AI25btech11038

a) A is a 2×2 matrix with $\det A = 2$. The $\det(2A)$ is

i) 4 ii) 8 iii) 32 iv) 16

(GATE MT 2012)

b) A is a 2×2 matrix given below: $\begin{pmatrix} -3 & 1 \\ -1 & -1 \end{pmatrix}$ The eigenvalues of A are

i) $-2, -2$ ii) $-3, -1$ iii) $2, 2$ iv) $3, 1$

(GATE MT 2012)

c) In a production facility, iron rods are made with a mean diameter of 6 cm and standard deviation of 0.02 cm. If a large number of rods are tested, the approximate percentage of rods whose sizes fall in the range of 5.98 cm to 6.02 cm is

i) 68 ii) 75 iii) 90 iv) 99.7

(GATE MT 2012)

d) Which one of the following methods is NOT used for numerical integration?

i) Rectangular rule ii) Trapezoidal rule iii) Simpson's rule iv) Cramer's rule

(GATE MT 2012)

e) How many boundary conditions are required to solve the following equation?

$$\frac{\partial^2 T}{\partial r^2} + \frac{1}{r}\frac{\partial T}{\partial r} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$$

i) Two in r-direction
ii) One in r-direction and one for time
iii) Two in r-direction and one for time
iv) Three in r-direction and one for time

(GATE MT 2012)

f) When a zinc metal rod is immersed in dilute hydrochloric acid, it results in

i) Evolution of hydrogen
ii) Evolution of chlorine
iii) Evolution of oxygen
iv) No evolution of any gas

(GATE MT 2012)

g) A fluid is flowing with a velocity of 0.5 m/s on a plate moving with a velocity of 0.01 m/s in the same direction. The velocity at the interface of the fluid and plate is

i) 0.0 m/s ii) 0.01 m/s iii) 0.255 m/s iv) 0.50 m/s

(GATE MT 2012)

h) Hot metal at 1700 K is poured in a sand mould that is open at the top. Heat loss from the liquid metal takes place by

i) Radiation only
ii) Radiation and conduction only
iii) Radiation and convection only
iv) Radiation, conduction and convection

(GATE MT 2012)

i) Which one of the following is an equilibrium defect?

i) Vacancies ii) Dislocations iii) Stacking faults iv) Grain boundaries

(GATE MT 2012)

j) Floatation beneficiation is based on the principle of

i) Mineral surface hydrophobicity
ii) Gravity difference
iii) Chemical reactivity
iv) Particle size difference

(GATE MT 2012)

k) Copper can be reduced from acidic copper sulphate solution by

i) Silver ii) Iron iii) Carbon iv) Lead

(GATE MT 2012)

l) Which one is NOT an agglomeration process?

i) Nodulizing ii) Briquetting iii) Roasting iv) Pelletizing

(GATE MT 2012)

m) During LD blow in steelmaking the impurity that gets removed first is

i) Carbon ii) Phosphorous iii) Manganese iv) Silicon

(GATE MT 2012)

n) During the solidification of a pure metal, it was found that dendrites are formed. Assuming that the liquid-solid interface is at the melting temperature, the temperature from the interface into the liquid

i) Decreases
ii) Increases
iii) Remains constant
iv) Increases and then decreases

(GATE MT 2012)

o) A peak in the X-ray diffraction pattern is observed at $2\theta = 78^\circ$, corresponding to $\{311\}$ planes of an fcc metal, when the incident beam has a wavelength of 0.154 nm. The lattice parameter of the metal is approximately

i) 0.6 nm ii) 0.4 nm iii) 0.3 nm iv) 0.2 nm

(GATE MT 2012)

p) If d is the inter-planar spacing of the planes $\{hkl\}$, the inter-planar spacing of the planes $\{nhnknl\}$, n being an integer, is

i) d ii) d/n iii) nd iv) d/n^2

(GATE MT 2012)

q) As temperature increases, the electrical resistivities of pure metals (ρ_m) and intrinsic semiconductors (ρ_s) vary as follows

i) Both ρ_m and ρ_s increase
ii) Both ρ_m and ρ_s decrease
iii) ρ_m increases and ρ_s decreases
iv) ρ_m decreases and ρ_s increases

(GATE MT 2012)

r) At equilibrium spacing in a crystalline solid, which of the following is true for net inter-atomic force (F) and potential energy (U)

i) F is zero and U is zero
ii) F is zero and U is minimum
iii) F is minimum and U is zero
iv) F is minimum and U is minimum

(GATE MT 2012)

s) The property of a material that CANNOT be significantly changed by heat treatment is

i) Yield strength
ii) Ultimate tensile strength
iii) Ductility
iv) Elastic modulus

(GATE MT 2012)

t) A unit dislocation splits into two partial dislocations. The correct combination of the Burgers vectors of the partial dislocations for a given unit dislocation having Burgers vector $\frac{a}{2}[\bar{1}10]$ is

i) $\frac{a}{6}[2\ \bar{1}\ 1]$ and $\frac{a}{6}[1\ 2\ \bar{1}]$
ii) $\frac{a}{6}[1\ \bar{1}\ 2]$ and $\frac{a}{6}[\bar{1}\ 2\ 1]$
iii) $\frac{a}{6}[1\ \bar{1}\ 2]$ and $\frac{a}{6}[2\ 1\ \bar{1}]$
iv) $\frac{a}{6}[2\ 1\ 1]$ and $\frac{a}{6}[1\ 2\ \bar{1}]$

(GATE MT 2012)

u) A polymer matrix composite is reinforced with long continuous ceramic fibres aligned in one direction. The Youngâs moduli of the matrix and fibres are E_m and E_f respectively, and the volume fraction of the fibres is f. Assuming iso-stress condition, Youngâs modulus of the composite E_c in a direction perpendicular to the length of fibres, is given by the expression

i) $E_c = (1-f)E_m + fE_f$
ii) $E_c = fE_m + (1-f)E_f$
iii) $\frac{1}{E_c} = \frac{(1-f)}{E_m} + \frac{f}{E_f}$
iv) $\frac{1}{E_c} = \frac{f}{E_m} + \frac{(1-f)}{E_f}$

(GATE MT 2012)

v) Which of the following is NOT a fusion welding process?

i) Arc welding
ii) Gas welding
iii) Resistance welding
iv) Friction stir welding

(GATE MT 2012)

w) Tungsten filament used in electric bulb is processed by

i) Extrusion
ii) Wire drawing
iii) Casting
iv) Powder metallurgy

(GATE MT 2012)

x) The riser is designed such that the melt in the riser solidifies
i) Before casting solidifies
ii) At the same time as casting solidifies
iii) After casting solidifies
iv) Irrespective of the solidification of the casting

(GATE MT 2012)

y) Radiography technique of detecting defects is based on the principle of

i) Diffraction ii) Reflection iii) Interference iv) Absorption

(GATE MT 2012)

z) At $x = 0.5$, the polynomial $x^2(1-x^2)$ has

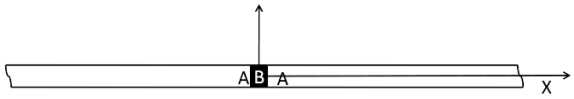

Fig. 1.

i) No extrema ii) A saddle point iii) A minima iv) A maxima

(GATE MT 2012)

) Given that **v** is a vector field and f is a scalar field, match the equations in **Group I** with their physical meaning in **Group II**

Group 1	Group 2
(P) div (**v**) = 0	(1) Irrotational
(Q) curl (grad(f)) = 0	(2) Incompressible
(R) div (grad(f)) = 0	(3) Potential
(S) **v** = grad(f)	(4) Laplace equation

i) P-1, Q-2, R-3, S-4 iii) P-1, Q-3, R-2, S-4
ii) P-2, Q-1, R-4, S-3 iv) P-2, Q-1, R-3, S-4

(GATE MT 2012)

) The temperature field of a slab is given by $T = 400 - 50z\exp(-t - x^2 - y^2)$. The temperature gradient in y-direction is

i) $100yz\exp(-t - x^2 - y^2)$ iii) $100xz\exp(-t - x^2 - y^2)$
ii) $-100yz\exp(-t - x^2 - y^2)$ iv) $-100xz\exp(-t - x^2 - y^2)$

(GATE MT 2012)

) What does the solution of the following ordinary differential equation represent?

$$y\frac{dy}{dx} + x = 0 \tag{1}$$

i) A parabola iii) An ellipse
ii) A circle iv) A hyperbola

(GATE MT 2012)

) A thin layer of material B (of total amount m) is plated on the end faces of two long rods of material A. These are then joined together on the plated side (see the figure below) and heated to a high temperature. Assuming the diffusion coefficient of B in A is D, the composition profile c_B along the rod axis x after a time t is described by

i) $c_B = \dfrac{m}{2\sqrt{\pi Dt}}\exp\left[-\dfrac{x^2}{4Dt}\right]$ iii) $c_B = \dfrac{m}{2\sqrt{\pi Dt}}\left[1 - \text{erf}\left(-\dfrac{x^2}{4Dt}\right)\right]$

ii) $c_B = \dfrac{m}{2\sqrt{\pi Dt}}\text{erf}\left[-\dfrac{x^2}{4Dt}\right]$ iv) $c_B = \dfrac{m}{2\sqrt{\pi Dt}}t$

(GATE MT 2012)

) Match the principles given in **Group I** with corresponding corrosion terminology in **Group II**

Group 1	Group 2
(P) Electrode polarization	(1) Dezinfication
(Q) Passivity	(2) Intergranular attack
(R) Selective leaching	(3) Over voltage
(S) Grain boundary precipitation	(4) Surface oxide film

i) P-3, Q-4, R-1, S-2
ii) P-3, Q-4, R-2, S-1
iii) P-4, Q-2, R-1, S-3
iv) P-2, Q-1, R-4, S-3

(GATE MT 2012)

) Identify the correct combination of the following statements
P. Hydrogen electrode is a standard used to measure redox potentials
Q. Activation polarization refers to electrochemical processes controlled by reaction sequence at metal-solution interface
R. Potential-pH diagrams can be used to predict corrosion rates of metals
S. Cathodic protection can use sacrificial anodes such as magnesium

i) P, Q and R
ii) Q, R and S
iii) P, Q and S
iv) P, R and S

(GATE MT 2012)

) Consider a reaction with activation energy of 8.314 kJ/mol that takes place at 300 K. If the reaction rate is to be tripled, the temperature of the reaction should be

i) 174.5 K
ii) 447.5 K
iii) 600.5 K
iv) 847.5 K

(GATE MT 2012)

) Match the processes in **Group I** with the objectives in **Group II**

Group 1	Group 2
(P) Vacuum Arc Degassing (VAD)	(1) Primary iron making
(Q) LD	(2) Secondary steel making
(R) COREX	(3) Direct smelting
(S) Blast Furnace	(4) Primary steel making

i) P-3, Q-4, R-2, S-1
ii) P-4, Q-3, R-1, S-2
iii) P-3, Q-2, R-1, S-4
iv) P-2, Q-4, R-3, S-1

(GATE MT 2012)

) The reduction of FeO with CO gas in co-current flow is given by the following equation:

$$FeO + CO = Fe + CO_2 \qquad \Delta G^\circ = 8120 \text{ J at } 1173 \text{ K}$$

The ratio of P_{CO}/P_{CO_2} for this reaction at 1173 K is

i) 0.0
ii) 0.25
iii) 0.44
iv) 2.3

(GATE MT 2012)

) The sulphide capacity (C_S) of liquid slag of composition 55 wt.% CaO, 20 wt.% SiO_2, 15 wt.% Al_2O_3, and 10 wt.% MgO is given by the following equation

$$\log C_S = -3.44\,(X_{CaO} + 0.1X_{MgO} - 0.8X_{Al_2O_3} - X_{SiO_2}) - \frac{9894}{T} + 2.05$$

where, X is mole fraction of the respective components. Atomic weights of Ca, Mg, Si, Al and O are 40, 24, 28, 27 and 16 respectively.
The value of C_S at 1900 K is

i) 0.0009
ii) 0.009
iii) 0.09
iv) 0.9

(GATE MT 2012)

) Match the processes given in **Group I** with the corresponding metals in **Group II**

(GATE MT 2012)

Group 1	Group 2
(P) Matte smelting	(1) Lead
(Q) Cyanide leaching	(2) Copper
(R) Carbothermic reduction	(3) Aluminium
(S) Fused salt electrolysis	(4) Gold

i) P-1, Q-2, R-1, S-4
ii) P-2, Q-3, R-1, S-4
iii) P-2, Q-1, R-3, S-4
iv) P-2, Q-3, R-4, S-1

(GATE MT 2012)

) Identify the correct combination of the following statements
P. Bessemer converter can be used in copper smelting
Q. The Mond process for nickel involves reaction of metal with H_2 gas
R. Roasted ZnS concentrates can be smelted in a blast furnace
S. Magnesium metal can be produced by electrolysis of sea water

i) P, R and S
ii) P, Q and R
iii) P and Q
iv) Q and S

(GATE MT 2012)

) Match the phases of steel in **Group I** with the crystal structures in **Group II**

Group 1	Group 2
(P) Martensite	(1) bcc
(Q) Cementite	(2) fcc
(R) Austenite	(3) bct
(S) Ferrite	(4) Orthorhombic

i) P-3, Q-4, R-1, S-2
ii) P-2, Q-3, R-1, S-4
iii) P-3, Q-4, R-2, S-1
iv) P-4, Q-3, R-2, S-1

(GATE MT 2012)

) Arrange the following in terms of increasing severity of quench
P. Oil quenching
Q. Water quenching
R. Water quenching with agitation
S. Brine quenching

i) P¡Q¡R¡S
ii) Q¡R¡P¡S
iii) P¡Q¡S¡R
iv) Q¡P¡R¡S

(GATE MT 2012)

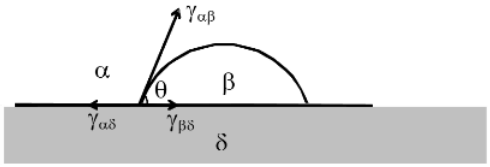

Fig. 2.

) Regarding recrystallization, which one of the following statements is NOT correct?

i) Higher the amount of cold work, lower is the recrystallization temperature
ii) Higher the recovery, higher is the recrystallization temperature
iii) Higher the temperature of cold work, higher is the recrystallization temperature
iv) Finer the initial grain size, higher is the recrystallization temperature

(GATE MT 2012)

) A liquid droplet (β) is on a substrate (δ) and is surrounded by air (α), as shown below. The angle of contact (θ) is determined using the following expression:

i) $\theta = \cos^{-1}\left(\frac{\gamma_{\alpha\delta} - \gamma_{\beta\delta}}{\gamma_{\alpha\beta}}\right)$
ii) $\theta = \cos^{-1}\left(\frac{\gamma_{\delta\delta} - \gamma_{\alpha\beta}}{\gamma_{\alpha\beta}}\right)$
iii) $0 = \cos^{-1}\left(\frac{\gamma_{\alpha\delta} - \gamma_{\beta\delta}}{\gamma_{\alpha\delta}}\right)$
iv) $\theta = \cos^{-1}\left(\frac{\gamma_{\alpha\delta} - \gamma_{\beta\delta}}{\gamma_{\beta\delta}}\right)$

(GATE MT 2012)

) Match the phenomena listed in **Group I** with the possible mechanisms in **Group II**

Group 1	Group 2
(P) Fatigue	(1) Grain boundary sliding
(Q) Creep	(2) Slip band extrusion and intrusion
(R) Strain hardening	(3) Cottrell atmosphere
(S) Yield point phenomenon	(4) Dislocation interaction

i) P-2, Q-3, R-4, S-1
ii) P-2, Q-4, R-3, S-1
iii) P-1, Q-2, R-4, S-3
iv) P-1, Q-2, R-4, S-3

(GATE MT 2012)

) Fracture stress for a brittle material having a crack length of 1 μm is 200 MPa. Fracture stress for the same material having a crack length of 4 μm is

i) 200 MPa
ii) 150 MPa
iii) 100 MPa
iv) 50 MPa

(GATE MT 2012)

) The flow stress ($\overline{\sigma}$) of an alloy varies with strain rate ($\dot{\epsilon}$) as $\overline{\sigma} = 100(\dot{\epsilon})^{0.1}$ MPa. When the alloy is hot extruded from 10 cm diameter to 5 cm diameter at a speed of 2 cm/s, the flow stress is

i) 1000 MPa
ii) 105 MPa
iii) 150 MPa
iv) 1050 MPa

(GATE MT 2012)

) Determine the correctness or otherwise of the following **Assertion (a)** and **Reason (r)**.

Assertion: During rolling, front tension and (or) back tension are (is) employed to decrease

rolling load.
Reason: Roll pressure decreases due to lowering of flow stress as a result of front tension/back tension.

i) A is false but R is true
ii) A is true and R is also true, but r is not the reason for a
iii) A is true and R is also true, and r is the reason for a
iv) A is true but R is false

(GATE MT 2012)

) Match the defects listed in **Group I** with the processes listed in **Group II**

Group 1	Group 2
(P) Cold shut	(1) Rolling
(Q) Earing	(2) Forging
(R) Alligatoring	(3) Deep drawing
(S) Shrinkage porosity	(4) Fusion welding

i) P-2, Q-4, R-1, S-4
ii) P-2, Q-4, R-3, S-1
iii) P-2, Q-3, R-1, S-4
iv) P-4, Q-1, R-2, S-3

(GATE MT 2012)

Common Data for Questions 48 and 49:
A steel ball (density ρ_{steel} = 7200kg/m^3) is placed in an upward moving liquid Al (density ρ_{Al} = 2360kg/m^3, viscosity $\mu_{Al} = 1 \times 10^3$ Pa.s and Reynolds number = 5×10^5). The force (F) exerted on the steel ball is expressed as

$$F = f\pi R^2 \left(\rho_{Al} v^2/2\right)$$

where f is friction factor (=0.2), v is the velocity of liquid Al and R is the radius of steel ball.

) The force exerted on the steel ball is

i) 8.32 N
ii) 6.70 N
iii) 1.67 N
iv) 0.52 N

(GATE MT 2012)

) The terminal velocity of a fine spherical steel particle having diameter d_p, in μm range, if allowed to fall in a quiescent liquid Al bath, is

i) $5.2 \times 10^6 d_p^2$ m/s
ii) $2.6 \times 10^6 d_p^2$ m/s
iii) $1.3 \times 10^6 d_p^2$ m/s
iv) $6.6 \times 10^5 d_p^2$ m/s

(GATE MT 2012)

Common Data for Questions 50 and 51:
For the above stress cycle:

) Stress ratio is

i) 4
ii) 2
iii) -2
iv) -4

(GATE MT 2012)

) Amplitude ratio is

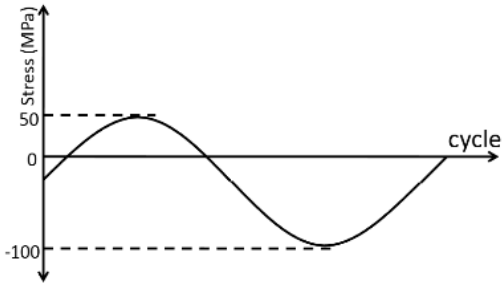

Fig. 3.

i) 3
ii) 1/3
iii) −1/3
iv) -3

(GATE MT 2012)

Statement for Linked Answer Questions 52 and 53:

A material with grain size of ASTM No. 6 has a lattice frictional stress 100 MN/m^2 and locking parameter (Hall-Petch constant) 0.10 MN/m$^{3/2}$

) Grain size of the material is approximately

i) 45 μm
ii) 35 μm
iii) 4.5 μm
iv) 3.5 μm

(GATE MT 2012)

) Yield strength of the material is approximately

i) 100 MPa
ii) 115 MPa
iii) 165 MPa
iv) 215 MPa

(GATE MT 2012)

Statement for Linked Answer Questions 54 and 55:

The strain hardening behaviour of an annealed rod during cold rolling is given by $\overline{\sigma} = 700(\epsilon)^{0.2}$ MPa, where $\overline{\sigma}$ is the flow stress at strain ϵ.

) Flow stress after 50% reduction in area of the annealed rod on cold rolling is approximately

i) 750 MPa
ii) 650 MPa
iii) 609 MPa
iv) 559 MPa

(GATE MT 2012)

) If a wire of 5 mm diameter is drawn from the above cold rolled rod of 10 mm diameter, the drawing stress, neglecting the effect of friction and redundant work, is approximately

i) 650 MPa
ii) 550 MPa
iii) 450 MPa
iv) 400 MPa

(GATE MT 2012)

) Which one of the following options is the closest in meaning to the word given below?

Latitude

i) Eligibility
ii) Freedom
iii) Coercion
iv) Meticulousness

(GATE MT 2012)

) Choose the most appropriate word from the options given below to complete the following sentence:

Given the seriousness of the situation that he had to face, his ___ was impressive.

i) beggary
ii) nomenclature
iii) jealousy
iv) nonchalance

(GATE MT 2012)

) Choose the most appropriate alternative from the options given below to complete the following sentence:

If the tired soldier wanted to lie down, he ___ the mattress out on the balcony.

i) should take
ii) shall take
iii) should have taken
iv) will have taken

(GATE MT 2012)

) If $(1.001)^{1259} = 3.52$ and $(1.001)^{2062} = 7.85$, then $(1.001)^{3321} =$

i) 2.23
ii) 4.33
iii) 11.37
iv) 27.64

(GATE MT 2012)

) One of the parts (A, B, C, D) in the sentence given below contains an **ERROR**. Which one of the following is **INCORRECT**?

I requested that he should be given the driving test today instead of tomorrow.

i) requested that
ii) should be given
iii) the driving test
iv) instead of tomorrow

(GATE MT 2012)

) The data given in the following table summarizes the monthly budget of an average household.

Category	Amount (Rs.)
Food	4000
Clothing	1200
Rent	2000
Savings	1500
Other expenses	1800

The approximate percentage of the monthly budget **NOT** spent on savings is

i) 10%
ii) 14%
iii) 81%
iv) 86%

(GATE MT 2012)

) There are eight bags of rice looking alike, seven of which have equal weight and one is slightly heavier. The weighing balance is of unlimited capacity. Using this balance, the minimum number of weighings required to identify the heavier bag is

i) 2
ii) 3
iii) 4
iv) 8

(GATE MT 2012)

) Raju has 14 currency notes in his pocket consisting of only Rs. 20 notes and Rs. 10 notes. The total money value of the notes is Rs. 230. The number of Rs. 10 notes that Raju has is

i) 5
ii) 6
iii) 9
iv) 10

(GATE MT 2012)

) **One of the legacies of the Roman legions was discipline. In the legions, military law prevailed and discipline was brutal. Discipline on the battlefield kept units obedient, intact and fighting, even when the odds and conditions were against them.** Which one of the following statements best sums up the meaning of the above passage?

i) Thorough regimentation was the main reason for the efficiency of the Roman legions even in adverse circumstances.
ii) The legions were treated inhumanly as if the men were animals.
iii) Discipline was the armies' inheritance from their seniors.
iv) The harsh discipline to which the legions were subjected to led to the odds and conditions being against them.

(GATE MT 2012)

) A and B are friends. They decide to meet between 1 PM and 2 PM on a given day. There is a condition that whoever arrives first will not wait for the other for more than 15 minutes. The probability that they will meet on that day is

i) 1/4
ii) 1/16
iii) 7/16
iv) 9/16

(GATE MT 2012)

END OF THE QUESTION PAPER