the best orator?
	Seating Arrangement

(A)	Meritorius
(B)	Meritorius' brother
(C)	Meritorius' son
(D)	Meritorius' daughter

Q.10	Which one of the patterns labelled P, Q, R, and S is used to generate the following figure?
	P Q
	R S
(A)	P
(B)	Q
(C)	R
(D)	S

Q.11 – Q.35 Carry ONE mark Each

Q.11   Given a function $f(t) = e^{-at}$, where a is a constant. The Laplace transform of the function is $\mathcal{L}[f(t)] = F(s)$. Which one of the following options is correct?

(A) $F(s) = 1\!\!\Big/\!(s-a)$

(B) $F(s) = s\!\!\Big/\!(s^2 - a^2)$

(C) $F(s) = a\!\!\Big/\!(s^2 - a^2)$

(D) $F(s) = 1\!\!\Big/\!(s+a)$

Q.12

Select the correct pair of eigen vectors for the following symmetric matrix.

$$\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$$

(A) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$ and $\begin{bmatrix} -2 \\ 1 \end{bmatrix}$

(B) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$ and $\begin{bmatrix} 2 \\ 1 \end{bmatrix}$

(C) $\begin{bmatrix} -1 \\ -2 \end{bmatrix}$ and $\begin{bmatrix} 2 \\ 1 \end{bmatrix}$

(D) $\begin{bmatrix} -1 \\ 2 \end{bmatrix}$ and $\begin{bmatrix} 2 \\ -1 \end{bmatrix}$

Q.13   Choose one correct option.

Given $w = f(ax + by)$ where a and b are constants.

The value of $\left(b\dfrac{\partial w}{\partial x} - a\dfrac{\partial w}{\partial y} \right)$ is:

(A) $-a$

(B) b

(C) $b - a$

(D) 0

Q.14 Which one of the following fusion welding techniques results in least Heat-Affected Zone (HAZ)?

(A)   Submerged Arc Welding (SAW)

(B)   Tungsten Inert Gas Welding (TIG)

(C)   Electron Beam Welding (EBW)

(D)   Oxy-Acetylene Welding (OAW)

Q.15

During metallography, Nital is the most commonly used for

etching _____.

(A)   Bronze

(B)   Brass

(C)   Mild Steel

(D)   Aluminium

Q.16   Which one of the following options is correct?

In a face-centered cubic metal, Shockley partial is:

(A)   Perfect and mobile dislocation

(B)   Perfect and immobile dislocation

(C)   Imperfect and immobile dislocation

(D)   Imperfect and mobile dislocation

Q.17

Deformation mechanism map of a given material is used for determining which one of the following properties?

(A)   Fatigue strength

(B)   Creep rate

(C)   Tensile strength

(D)   Impact toughness

Q.18 Which one of the following dislocation dissociation reactions is feasible in face-centered cubic metals?

(A) $a/2 \ [0 \ \bar{1} \ 1] \rightarrow a/6 \ [1 \ \bar{2} \ 1] + a/6 \ [\bar{1} \ \bar{1} \ 2]$

(B) $a/2 \ [0 \ \bar{1} \ 1] \rightarrow a/6 \ [1 \ 1 \ 2] + a/6 \ [2 \ 1 \ \bar{1}]$

(C) $a/2 \ [0 \ \bar{1} \ 1] \rightarrow a/6 \ [1 \ \bar{1} \ 2] + a/6 \ [\bar{1} \ \bar{2} \ \bar{1}]$

(D) $a/2 \ [0 \ \bar{1} \ 1] \rightarrow a/6 \ [1 \ \bar{2} \ 1] + a/6 \ [2 \ \bar{1} \ \bar{1}]$

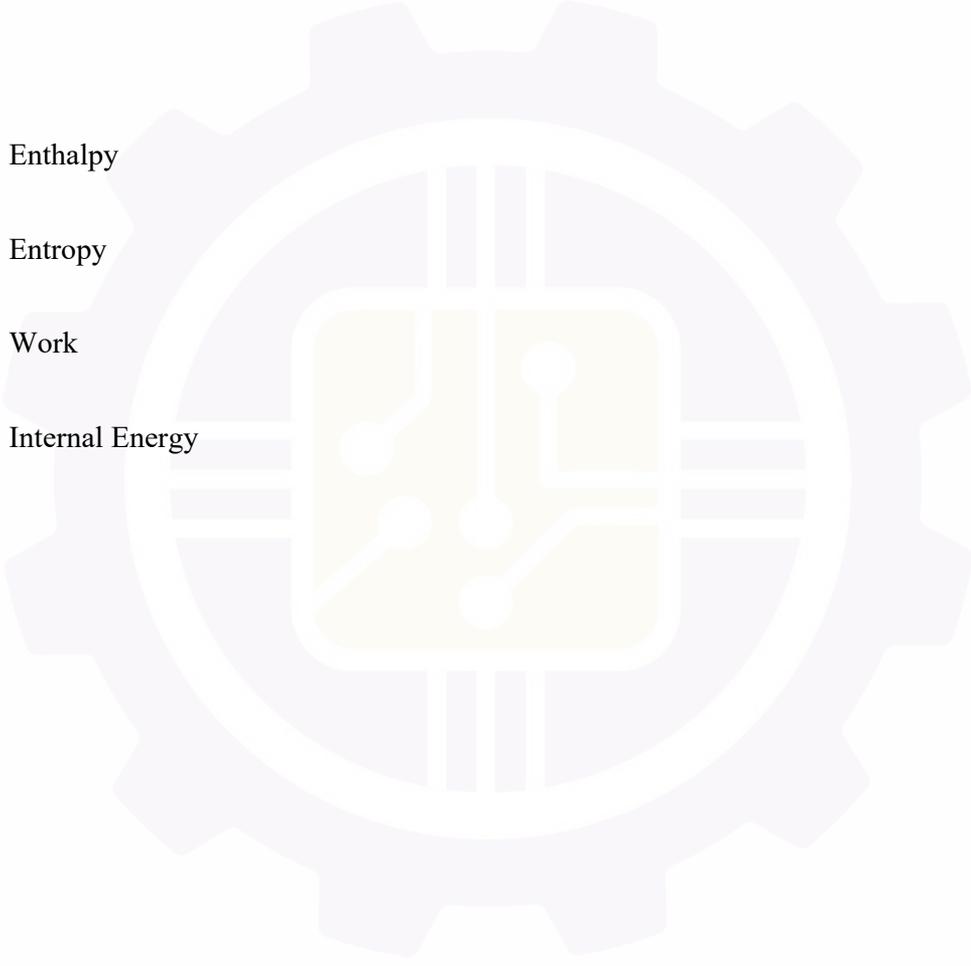Q.19   Which one of the following options is correct?

For Al - 4 % Ag alloy (composition in atom %), the correct sequence of operations involved in precipitation hardening is:

(A)   Quenching → Aging → Solution treatment

(B)   Solution treatment → Aging → Quenching

(C)   Aging → Solution treatment → Quenching

(D)   Solution treatment → Quenching → Aging

Q.20 Which one of the following is NOT a state function?

(A) Enthalpy

(B) Entropy

(C) Work

(D) Internal Energy

Q.21   For a regular solution, which one of the following statements is correct?

(ΔH$_{mix}$ is the enthalpy of mixing and ΔS$_{mix}$ is the entropy of mixing)

(A)   Both ΔH$_{mix}$ and ΔS$_{mix}$ are finite

(B)   ΔH$_{mix}$ is zero and ΔS$_{mix}$ is finite

(C)   ΔH$_{mix}$ is finite and ΔS$_{mix}$ is zero

(D)   Both ΔH$_{mix}$ and ΔS$_{mix}$ are zero

Q.22   Which one of the following options is correct?

In a binary alloy system, during spinodal decomposition, uphill diffusion occurs:

(A)   From higher to lower concentration and from higher to lower chemical potential

(B)   From higher to lower concentration and from lower to higher chemical potential

(C)   From lower to higher concentration and from lower to higher chemical potential

(D)   From lower to higher concentration and from higher to lower chemical potential

Q.23   Which one of the following options is correct?

In Al - 4 wt.% Cu alloy during isothermal aging, the correct precipitation sequence is:

(A) $\theta'' \rightarrow \theta' \rightarrow \theta \rightarrow$ GP zone

(B)   GP zone $\rightarrow \theta \rightarrow \theta' \rightarrow \theta''$

(C) $\theta \rightarrow \theta' \rightarrow \theta'' \rightarrow$ GP zone

(D)   GP zone $\rightarrow \theta'' \rightarrow \theta' \rightarrow \theta$

Q.24   Which one of the following options is correct?

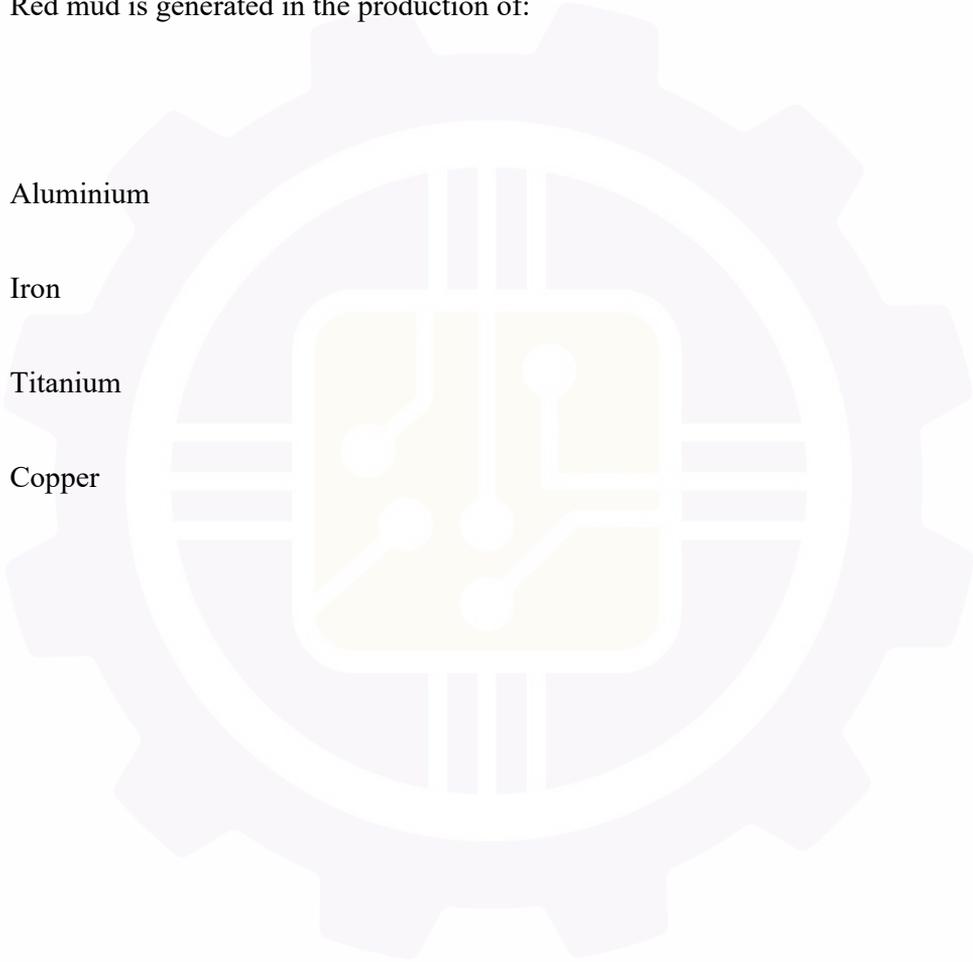After cold-working of a metallic specimen, during the recovery stage, its electrical conductivity:

(A)   Always increases

(B)   Always decreases

(C)   Can increase or decrease

(D)   Remains unaffected

Q.25   Which one of the following options is correct?

Red mud is generated in the production of:

(A)   Aluminium

(B)   Iron

(C)   Titanium

(D)   Copper

Q.26   Residual stress present in a material can be determined by which one of the following techniques:

(A)   X-ray Diffraction (XRD)

(B)   Tensile Testing

(C)   Thermo-Gravimetric Analysis (TGA)

(D)   Optical Microscopy

Q.27   Which one of the following options is correct?

In a convective heat transfer for laminar flow over a flat plate, Nusselt number is a function of Reynolds number and Prandtl number. Similarly, in a convective mass transfer for laminar flow over a flat plate, Sherwood number is a function of:

(A)   Schmidt number and Reynolds number

(B)   Weber number and Reynolds number

(C)   Schmidt number and Weber number

(D)   Weber number and Prandtl number

Q.28   Which one of the following options is correct?

For a solid immersed in a fluid, the convective heat transfer coefficient across the solid-fluid interface is NOT dependent on:

(A)   Solid-fluid interfacial area

(B)   Thermal conductivity of solid

(C)   Roughness of solid surface

(D)   Viscosity of fluid

Q.29   Ergun equation is NOT applied in which one of the following unit operations to analyze gas flow behavior:

(A)   Blast Furnace

(B)   Sintering

(C)   Roasting

(D)   LD Converter
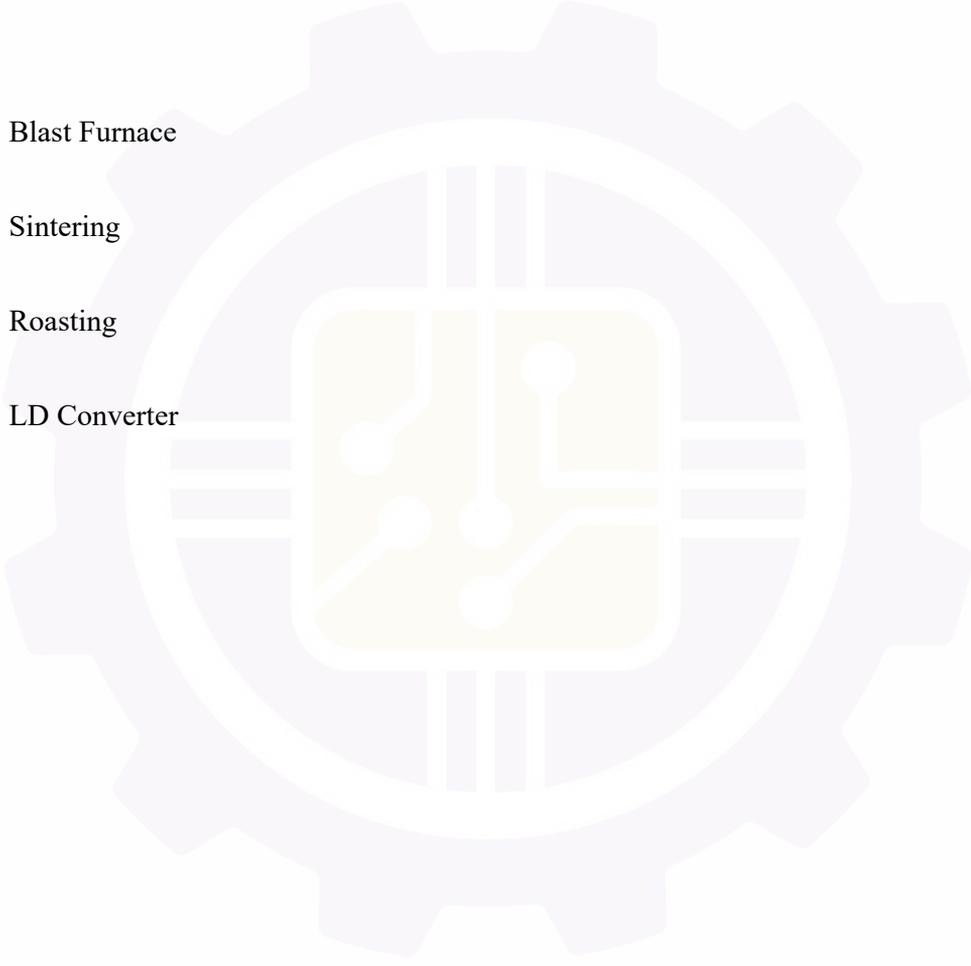
Q.30   Choose the correct option(s).

Here 'A' is the Helmholtz free energy and 'G' is the Gibbs free energy.

(A)   'A' provides a criterion for equilibrium in a system with constant temperature and constant pressure

(B)   'G' provides a criterion for equilibrium in a system with constant temperature and constant pressure

(C)   'A' provides a criterion for equilibrium in a system with constant temperature and constant volume

(D)   'G' provides a criterion for equilibrium in a system with constant temperature and constant volume

Q.31   Which of the following elements, when present in iron, enhance(s) its corrosion resistance?

(A)   H

(B)   Cr

(C)   S

(D)   C
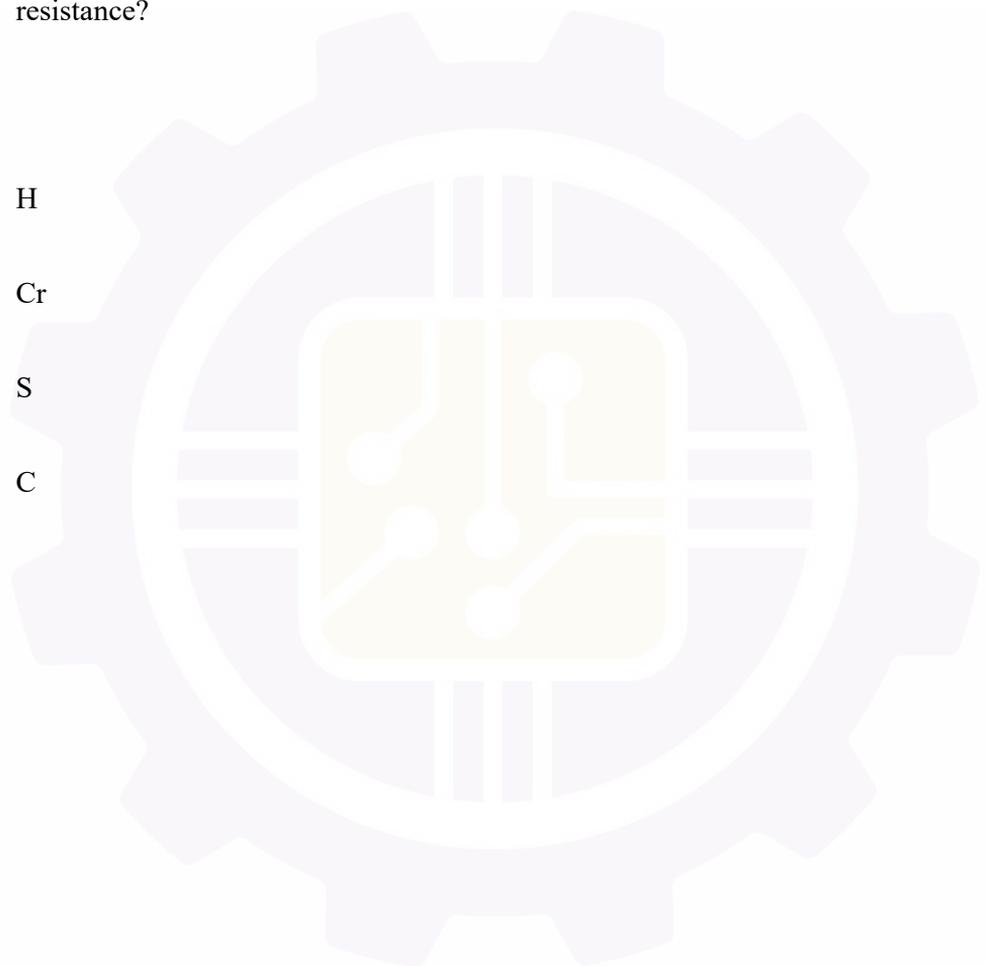
Q.32   Value of scalar triple product $\vec{a} \cdot (\vec{b} \times \vec{c})$ is (answer in integer) _____.

$$\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$$

$$\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$$

$$\vec{c} = 3\hat{i} + 4\hat{j} - \hat{k}$$

Here, $\hat{i}$, $\hat{j}$ and $\hat{k}$ are mutually orthogonal unit vectors.

Q.33   A box contains 20 thermometers, 3 of which are defective. One person randomly draws 2 thermometers from the box, one-by-one, without replacement. The probability in percent (rounded-off to two decimal places) that none of these TWO thermometers is defective, is _____ %.

Q.34 For an equilibrium phase diagram of a binary A-B alloy at a constant pressure as shown in the figure, the degree of freedom at 'X' is (answer in integer) _____.
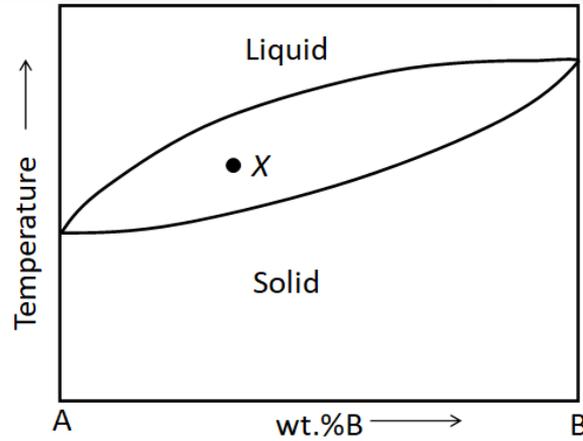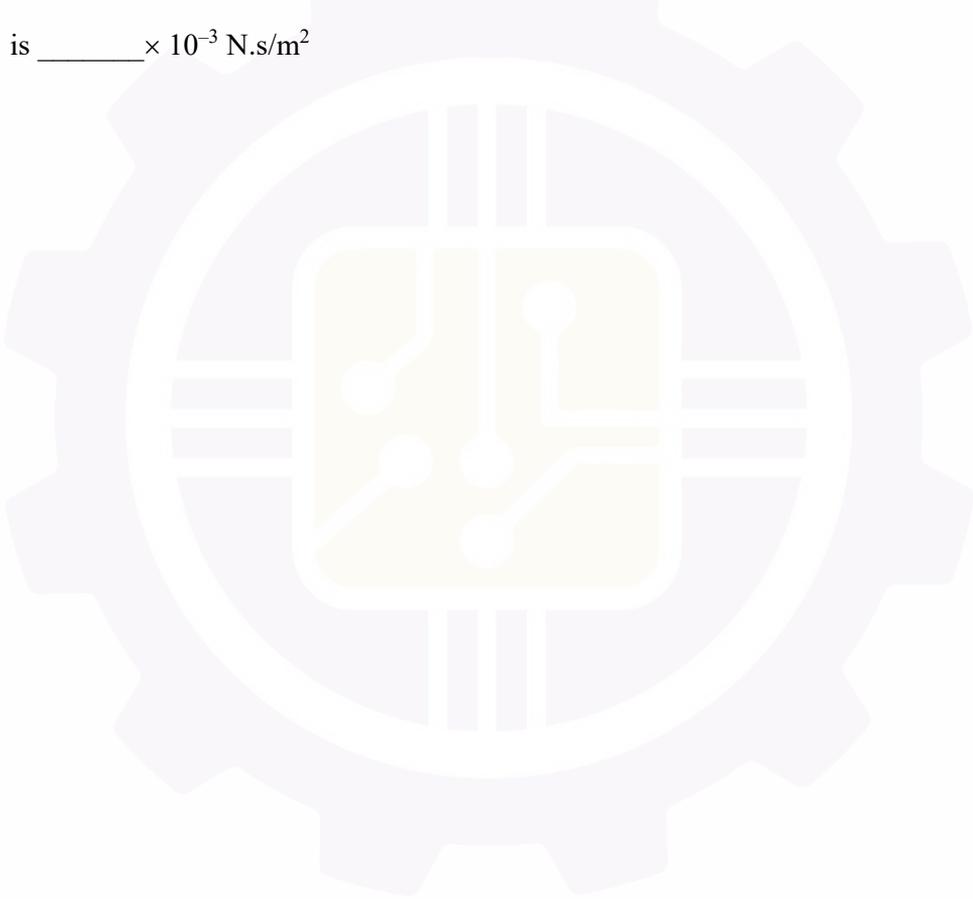
Q.35 Two parallel plates, with Newtonian incompressible liquid in between, are 2 mm apart. The upper plate is stationary and the lower plate moves with a velocity of 4 m/s. A force per unit area of 5 N/m^2 is applied parallel to the lower plate to maintain its motion. The viscosity of the liquid (rounded off to two decimal places)

is _____ $\times 10^{-3}$ $N.s/m^2$

Q.36 – Q.65 Carry TWO marks Each

Q.36

Match the crystal systems in Column I with the corresponding
axial lengths (a, b, c) and interaxial angles (α, β, γ) provided in Column II

Column I	**Column II**
(P) Tetragonal	(1) $a \neq b \neq c$, $\alpha = \beta = \gamma = 90°$
(Q) Rhombohedral	(2) $a = b \neq c$, $\alpha = \beta = \gamma = 90°$
(R) Orthorhombic	(3) $a \neq b \neq c$, $\alpha = \gamma = 90° \neq \beta$
(S) Monoclinic	(4) $a = b = c$, $\alpha = \beta = \gamma \neq 90°$

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

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

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

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

Q.37

Match the concepts listed in Column I with the associated terms listed in Column II

Column I	Column II
(P) Paris Law	(1) Creep
(Q) Schmid Factor	(2) Fatigue
(R) Larson - Miller Parameter	(3) Dynamic Strain Aging
(S) Portevin - Le Chatelier Effect	(4) Critical Resolved Shear Stress

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

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

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

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

Q.38

Match the type of defects in Column I with the corresponding metal manufacturing processes listed in Column II:

Column I	Column II
(P) Edge Cracking	(1) Casting
(Q) Flashline Cracking	(2) Forging
(R) Chevron Cracking	(3) Rolling
(S) Cracked Core	(4) Extrusion

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

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

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

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

Q.39

Match the descriptions listed in Column I with the corresponding non-destructive testing methods listed in Column II:

Column I	Column II
(P) Internal flaws in railroad wheel	(1) Ultrasonic
(Q) In-service monitoring of crack	(2) Radiography
(R) Inclusion in mild steel	(3) Dye Penetrant
(S) Surface crack in Al-based alloy	(4) Acoustic Emission

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

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

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

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

Q.40   The equation below represents a steady-state laminar flow of a fluid through a horizontal tube:
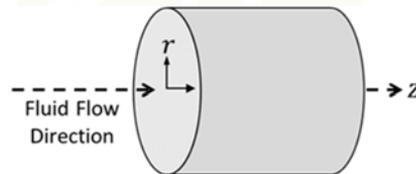
$$\eta \frac{1}{r} \frac{d}{dr}\left(r \frac{dv_z}{dr}\right) - \frac{dP}{dz} = 0$$

P is fluid pressure

η is dynamic viscosity

(r, z): coordinates of cylindrical polar system, and

v_z is axial velocity in z-direction

Which one of the following statements related to the above case is NOT correct?

(A)   The fluid is Newtonian

(B)   Shear stress is maximum at the center $(r = 0)$

(C)   Radial velocity is zero

(D)   There is no variation of v_z in z-direction

Q.41

Match the unit operation in Column I with the resulting product in Column II:

Column I	Column II
(P) COREX Process	(1) Direct Reduced Iron
(Q) Bayer Process	(2) Pig Iron
(R) Matte Smelting	(3) Alumina
(S) MIDREX Process	(4) Copper

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

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

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

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

Q.42

Match the terms in Column I with the corresponding attributes in Column II:

Column I	Column II
(P) Wiedemann-Franz law	(1) Charge carrier concentration
(Q) Neel temperature	(2) Paramagnetism
(R) Hall voltage	(3) Ratio between thermal conductivity and electrical conductivity of metals
(S) Curie law	(4) Diamagnetism
	(5) Anti-ferromagnetism

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

(B)   P-2, Q-5, R-1, S-3

(C)   P-3, Q-5, R-1, S-2

(D)   P-3, Q-4, R-5, S-2

Q.43   Choose the correct option(s).

Permeability of a porous bed made of spherical particles is/are:

(A)   Independent of particle size

(B)   Increases with increase in particle size

(C)   Decreases with increase in particle size

(D)   Affected by particle size distribution

Q.44   Consider a distribution with the following probability density function

$$f(x) = \begin{cases} 0.5, & 0 < x < 2 \\ 0.0, & Otherwise \end{cases}.$$

Given that the mean of the above probability distribution is 1, the variance (rounded off to two decimal places) is _____.
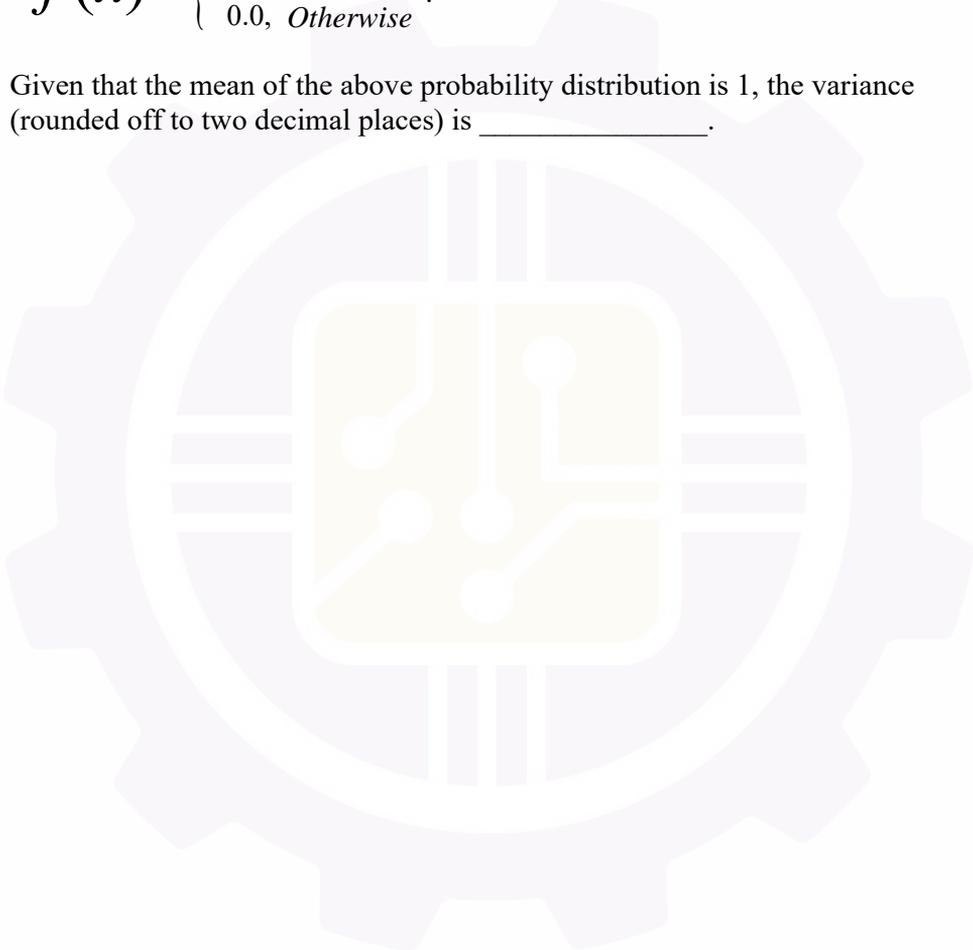
Q.45 Taking number of intervals n = 3, the value of the integral $\int_0^{0.3} e^{-x^2} dx$ using Trapezoidal method, is _____ (rounded off to two decimal places).

Q.46 Solution of the differential equation $10x^2 \dfrac{d^2y}{dx^2} - 20x\dfrac{dy}{dx} + 22.4\,y = 0$ is

$y = c_1 x^{m_1} + c_2 x^{m_2}$ where $m_1 \neq m_2$.

The value of $m_1 + m_2$ (answer in integer) is _____
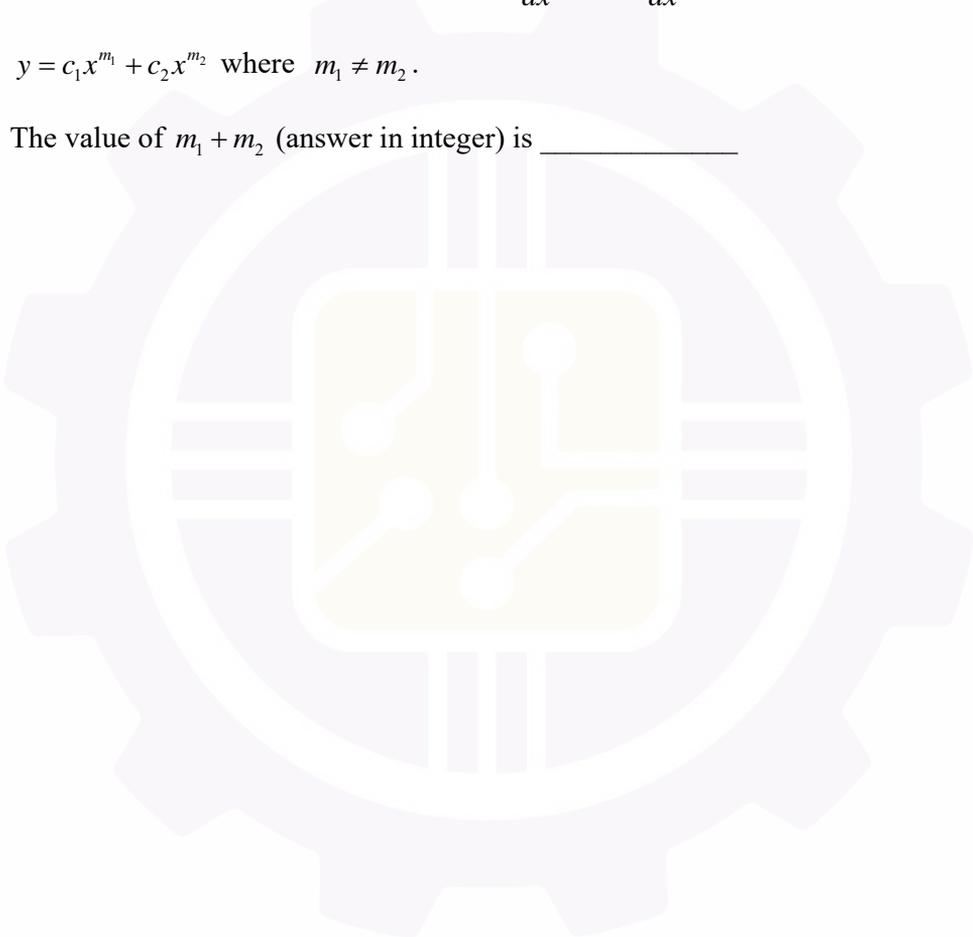
Q.47 Iron powder is compacted at room temperature to 75% of its theoretical density. The as-pressed iron compact is sintered in inert-gas atmosphere at 1200 °C to 90% of its theoretical density. Assuming isotropic shrinkage, the linear shrinkage (in percent) undergone by the iron compact during sintering (rounded off to one decimal place) is _____ %
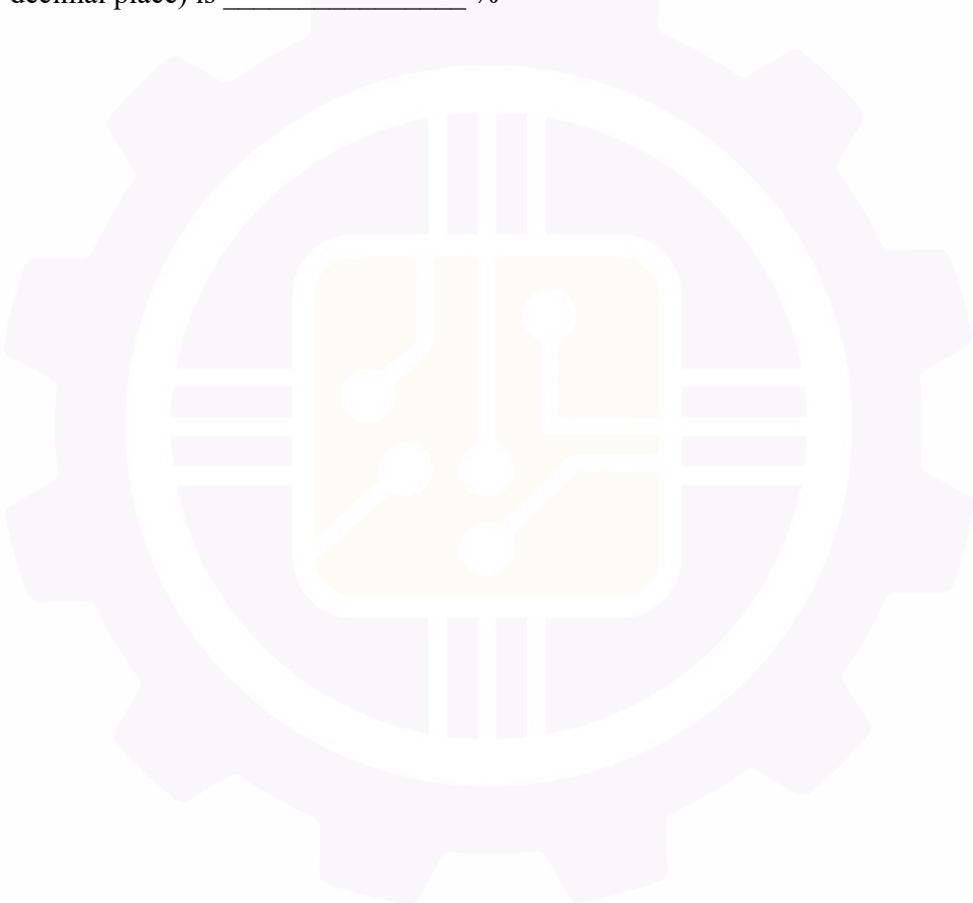
Q.48   An alloy having composition W-20 wt.% Ni is prepared by mixing elemental powders. The resulting powder mixture is liquid phase sintered at 1550 °C for 1 hour. The liquid phase sintered microstructure consists of interconnected, spherical tungsten grains dispersed in nickel. The tungsten grain size is 70 μm and the W-W interparticle neck diameter is 35 μm. If W-Ni interfacial energy is 0.30 J/m^2, the W-W interfacial energy (in J/m^2), rounded off to two decimal places is
_____

(Given: melting point of W: 3410 °C and melting point of Ni: 1455 °C)
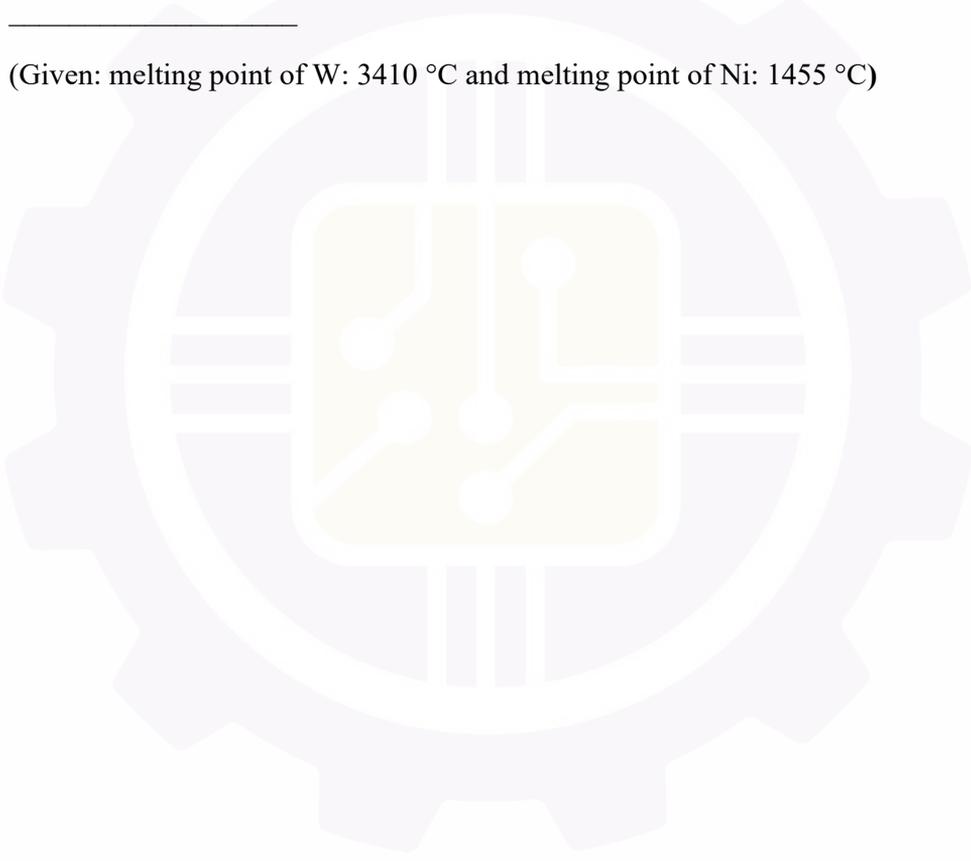
Q.49 A metal having body-centered cubic structure is analyzed through X-ray diffraction using monochromatic X-ray of wavelength 0.154 nm. The diffraction angle (2θ) corresponding to {2 0 0} plane is 60° (for first order reflection).

The atomic radius of this element (rounded off to three decimal places) is _____nm.

Q.50 A cylindrical single crystal of copper having 10 mm diameter is deformed under a uniaxial tensile load of 2200 N. The angle between the normal to the slip plane and the tensile loading axis is α, whereas, the angle between slip direction and the tensile axis is β. The slip direction is in the plane defined by the stress axis and the normal to the slip plane.

If $\alpha = \beta$, the critical resolved shear stress (CRSS), rounded off to one decimal place, is _____ MPa.
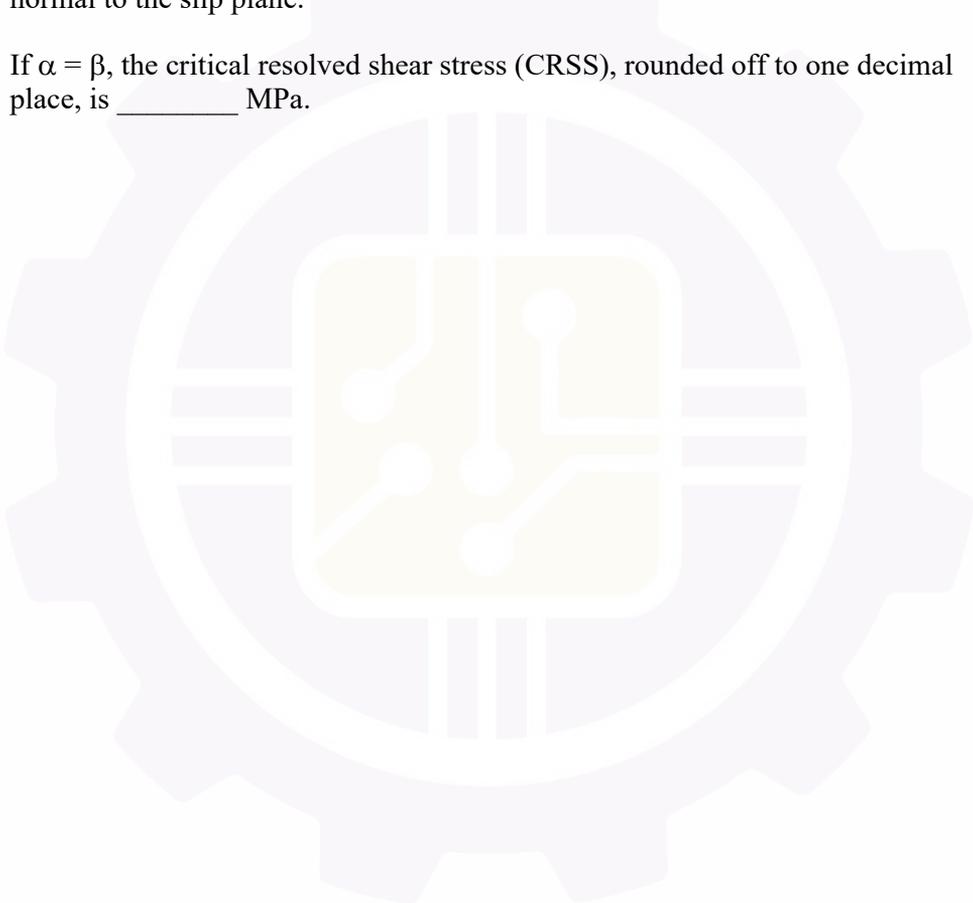
Q.51 For plane strain fracture toughness (K_{Ic}) testing of Maraging steel, the minimum thickness to achieve valid K_{Ic} is (answer in integer) _____ mm.
(Given: $K_{Ic} = 90$ MPa$\sqrt{m}$ and yield stress = 900 MPa)

Q.52   The lattice parameter of Ni (face-centered cubic) is 0.35 nm and its shear modulus is 76 GPa. The strain energy per unit length of a screw dislocation in Ni crystal (rounded off to two decimal places) is _____ × 10^{-9} J/m.

Q.53 20 g of gold (Au) and 20 g of silver (Ag) are mixed to form a single-phase solid solution (assume ideal mixing). The atomic weight of Au is 197 g/mol and the atomic weight of Ag is 108 g/mol. The value of universal gas constant R is 8.314 J/mol-K. The total entropy of mixing (rounded off to two decimal places) is _____ J/K.

Q.54　2 moles of an ideal gas is reversibly expanded from 10 liter to 20 liter at isothermal condition. The value of universal gas constant R is 8.314 J/mol-K. If the temperature of the gas is 27 °C, the magnitude of work done in the process (rounded off to two decimal places) is _____ Joules.
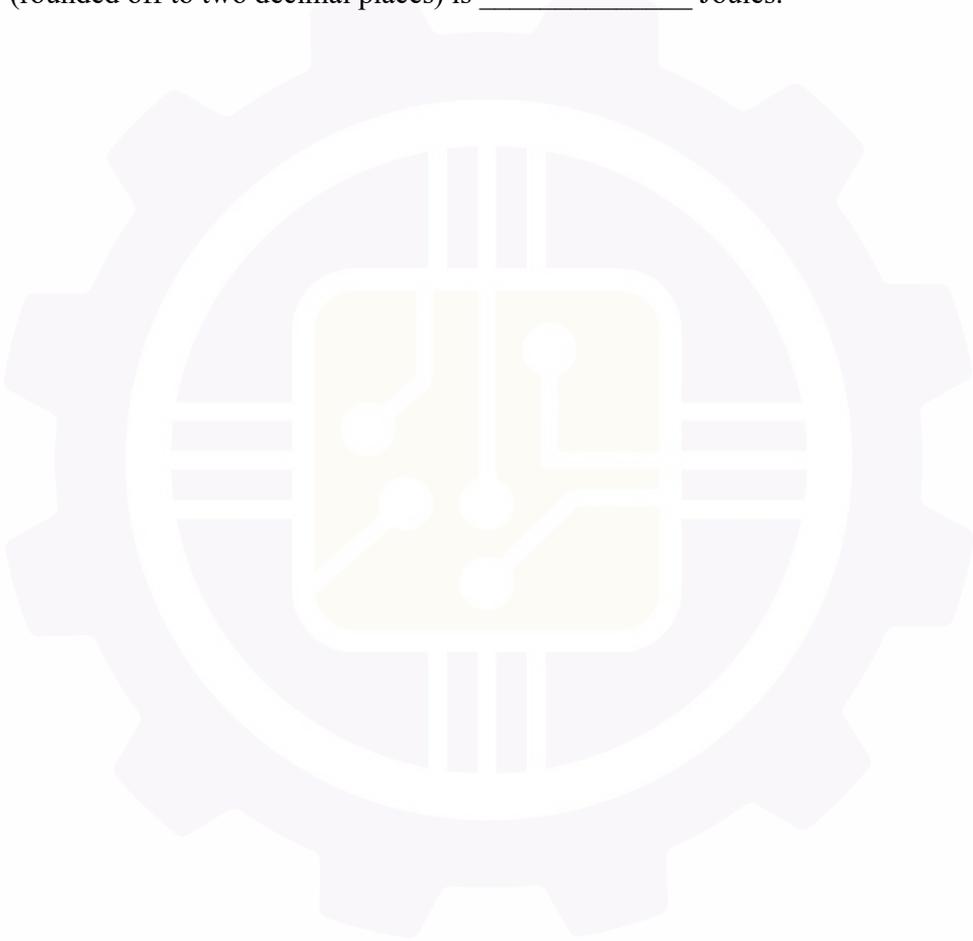
Q.55 Specific heat capacity at constant pressure (C_p) of a solid metal is given by the following expression:

C_p (in J/mol-K) $= 20 + (5 \times 10^{-3}) \cdot T$ (for T= 298 K to 1000 K)
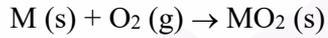
At constant pressure, if the temperature (T in K) of 2 moles of metal is increased from 300 K to 600 K, the change in enthalpy of the metal (answer in integer) is _____ Joules.

Q.56   With reference to the Ellingham diagram, the standard Gibbs free energy change for the oxidation of solid metal M (s) and liquid metal M (l) is given below:
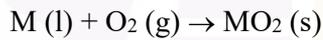
Reaction I:

M (s) + O$_2$ (g) → MO$_2$ (s)

ΔG° = (− 338900 − 15.2T lnT + 247T) Joules;

from T = 300 K to melting point.

Reaction II:

M (l) + O$_2$ (g) → MO$_2$ (s)

ΔG° = (− 390800 − 15.2T lnT + 285.3T) Joules;

from melting point to T = 1800 K

The melting point of the metal M (rounded off to one decimal place)

is _____ Kelvin.

Q.57 A given volume of liquid is undercooled just below the melting temperature to form a spherical solid nucleus (consider homogeneous nucleation). The Gibbs free energy of solidification (ΔG_v) is (-0.5×10^8) J/m^3. The solid-liquid interfacial energy (γ) is isotropic and its value is 0.1 J/m^2.

The critical nucleus size for a stable nucleus is _____ nm
(answer in integer).
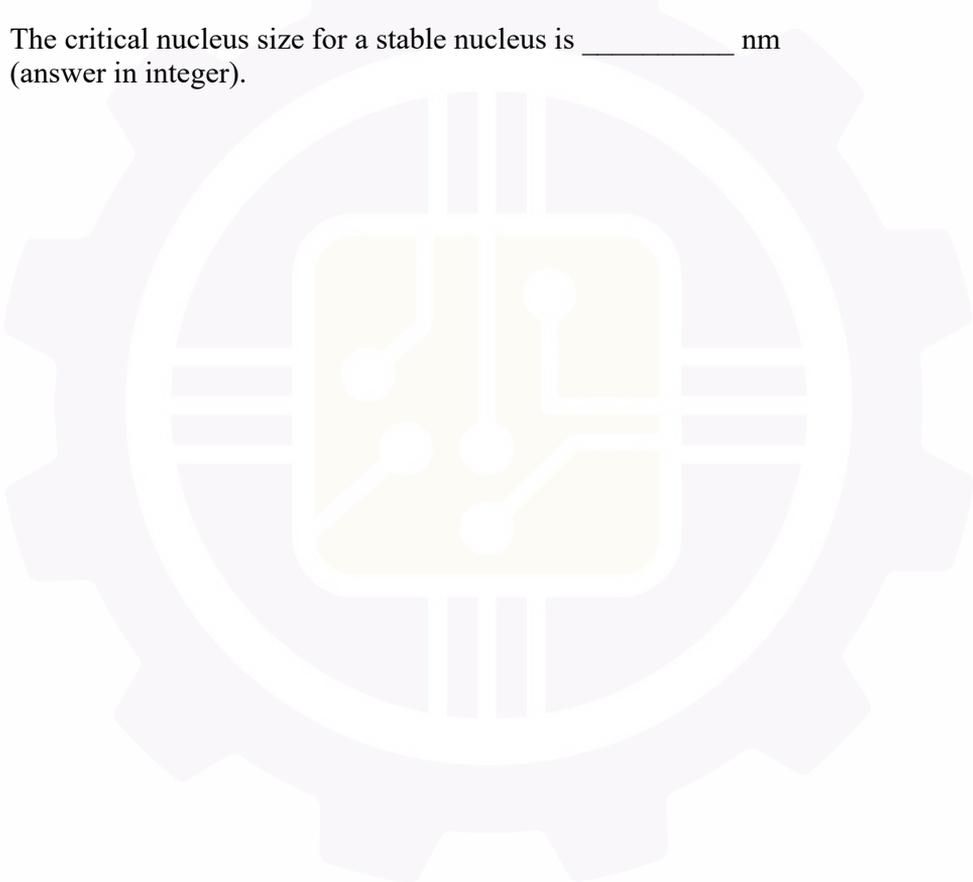
Q.58   A 50 mm flat aluminium plate is reduced in thickness to 25 mm in a single pass cold-rolling operation with the rolling diameter of 1250 mm. For this case, the minimum required coefficient of friction between the plate and the roll (rounded off to two decimal places) is _____.

A cylindrical furnace has 0.1 m inner diameter and 0.2 m height. Walls A_1 (inner section of cylindrical surface area) and A_2 (inner section of bottom surface area) are maintained at 1873 K. The sides and bottom are assumed to be black bodies, well insulated and heated electrically. The top area (A_3) is open to atmosphere maintained at 300 K, resulting in loss of heat 'q'.

Q.59

Given:
View factors $F_{13} = 0.1175$ and $F_{23} = 0.06$, where F_{ij} is the fraction of radiation leaving surface 'i' that is intercepted by surface 'j'.

Stefan-Boltzmann constant $= 5.67 \times 10^{-8}$ W/m^2-K^4.

The power needed to maintain the furnace at 1873 K, is (approximate to the nearest integer) _____ W.

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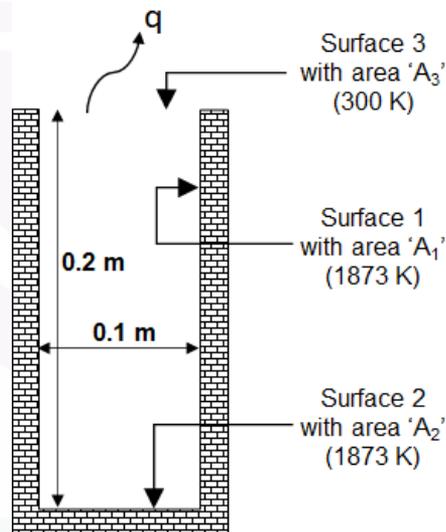
Q.60 During carburizing of a steel, the surface concentration is kept constant at 1.4 wt.% carbon. Diffusivity of carbon for the steel at 950 °C is 6.25×10^{-11} m^2/s. At 950 °C, the time required to carburize the steel with an initial composition of 0.2 wt.% carbon to 0.8859 wt.% carbon at a depth of 0.2 mm is _____ seconds (approximate to the nearest integer).

Use the nearest value of the error function from the table given below for your calculation.

z	erf (z)
0.3	0.3268
0.4	0.4284
0.5	0.5205

Q.61 For the following reaction between methane and stochiometric air having composition 20 vol.% O_2 and 80 vol.% N_2, the estimated adiabatic flame temperature (rounded off to one decimal place) is _____ Kelvin.

CH_4 (g) + 2 O_2 (g) $\rightarrow$ CO_2 (g) + 2 H_2O (g)
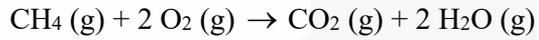
Given: $\Delta H = -850$ kJ/mol at 298 K

Assume specific heat at constant pressure (C_p) for each reactant and product is 50 J/mol-K and is independent of temperature.

Q.62　A copper ore contains 30 wt.% chalcopyrite ($CuFeS_2$) and remaining gangue material. Assuming no copper in gangue material, the amount of copper in the ore (rounded off to one decimal place) is _____ wt.%.

Given: Atomic weights of Fe, Cu and S are 56, 63.5, and 32 g/mol, respectively.

Q.63 A blast furnace produces hot metal with the following composition:

4 wt.% C, 1.5 wt.% Si, and rest Fe.

Only input of iron is through iron ore containing 85 wt.% Fe_2O_3 and 15 wt.% gangue consisting of SiO_2 and Al_2O_3.

2% of all iron (by weight) is lost in slag.

The amount of ore used to produce 1000 kg of hot metal (rounded off to one decimal place) is _____ kg.

Given: Atomic weights of Fe and O are 56 g/mol and 16 g/mol, respectively.

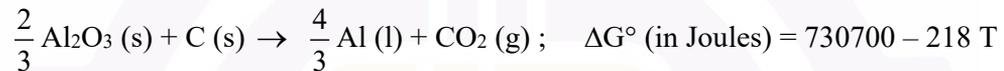Al₂O₃ can be electrolyzed with an inert anode or a carbon anode.

Q.64

Overall reactions are as follows:

Reaction I: For inert anode,

$$\frac{2}{3}\,Al_2O_3\,(s) \rightarrow \frac{4}{3}\,Al\,(l) + O_2\,(g)\,; \qquad \Delta G° \text{ (in Joules)} = 1124800 - 218\,T$$

Reaction II: For carbon anode,

$$\frac{2}{3}\,Al_2O_3\,(s) + C\,(s) \rightarrow \frac{4}{3}\,Al\,(l) + CO_2\,(g)\,; \qquad \Delta G° \text{ (in Joules)} = 730700 - 218\,T$$

T denotes temperature in Kelvin

Given: Faraday constant = 96500 Coulomb

If inert anode is replaced by carbon anode during electrolysis of Al₂O₃ at temperature 1300 K, the decrease in the magnitude of decomposition potential between the two reactions (rounded off to two decimal places) is _____ Volts.

Q.65   Given a scalar field $\phi(x, y, z) = x^2 - yz$

Magnitude of a vector in the direction of the most rapid increase of ϕ at a point P (3,4,1), rounded-off to two decimal places, is _____