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PGAT 2014

METALLURGICAL ENGINEERING

There are a total of 60 questions. All questions are of multiple choice types. A question will have four choices for the answer with only one correct choice.

Q1. Which cubic crystal structure posses atomic packing factor (APF) = 0.74 and co-ordination number of 12.
- (A) BCC,
- (B) HCP
- (C) FCC
- (D) Simple cubic

Q2. The phenomenon of dislocations developing a low energy configuration on annealing is known as.
- (A) Polygonization
- (B) Polymerization
- (C) Crystallization
- (D) Homogenization

Q3. A defect that creates extra or missing of number of close-packed planes in wrong sequence is known as.
- (A) Planar defect
- (B) Line defect
- (C) Point defect
- (D) Volume defect

Q4. A copper metal deforms by slip on closed packed plane and direction is
- (A) {111} <110>
- (B) {110} <111>
- (C) {121} <110>
- (D) None of these

Q5. The criteria for the predicting the onset of failure in engineering materials is
- (A) Tresca
- (B) Von Mises
- (C) Tresca and Von Mises
- (D) None of these

Q6. The test carried out to determine the resistance of materials to crack propagation is known as
- (A) Hardness test
- (B) Fatigue test
- (C) Fracture toughness test
- (D) Compressive test

Q7. The major factor which determines the strength and hardness of steel in the martensitic structure is
- (A) Amount of cementite
- (B) Amount of austenite

(C) Amount of ferrite
(D) Amount of carbon

Q8. The decrease in hardness and strength of precipitation or age hardened materials is due to.
(A) Annealing
(B) Strain aging
(C) Over aging
(D) None of these

Q9. A parent ion moving to an interstitial site in the crystal lattice to produce a defect is known as
(A) Schottky defect
(B) Frenkel defect
(C) Lattice defect
(D) None of these

Q10. A brass bolt changed its colour from yellow to red and became brittle in acid solution due to.
(A) Pitting
(B) Leaching
(C) Dezincification
(D) Oxidising

Q11. Kevlar fibre has very low resistance to
(A) Axial compressive
(B) Axial tensile
(C) Transverse compressive
(D) Transverse tensile

Q12. The variation of limiting range of stress on the mean stress is shown in
(A) S-N curve
(B) Goodman diagram
(C) Master diagram
(D) None of the these

Q13. The material which exhibits piezoelectric behaviour at room temperature.
(A) $CaTiO_3$
(B) $BaTiO_3$
(C) $SrTiO_3$
(D) All the above

Q14. Brinell hardness test consists of indenting the metal surface with a steel ball of diameter.
(A) 20 mm
(B) 8 mm
(C) 10 mm
(D) 12 mm

Q15. Stress intensity factor K_{Ic} can be described as fracture toughness of
(A) Brittle materials
(B) Ductile materials
(C) Composite materials
(D) All the three

Q16. S-N curve indicates the fatigue failures at
(A) $N>10^5$
(B) $N<10^5$
(C) $N=10^4$
(D) $N<10^4$

Q17. The materials with high strain rate sensitivity at high temperature ($T>0.5Tm$) are
(A) Superalloys
(B) Superplastic
(C) Superelastic
(D) None of these

Q18. The susceptibility of material to brittle behaviour is determined by
(A) Tensile test
(B) Compression test
(C) Impact test
(D) Torsion test

Q19. High angle grain boundary indicates
(A) Low surface energy
(B) High surface energy
(C) Both low and high surface energy
(D) None of these

Q20. The upper yield point in low carbon steel is associated with presence of small amount of
(A) Nitrogen
(B) Sulphur
(C) Phosporous
(D) Manganese

Q21. The dislocations found in most polycrystalline materials are
(A) Pure edge dislocation
(B) Pure screw dislocation
(C) Mixed dislocation
(D) All the above

Q22. The ratio of molecular diffusivity of momentum to molecular diffusivity of heat is known as
(A) Nussalt number
(B) Prandtl number
(C) Schemidt number
(D) Reynold number

Q23. In an electrochemical cell dissolution/oxidation takes place at
(A) Cathode
(B) Anode
(C) Anolyte
(D) Catholyte

Q24. The electrochemical half cell reactions occurring due to externally applied potential is known as
(A) Daniel cell
(B) Galavanic cell
(C) Electrorefinning cell
(D) Electrowinning cell

Q25. As compared to the engineering stress- engineering strain curve, the true stress-true strain curve for a given material

(A) Lies above and to the left
(B) Lies below and to the right
(C) Crosses the engineering stress- engineering strain curve
(D) Is identical

Q26. The manufacturing process used for producing large curved disc is
(A) Drawing
(B) Forging
(C) Rolling
(D) Stretch forming

Q27. The condition that is not favourable for Phosphorous removal during steel making is
(A) Oxidizing atmosphere
(B) High temperature
(C) High basicity
(D) Thin slag

Q28. The indenter used in Vickers hardness test is
(A) Brale indenter
(B) Square based diamond pyramid
(C) 10 mm diameter steel ball
(D) 1.6 mm diameter steel ball

Q29. The heat treatment process in steel which results in a microstructure consisting of Spheroidised cementite in the matrix of ferrite is

(A) Martempering
(B) Normalising
(C) Subcritical annealing for long time
(D) Full annealing

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Q30. With the increase in the degree of supercooling the rate of nucleation
(A) First increases and then decreases
(B) First decreases and then increases
(C) Only increases
(D) Only decreases

Q31. In eutectoid Plain carbon steel, which one of the following structures does NOT form during continuous cooling?
(A) Fully pearlitic
(B) pearlitic + bainitic
(C) Fully bainitic
(D) Martensitic

Q32. Which one of the following elements is a ferrite stabilizer in steels?
(A) Ni
(B) Cu
(C) Cr
(D) Mn

Q33. Which of the following is the possible mechanism for creep deformation?
(A) Grain boundary sliding
(B) Slip band extrusion and intrusion
(C) Cottrell atmosphere
(D) Dislocation interaction

Q34. Which among the following results in highest severity of quench?
(A) Oil quenching
(B) Water quenching
(C) Water quenching with agitation
(D) Brine quenching

Q35. The structure of martensite is
(A) Body centred cubic
(B) Face centred cubic
(C) Body centred tetragonal
(D) Orthorhombic

Q36. Superalloys are
(A) Al-based alloys
(B) Cu-based alloys
(C) Ni-based alloys
(D) Mg-based alloys

Q37. Which of the following non-destructive testing method is suitable for the detection of surface crack in austenitic stainless steels?
(A) Magnetic particle inspection
(B) X-ray radiography
(C) Dye penetrant test
(D) Ultrasonic testing

Q38. The engineering stress-strain curve for a ceramic material is

(A) Parabolic
(B) Exponential
(C) Logarithmic
(D) Linear

Q39. Risers are NOT required for casting

(A) Stainless steel
(B) Plain carbon steel
(C) Grey cast iron
(D) White cast iron

Q40. Nernst equation for generation of electromotive force (E) between the solution and the electrode (as encountered in electrometallurgy) is given by

(A) $E = \frac{RT}{nF} ln \frac{p}{pE}$
(B) $E = \frac{nF}{RT} ln \frac{p}{PE}$
(C) $E = \frac{nF}{RT} ln \frac{pE}{P}$
(D) $E = \frac{nF}{RT} ln \frac{PE}{P}$

Q41. Chemical formula of chalcopyrite is

(A) CaS_2
(B) CuS_2
(C) Cu_2S FeS
(D) $Cu_2S.Fe_2S_3$

Q42. Manganese recovery in steel making is aided by

(A) Low slag basicity
(B) Low silicon content in the hot metal
(C) High slag basicity and high silicon content in the hot metal
(D) None of the above

Q43. High top pressure in blast furnace

(A) Increases the silicon content in the hot metal
(B) Increases the sulphur content in the hot metal
(C) Increases the phosphorous content in the hot metal
(D) Increases the manganese content in the hot metal.

Q44. In blast roasting of copper ore, which of the following is blown through a layer of ore that is on a moving grate.

(A) Oxygen
(B) Oxygen and steam
(C) Air
(D) Air and oxygen

Q45. When the wave length of incident X-ray increases, the angle of diffraction
- (A) Decreases
- (B) Increases
- (C) Remain constant
- (D) Shows no systematic variation.

Q46. For real gas, the chemical potential is given by
- (A) RT dln P
- (B) RT dln F
- (C) Rd dln f
- (D) None of these

Q47. Which of the following is not an extensive property?
- (A) Free energy
- (B) Entropy
- (C) Refractive index
- (D) None of these

Q48. Angle of nip of the crushing rolls does not depend upon the
- (A) Diameter of the rolls
- (B) Speed of the rolls
- (C) Product size
- (D) Feed size

Q49. Main function of a riser is to
- (A) Permit escape of the hot gases
- (B) Feed the metal to the casting, as it shrinks during solidification
- (C) Help for flow metal towards the mould cavity.
- (D) Act as a reservoir for molten metal.

Q50. True centrifugal casting is used to
- (A) Obtain high density and purity casting
- (B) Ensure purity and density at extremities of a casting
- (C) Cast symmetrical shapes
- (D) All the above

Q51. Desulfurization of molten pig iron outside the blast furnace is carried out by the
- (A) Aston process
- (B) Bayer process
- (C) Perrin process
- (D) Strategic-Udy process

Q52. The main function of the RH process of steel treatment is to
- (A) Reduce dissolved nitrogen in steel
- (B) Improve ferro-alloy recovery
- (C) Reduce sulphur in steel
- (D) Reduce carbon and hydrogen in steel

Q53. In AOD process of stainless steel making, a mixture of argon and oxygen gas is blown through the bottom because the argon gas

(A) Dissolves in steel to offer better corrosion protection
(B) Acts as a catalyst for the reaction of carbon and oxygen
(C) Lowers the partial pressure of CO gas in the bubble and hence helps to increase the decarburization rate
(D) Prevents the oxidation of expensive nickel in the stainless steel

Q54. To produce one ton of iron from a conventional blast furnace amount of air to be passed through the tuyeres is equal to

(A) 0.5 – 0.6 ton
(B) 1.0– 1.2 ton
(C) 1.8 – 2.0 ton
(D) 2.5 – 2.7 ton

Q55. The carbon content of low carbon, medium carbon and high carbon steel are respectively.

(A) (0-0.1)%; (0.1 – 0.4)% and (0.4 – 1.8)%
(B) Upto 0.25%; (0.25-0.65)% and (0.65 – 1.7)%
(C) (0.25-0.4) %; (0.4 – 0.7)% and (0.7 – 1.7)%
(D) None of these

Q56. Which of the following metal is extracted by Pidgeon process

(A) Tin
(B) Nickel
(C) Aluminium
(D) Magnesium

Q57. Due to which of the following factor spalling of a refractory occurs

(A) Low refractoriness value
(B) Unequal thermal expansion or contraction
(C) Poor strength
(D) Increased porosity

Q58. Which of the following brick is used for the lining of Vacuum steel degassing unit?

(A) Silica
(B) Low duty fireclay
(C) High alumina
(D) Graphite

Q59. Which of the following metals cannot be produced by aqueous electrolysis?

(A) Copper
(B) Zinc
(C) Aluminium
(D) Tin

Q60. In fused salt electrolysis process, lower current efficiency results due to

(A) evaporation of the metal from cathode
(B) unwanted side chemical reaction
(C) dissolution of the metal in fused salt
(D) All the above

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KEY

1	C	11	A	21	C	31	C	41	D	51	C
2	A	12	B	22	B	32	C	42	C	52	D
3	A	13	B	23	B	33	A	43	A	53	D
4	A	14	C	24	D	34	D	44	A	54	A
5	C	15	A	25	A	35	C	45	A	55	B
6	C	16	A	26	D	36	C	46	B	56	D
7	D	17	B	27	B	37	C	47	C	57	B
8	C	18	C	28	B	38	D	48	B	58	C
9	B	19	B	29	C	39	C	49	B	59	C
10	C	20	A	30	A	40	A	50	C	60	D