METALLURGY ENGINEERING (MT)

GATE 2025 Questions
EE25BTECH11027-INDHIRESH S

General Aptitude

Q.1 - Q.5 Carry ONE mark Each

1) If '→' denotes increasing order of intensity, then the meaning of the words [dry → arid → parched] is analogous to [diet → fast → _]. (GATE MT 2025)
Which one of the given options is appropriate to fill the blank?

a) starve b) reject c) feast d) deny

2) If two distinct non-zero real variables x and y are such that $(x + y)$ is proportional to $(x - y)$ then the value of $\frac{x}{y}$ (GATE MT 2025)

a) depends on xy
b) depends only on x and not on y
c) depends only on y and not on x
d) is a constant

3) Consider the following sample of numbers:
9, 18, 11, 14, 15, 17, 10, 69, 11, 13. (GATE MT 2025)
The median of the sample is

a) 13.5 b) 14 c) 11 d) 18.7

4) The number of coins of ₹1, ₹25, and ₹10 denominations that a person has are in the ratio 5:3:13. Of the total amount, the percentage of money in 25 paise coins is (GATE MT 2025)

a) 21%
b) $14\frac{2}{7}$%
c) 10%
d) 30%

5) For positive non-zero real variables p and q, if

$$\log(p^2 + q^2) = \log p + \log q + 2\log 3 \tag{1}$$

, then, the value of $\frac{p^4+q^4}{p^2q^2}$ is (GATE MT 2025)

a) 79 b) 81 c) 9 d) 83

Q.6 - Q.10 Carry TWO marks Each

6) In the given text, the blanks are numbered (i)-(iv). Select the best match for all the blanks. (GATE MT 2025)
Steve was advised to keep his head ___(i)___ before heading ___(ii)___ to bat; for, while he had a head ___(iii)___ his shoulders, he could only do so with a cool head.
a) (i) down, (ii) down, (iii) on
b) (i) on, (ii) down, (iii) for
c) (i) down, (ii) out
d) (i) on

7) A rectangular paper sheet of dimensions 54 cm × 4 cm is taken. The two longer edges of the sheet are joined together to create a cylindrical tube. A cube whose surface area is equal to the area of the sheet is also taken. Then, the ratio of the volume of the cylindrical tube to the volume of the cube is (GATE MT 2025)

a) $1/\pi$ b) $2/\pi$ c) $3/\pi$ d) $4/\pi$

8) The pie chart presents the percentage contribution of different macronutrients to a typical 2,000 kcal diet of a person. The typical energy density (kcal/g) of these macronutrients is given in the table. The total fat (all three types), in grams, this person consumes is (GATE MT 2025)

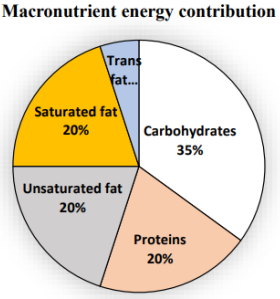


Fig. 8.

MACRONUTRIENT ENERGY CONTRIBUTION

Macronutrient	Energy density (kcal/g)
Carbohydrates	4
Proteins	4
Unsaturated fat	9
Saturated fat	9
Trans fat	9

a) 44.4 b) 77.8 c) 100 d) 3,600

9) A rectangular paper of 20 $cm \times 8$ cm is folded 3 times. Each fold is made along the line of symmetry, which is perpendicular to its long edge. The perimeter of the final folded sheet (in cm) is (GATE MT 2025)

a) 18 b) 24 c) 20 d) 21

10) The least number of squares to be added in the figure to make AB a line of symmetry is (GATE MT 2025)

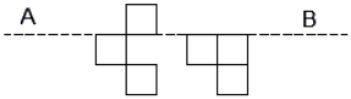


Fig. 10.

FIGURE

a) 6 b) 4 c) 5 d) 7

Metallurgical Engineering

Q.11 - Q.35 Carry ONE mark Each

11) If X_1 and X_2 are independent normally distributed random variables with means μ_1 and μ_2, and variances ρ_1 and ρ_2, respectively, then the combination $X = X_1 + X_2$ has mean μ and variance ρ such that (GATE MT 2025)

a) $\mu = \mu_1 + \mu_2$ and $\rho = \rho_1 + \rho_2$
b) $\mu^2 = \mu_1^2 + \mu_2^2$ and $\rho = \rho_1 + \rho_2$
c) $\mu = \mu_1 + \mu_2$ and $\rho^2 = \rho_1^2 + \rho_2^2$
d) $\mu^2 = \mu_1^2 + \mu_2^2$ and $\rho^2 = \rho_1^2 + \rho_2^2$

12) Which one of the following is the Taylor series expansion of $\ln(\frac{1+x}{1-x})$ about the origin for $|x| < 1$? x is a real number (GATE MT 2025)

a) $x - \frac{x^2}{2} + \frac{x^3}{3} - \ldots$
b) $2(x - \frac{x^2}{2} + \frac{x^3}{3} - \ldots)$
c) $x + \frac{x^3}{3} + \frac{x^5}{5} + \ldots$
d) $2(x + \frac{x^3}{3} + \frac{x^5}{5} + \ldots)$

13) Consider the normal (Gaussian) distributions a, b, c shown in the figure. σ_p and μ_p are the standard deviation and mean of a distribution p, respectively, and the means are positive. Which one of the following deductions is correct? (GATE MT 2025)

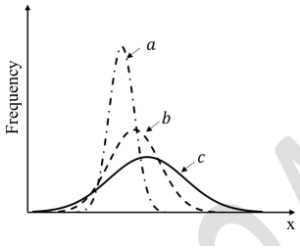


Fig. 13.

FIGURE

a) $\sigma_a < \sigma_b < \sigma_c$
b) $\sigma_a > \sigma_b > \sigma_c$
c) $\mu_a = \mu_b = \mu_c$
d) $\mu_a > \mu_b > \mu_c$

14) If in an A-B solid solution, the activity and mole fraction of A are given by a_A and X_A, respectively, then the activity coefficient of A is given by (GATE MT 2025)

a) $\frac{a_A}{X_A}$ b) $\frac{X_A}{a_A}$ c) $a_A X_A$ d) $a_A X_A^2$

15) As shown in the figure, two rods of different metals of equal lengths, $L/2$, diameter d ($d \ll L$), and constant thermal conductivities k_1 and k_2 (with $k_1 > k_2$) are connected perfectly (i.e., zero interface thermal resistance).

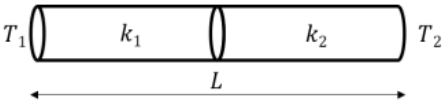
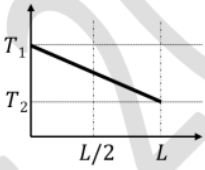


Fig. 15.

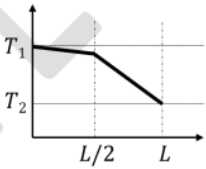
FIGURE

The left and right ends of the connected rod are maintained at temperatures T_1 and T_2 ($T_1 > T_2$). Assume that the rods are insulated from the environment, apart from the two flat ends. Which one of the following graphs represents the temperature distribution at steady-state? The thickest line shows the temperature profile. The horizontal axis shows the distance from the left end of the rod to the right and the vertical axis denotes temperature. (GATE MT 2025)

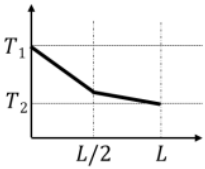
(A)



(B)



(C)



(D)

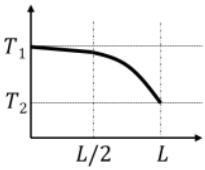


Fig. 15.

GRAPHS

16) Match the laws listed in Column I with the corresponding material properties listed in Column II. (GATE MT 2025)

Column I	**Column II**
(P) Hooke's law	(1) Thermal conductivity
(Q) Fick's law	(2) Young's modulus
(R) Fourier's law	(3) Permeability
(S) Darcy's law	(4) Diffusivity

a) P-2, Q-1, R-4, S-3
b) P-4, Q-3, R-1, S-2
c) P-2, Q-4, R-1, S-3
d) P-4, Q-3, R-2, S-1

17) Wet high intensity magnetic separators (WHIMS) are used to concentrate (GATE MT 2025)

a) fine ($< 75\ \mu m$) paramagnetic minerals.

b) coarse ($> 75\ \mu m$) ferromagnetic minerals.
c) coarse ($> 75\ \mu m$) paramagnetic minerals.
d) fine ($< 75\ \mu m$) ferromagnetic minerals.

18) Which one of the following reagents is NOT used in froth flotation process? (GATE MT 2025)

a) Lixiviants
b) Collectors
c) Activators
d) Depressants

19) Which one of the following reactions is the Boudouard's reaction? Given: (s): solid,(l):liquid, (g): gas (GATE MT 2025)

a) $C(s) + H_2O(l) \rightarrow H_2(g) + CO(g)$
b) $C(s) + O_2(g) \rightarrow CO_2(g)$
c) $C(s) + CO_2(g) \rightarrow 2CO(g)$
d) $2C(s) + O_2(g) \rightarrow 2CO(g)$

20) Which one of the following processes is NOT related to the extraction and refining of titanium from ilmenite ore? (GATE MT 2025)

a) Pidgeon's process
b) Sorel process
c) Van Arkel process
d) Kroll's process

21) Which one of the following is the correct statement about the industrial production of aluminium from pure dry alumina by Hall-Héroult electrolytic reduction? (GATE MT 2025)

a) Cell is operated at a high voltage (220 to 240 V) with a very low current density.
b) Cell is operated at a low voltage (5 to 7 V) with a very low current density.
c) Cell is operated at a high voltage (220 to 240 V) with a very high current density.
d) Cell is operated at a low voltage (5 to 7 V) with a very high current density.

22) Which one of the following schematics represents the variation of the rate of nucleation of solid from a pure liquid metal as a function of undercooling ($\Delta T = T_m - T$, where T_m and T are the freezing temperature and the liquid temperature, respectively)? (GATE MT 2025)

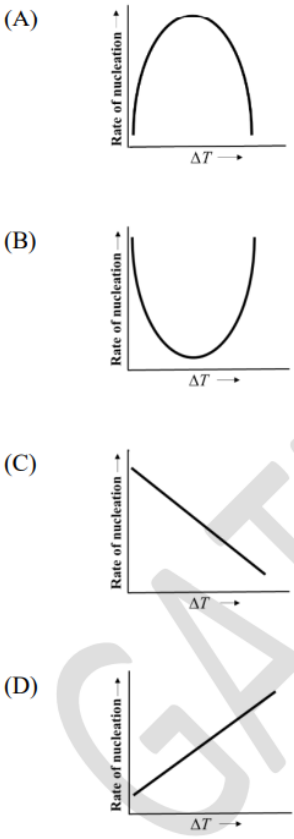


Fig. 22.

SCHEMATIC DIAGRAMS

23) Which one of the following crystal structure changes occurs during the transformation of mild steel from austenite to martensite? (GATE MT 2025)

a) Face centered cubic to body centered cubic
b) Face centered cubic to body centered tetragonal
c) Body centered cubic to body centered tetragonal
d) Body centered tetragonal to face centered cubic

24) The figure shows a dislocation loop (shown by the solid circle), whose Burgers vector is b (shown by the horizontal arrow inside the dislocation loop). Identify the nature of the dislocation segment at locations p, q and r. The dash-dot lines show the horizontal and vertical diameters of the loop, and the arrow along the dislocation loop indicates the line vector. (GATE MT 2025)

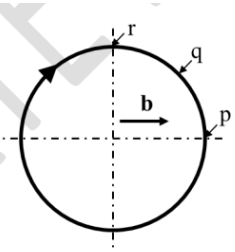


Fig. 24.

DISLOCATION LOOP

a) p: pure edge, q: mixed, r: pure screw
b) p: pure edge, q: pure screw, r: pure edge
c) p: pure screw, q: mixed, r: pure screw
d) p: pure screw, q: pure edge, r: pure screw

25) Match the concepts listed in Column I with the phenomena listed in Column II. (GATE MT 2025)

Column I	**Column II**
P. Peierls-Nabarro stress	1. Yield point phenomenon
Q. Cottrell's atmosphere	2. Fatigue
R. Paris law	3. Dislocation glide
S. Considère's criterion	4. Onset of necking

a) P-1, Q-2, R-3, S-4
b) P-4, Q-1, R-2, S-3
c) P-3, Q-1, R-2, S-4
d) P-3, Q-4, R-2, S-1

26) Match the defects listed in Column I with the associated manufacturing processes listed in Column II. (GATE MT 2025)

Column I	**Column II**
P. Misrun	1. Extrusion
Q. Earing	2. Rolling
R. Alligatoring	3. Casting
S. Chevron cracking	4. Deep drawing

a) P-3, Q-1, R-2, S-4
b) P-3, Q-4, R-2, S-1
c) P-2, Q-4, R-3, S-1
d) P-1, Q-3, R-2, S-4

27) Which one of the following processes is NOT involved in the sintering of a green compact of ceramic powders? Assume that sintering is performed without application of external pressure. (GATE MT 2025)

a) Pore shrinkage
b) Dynamic recrystallization
c) Lattice diffusion
d) Grain boundary diffusion

28) Which of the following statements is/are correct for a square matrix $\boldsymbol{A}$ with real number entries? $\boldsymbol{A}^T$ denotes the transpose of $\boldsymbol{A}$ and $\boldsymbol{A}^{-1}$ denotes the inverse of $\boldsymbol{A}$. (GATE MT 2025)
a) $\boldsymbol{A}$ is symmetric if $\boldsymbol{A}^T = -\boldsymbol{A}$.
b) $\boldsymbol{A}$ is skew-symmetric if $\boldsymbol{A}^T = -\boldsymbol{A}$.
c) If $\boldsymbol{A}$ is orthogonal, then $\boldsymbol{A}^T = \boldsymbol{A}^{-1}$.
d) If $\boldsymbol{A}$ is orthogonal, then its determinant is zero.

29) Which of the following is/are criterion/criteria for equilibrium of an isolated system held at constant temperature and constant pressure? (GATE MT 2025)
a) Entropy maximization
b) Entropy minimization
c) Maximization of Gibbs free energy
d) Minimization of Gibbs free energy

30) Which of the following (h k l) reflections is/are allowed in an X-ray diffraction pattern of a crystal with face centered cubic lattice? (GATE MT 2025)

a) (0 0 1) b) (0 1 1) c) (1 1 1) d) (0 0 2)

31) The divergence of the vector field

$$\mathbf{V} = x^2y\hat{i} + y^3z\hat{j} + z^4\hat{k} \tag{2}$$

at the point (1,1,1) is _____. (Round off to the nearest integer) (GATE MT 2025)

32) The pair-interaction energy between two atoms is given by the following expression:

$$U = -\frac{1.6}{r^6} + \frac{51.2}{r^{12}} \tag{3}$$

where U is the interaction energy in eV and r is the interatomic distance in Å. The equilibrium bond-length between the atoms is _____ Å. (Round off to the nearest integer) (GATE MT 2025)

33) For a solid embryo in contact with a perfectly flat mould wall as shown in the schematic, the wetting angle θ is _____ degrees. (Round off to one decimal place). (GATE MT 2025)
Given:
Surface tension between liquid and mould wall = 0.35 $J.m^{-2}$
Surface tension between solid and mould wall = 0.02 $J.m^{-2}$
Surface tension between liquid and solid = 0.40 $J.m^{-2}$

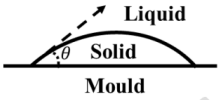


Fig. 33.

SCHEMATIC DIAGRAM

34) A single crystal is oriented such that the normal to the slip plane makes an angle of 60° with the tensile axis. If the slip direction makes an angle of 45° with respect to the tensile axis and the critical resolved shear stress for slip is 2 MPa, then the tensile stress at which plastic deformation commences is _____ MPa. (Round off to one decimal place) (GATE MT 2025)

35) The extrusion force required to extrude an aluminum rod of cross-sectional area of 150 mm^2 to cross-sectional area of 50 mm^2 is _____ N. (Round off to the nearest integer) (GATE MT 2025)
Assume that the extrusion constant, which accounts for the flow stress, strain hardening, friction and inhomogeneous deformation, is equal to 2 MPa.

Q.36 - Q.65 Carry TWO marks Each

36) If

$$\begin{pmatrix} 1 & 2 \\ 8 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \lambda \begin{pmatrix} x \\ y \end{pmatrix} \tag{4}$$

where x, y are not identically zero, then the values of λ are (GATE MT 2025)

a) 5, -3 b) 4, -4 c) 3, -5 d) 5, -4

37) If $\frac{dy}{dx} = 4xy$, $y(0) = 1$, then (GATE MT 2025)

a) $y = 2x^2 + 1$
b) $y = 2e^{2x^2} - 1$
c) $y = 2e^{x^2} - 1$
d) $y = e^{2x^2}$

38) As shown in the figure, the right end of a slender, long solid cylindrical metal rod of thermal conductivity k, length L and diameter $d(\ll L)$ is in contact with an infinite liquid heat sink. At steady-state, the temperatures of the right end of the rod and the heat sink are T_2 and T_0, respectively. If the convection heat transfer coefficient between the liquid heat sink and the right end of the rod is h, then what would be the temperature of the left end of the rod, T_1, at steady-state? Assume that there is no other heat loss. (GATE MT 2025)

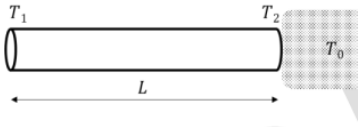


Fig. 38.

SOLID CYLINDRICAL ROD

a) $T_1 = T_2 + (T_2 - T_0)\frac{hL}{k}$
b) $T_1 = T_2 - (T_2 - T_0)\frac{hL}{k}$
c) $T_1 = T_2 - (T_2 - T_0)\frac{k}{hL}$
d) $T_1 = T_2 + (T_2 - T_0)\frac{k}{hL}$

39) Match the dimensionless numbers listed in Column I with their applications to transport phenomena listed in Column II. (GATE MT 2025)

Column I	**Column II**
P. Reynolds number	1. Momentum and mass transfer
Q. Schmidt number	2. Momentum and heat transfer
R. Prandtl number	3. Convective and conductive heat transfer
S. Biot number	4. Laminar to turbulent flow

a) P-4, Q-1, R-3, S-2
b) P-3, Q-2, R-4, S-1
c) P-4, Q-1, R-2, S-3
d) P-2, Q-3, R-1, S-4

40) In a cubic lattice, what is the ratio of interplanar spacings of the (100), (110) and (111) planes? (GATE MT 2025)

a) 1 : 0.32 : 0.71
b) 1 : 0.71 : 0.58
c) 1 : 0.58 : 0.71
d) 1 : 0.58 : 0.32

41) The constitutional undercooling condition for a hypothetical binary alloy of A with solute B during solidification is shown in the figure along with its binary phase diagram. Based on these two schematics, one can conclude that the solute concentration in region X will be _____ the average composition of the initial liquid phase. (GATE MT 2025)

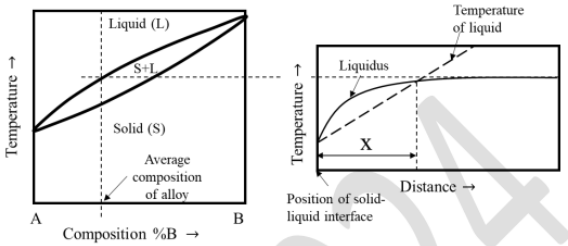


Fig. 41.

FIGURE

a) less than
b) greater than
c) same as
d) independent of

42) The microstructures of a quenched steel tempered at three temperatures $T_1 < T_2 < T_3$ for a fixed time are schematically illustrated. The solid circles represent cementite particles in ferrite matrix; $\bar{r}_1, \bar{r}_2$ and $\bar{r}_3$ are average radii of cementite particles, and V_1, V_2 and V_3 are volume fractions of cementite at temperatures T_1, T_2 and T_3, respectively. If the cementite in steel is more noble than ferrite, then which one of the three microstructures will have the highest corrosion rate when exposed to an aqueous solution of 3.5 wt.% NaCl? (GATE MT 2025)

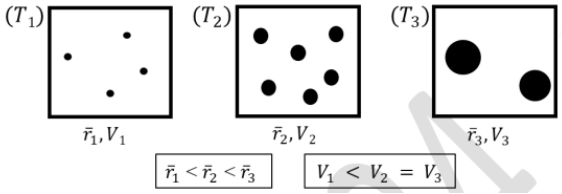


Fig. 42.

MICROSTRUCTURE OF QUENCHED STEEL

a) Microstructure at T_1
b) Microstructure at T_2
c) Microstructure at T_3
d) Independent of microstructure

43) An isotropic metallic cuboid block shown in the figure has a coefficient of linear thermal expansion α, Young's modulus E and Poisson's ratio ν. The dimensions of the cuboid are a, b and c in the X, Y and Z directions, respectively. It is rigidly constrained against expansion in the X direction. However, it is free to expand in the Y and Z directions. It is initially stress-free. Subsequently, it is heated so that its temperature increases by ΔT. What would be the CHANGE in the dimension of the cuboid in the Y direction? Assume linear elasticity, and that thermal as well as mechanical strains are infinitesimally small. (GATE MT 2025)

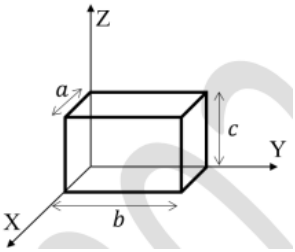


Fig. 43.

CUBOID

a) $b(1-\nu)\alpha\Delta T$
b) $b(1+\nu)\alpha\Delta T$
c) $b\alpha\Delta T$
d) $b(1+\alpha)\Delta T$

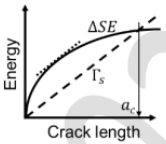
44) Match the entries in Column I with the stacking sequences of the close-packed planes listed in Column II. (GATE MT 2025)

Column I	**Column II**
P. Face centered cubic (FCC) structure	1. ABCABABC
Q. Intrinsic stacking fault in FCC	2. ABABABAB
R. Across an annealing twin boundary in FCC	3. ABCABCABC
S. Hexagonal close-packed structure	4. ABCABCACBACBA

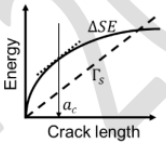
a) P-1, Q-3, R-4, S-2
b) P-2, Q-3, R-1, S-4
c) P-3, Q-1, R-4, S-2
d) P-2, Q-4, R-1, S-3

45) Which one of the following graphs represents Griffith's criterion for the growth of a crack in a brittle isotropic infinitely large plate with a center crack? In the graph, ΔSE is the magnitude of the total strain energy released (shown by solid curve) and Γ_s is the total surface energy (shown by dashed line) and a_c is the critical crack length (shown by downward arrow) at which the crack starts growing. The tangent to the ΔSE curve parallel to the Γ_s line is shown by the dotted line. (GATE MT 2025)

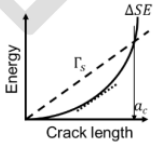
(A)



(B)



(C)



(D)

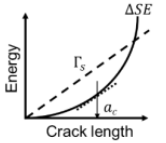


Fig. 45.

GRAPHS

46) For rolling of slabs, determine the correctness or otherwise of the following Assertion [a] and Reason [r]. (GATE MT 2025)

Assertion [a]: Grooves are made on the surface of the rolls parallel to their roll axes to achieve large thickness reduction in a short time.

Reason [r]: Given μ is the coefficient of friction between the rolls and the slab, and α is the angle of bite between the entrance plane and the centerline of the rolls, unaided entry of slab in the rolls can take place only if $\mu < \tan\alpha$.

a) Both [a] and [r] are true, and [r] is the correct reason of [a].
b) Both [a] and [r] are true, but [r] is not the correct reason of [a].
c) Both [a] and [r] are false.
d) Statement [a] is true, but [r] is false.

47) Which of the following statements is/are correct? (GATE MT 2025)

a) Ultimate analysis of coal involves determination of moisture, volatile matter, fixed carbon and ash.
b) Reduction of wustite in blast furnace occurs at the lower part of the stack.
c) Roasting involves reduction of sulfide ores to pure metals.
d) White metal (impure Cu_2S) is produced by oxidizing Fe and S during smelting of

Cu-Fe matte.

48) A creep test of a pure polycrystalline metal is performed in tension and the creep strain rate is observed to decrease during the primary stage. The creep mechanism is later determined to be dislocation-climb-controlled. The observed decrease in creep strain rate is/are due to (GATE MT 2025)

a) an increase in dislocation density.
b) grain growth.
c) a decrease in the dislocation density.
d) an increase in the cross-sectional area of the sample.

49) Which of the following statements is/are correct for joining processes? (GATE MT 2025)

a) In case of soldering and brazing, the filler material has a melting point lower than that of the metals joined.
b) In tungsten inert gas welding, tungsten is the filler material.
c) Friction welding is a solid-state joining process.
d) The following reaction is associated with thermit welding:
$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(g) + \text{Heat}(\Delta H)$.

50) Which of the following statements is/are correct for non-destructive testing? (GATE MT 2025)

a) Liquid dye penetration technique can be utilized for detecting surface cracks.
b) In radiographic examination, internal cracks cannot be detected.
c) Eddy current-based techniques can be used for detecting sub-surface defects in pure alumina at room temperature.
d) Ultrasonic inspection is unsuitable for inspecting sub-surface defects in high damping capacity material (e.g., cast iron).

51) The following data is obtained from an experiment:

x	1	2	3
y	8	15	19

If the data is fit using the straight line $y = mx + c$ (where m and c are constants) using the least-squares method, then the value of m is _____. (Round off to one decimal place). (GATE MT 2025)

52) The integral $\int_0^1 xe^{-x}dx$ evaluates to _____. (Round off to two decimal places) (GATE MT 2025)

53) If for element A, the formation enthalpy and formation entropy per vacancy created are 0.5 eV and $3k_B$, respectively, then the equilibrium vacancy concentration (in mole fraction) at 500 K is _____ $\times 10^{-4}$. (Round off to two decimal places) (GATE MT 2025)
Given: Boltzmann constant, $k_B = 8.62 \times 10^{-5}\ eV \cdot atom^{-1} \cdot K^{-1}$

54) A steel bar is subjected to fatigue loading with a tensile mean stress. Given that the ultimate tensile strength is 1000 MPa and the fatigue limit under fully reversed loading is 250 MPa, the fatigue limit for a mean stress of 100 MPa, considering Goodman relationship is _____ MPa. (Round off to the nearest integer) (GATE MT 2025)

55) During carburization of a steel at 950°C, carbon concentration is measured as $0.8 wt.\%$ at a depth of 0.3 mm after one hour. The time required to get the same carbon concentration at a depth of 0.6 mm at the same carburization temperature is _____ hours. (Round off to the nearest integer). (GATE MT 2025)

56) An ideal solution is formed by mixing 10 grams of A and 50 grams of B at 673 K. The molar free energy of mixing _____ $kJ.mol^{-1}$. (Round off to one decimal place) (GATE MT 2025)
Given: Universal gas constant $R = 8.314\ J.mol^{-1}.K^{-1}$
Atomic weight of A = 40 $grams.mol^{-1}$
Atomic weight of B = 60 $grams.mol^{-1}$

57) The cupric ion (Cu^{2+}) concentration in the electrolyte (at 298 K) required to make the potential of pure copper equal to 0.17 V is _____ $\times 10^{-6}\ gram-mol\cdot(litre)^{-1}$. (Round off to two decimal places). (GATE MT 2025)
Gas constant $R = 8.314\ J.mol^{-1}.K^{-1}$
Faraday's constant $F = 96500\ C.mol^{-1}$(of electrons)
Standard reduction potential of Cu, $E^o = 0.34\ V$

58) A non-porous spherical Fe_2O_3 particle of initial radius of $5 \times 10^{-2}\ m$ is topochemically reduced by H_2, where the reactant-product interface is sharp and spherical, and reaction rate is proportional to the interfacial area. The radius of the unreacted Fe_2O_3 particle after 600 s will be _____ $\times 10^{-2}\ m$. (Round off to the nearest integer). (GATE MT 2025)
Given: Rate constant $k = 5 \times 10^{-5}\ m.s^{-1}$

59) A long metallic cylindrical rod of radius r, length $L(\gg r)$ and electrical resistivity ρ_e is kept in vacuum and is carrying an electric current of I. The only way it loses heat to the ambient is via radiation. If the ambient temperature is T_0, then the steady-state temperature of the rod is _____ K. (Round off to the nearest integer). (GATE MT 2025)
Given: Stefan-Boltzmann constant = $5.667 \times 10^{-8}\ W.m^{-2}.K^{-4}$
$r = 0.1\ mm$, $L = 1\ m$, $\rho_e = 10^{-8}\ \Omega.m$, $I = 0.3\ A$, $T_0 = 300\ K$
Neglect the heat loss by the two flat ends of the rod and assume emissivity = 1.

60) 1000 kg of sphalerite concentrate containing 60% ZnS is COMPLETELY roasted with stoichiometric amount of pure oxygen. The amount of oxygen required is _____ kg. (Round off to one decimal place). (GATE MT 2025)
Assume that the other components in the concentrate are not reactive.
Given: Atomic weight values (in $gram.mol^{-1}$) for Zn = 65, S = 32, O = 16.

61) 800 grams of A-B alloy containing $20 wt.\%$ B is held at temperature T_1. The weight of B dissolved in α at that temperature is _____ grams. (Round off to the nearest integer). (GATE MT 2025)

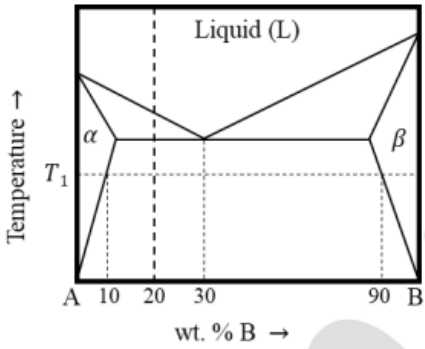


Fig. 61.

GRAPH

62) A mild steel pipeline is connected to zinc for cathodic protection at a current density of 10 $mA.m^{-2}$. The quantity of zinc required per square meter of the pipeline per year is _____ grams. (Round off to the nearest integer). (GATE MT 2025)
Given: Atomic weight of Zn is 65 $gram.mol^{-1}$.
Faraday's constant $F = 96500\ C.mol^{-1}$(of electrons)

63) A large rectangular component is undergoing fully-reversed cyclic loading, and the component is known to grow the dominant fatigue crack from the outer surface. If the stress amplitude (σ_A) is 100 MPa and the critical stress intensity factor K_{IC} of the material is 50 $MPa.m^{\frac{1}{2}}$ then the crack length at which the component will fail catastrophically is _____ mm. (Round off to one decimal place) (GATE MT 2025)
Given: The geometric factor α for this loading condition is 1.12.

64) In casting, for a simple vertical gating system with a gate of cross-sectional area 2 cm^2 and sprue height of 10 cm, the filling time for a mould of dimensions 40 $cm \times 20\ cm \times 10\ cm$, is _____ s. (Round off to one decimal place) (GATE MT 2025)
Given: Acceleration due to gravity $g = 980\ cm.s^{-2}$

65) During arc welding, the actual heat input is 200 $J.mm^{-3}$ and the current and voltage are 200 A and 20 V, respectively. For a weld cross-sectional area of 2 mm^2 and heat transfer efficiency of 0.9, the velocity of welding is _____ $mm.s^{-1}$. (Round off to the nearest integer). (GATE MT 2025)

END OF THE QUESTION PAPER