Metallurgical Engineering

3rd Sept 2017 (9.30-11.30 AM) CBRT

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1. The equilibrium in multi-component systems has ***not*** been derived, to avoid:

   (a) Elaboration and complexity

   (b) Simplicity

   (c) Elaboration

   (d) Mathematical equation

2. Quasi chemical theory helps to understand:

   (a) The qualitative behaviour of solution

   (b) The qualitative behaviour of solvent

   (c) The qualitative behaviour of solute

   (d) The chemical reaction

3. The Gibbs-Duhem equation is very useful to:

   (a) Evaluate the activity of a component in solution when that of the other component is known

   (b) Evaluate the activity of a component in solution when that of the other component is not known

   (c) Evaluate the activity of a component in solution and is very easy

   (d) Measure the activity accurately

4. What is the entropy change for the reaction as below at $298\ K$?

$$Fe_2O_3 + 3\ C = 2\ Fe + 3\ CO$$

Given the standard values of entropies at $298\ K$ for the following elements/compounds:

Fe_2O_3	$21.4\ cal/mole$
C	$49.5\ cal/mole$
Fe	$32.63\ cal/mole$
CO	$47.3\ cal/mole$

(a) $27.16\ cal/mol$

(b) $47.3\ cal/mol$

(c) $30.82\ cal/mol$

(d) $37.26\ cal/mol$

5. The free energy of the reaction: $< CaCO_3 > = < CaO > + \{CO_2\}$ is,

$$\Delta\ G^o = +40250 - 34.4\ T\ Cal/g\ mol.$$

What is the minimum temperature at which the reaction will occur?

(a) $789^{\circ}C$

(b) $879^{\circ}C$

(c) $897^{\circ}C$

(d) $910^{\circ}C$

6. Fractography is evaluated by:

(a) *X*-ray Diffraction

(b) *X*-ray Fluorescence Spectroscopy

(c) Scanning Electron Microscopy

(d) Transmission Electron Microscopy

7. *X*-ray Diffraction technique is used to determine:

(a) Grain size of cold-worked material

(b) Inclusion content in steel

(c) Microstructure of metal

(d) Curie temperature of magnetic material

8. In solid solution strengthening, which mechanism is relatively insensitive to temperature?

(a) Stacking - fault interaction

(b) Elastic interaction

(c) Electrical interaction

(d) Short-range order interaction

9. Which of the following is a sessile dislocation?

(a) Shockley partial dislocation

(b) Frank partial dislocation

(c) Edge dislocation

(d) Screw dislocation

10. In ductile metals, the Bauschinger effect causes lowering of:

(a) Tensile stress

(b) Fracture stress

(c) Elastic Modulus

(d) Yield stress

11. Fluxed sinter contains:

(a) The amount of flux added in the sinter mix is such that the basicity of mix is equal to that of slag to be produced

(b) The entire amount of flux required to be otherwise charged in the furnace, when run on 100 % natural ore charge added to the mix

(c) No flux to be added in the mix

(d) The amount of flux added in mix is such that the basicity of mix is lower than that of slag to be produced

12. Hanging occurs in the blast furnace due to:

1. Slag quality
2. Carbon deposition in the stack
3. Low voidage in the stack
4. Condensation of alkali vapours in the upper part of the stack

(a) 1 and 3 only

(b) 2 and 4 only

(c) 1 and 4 only

(d) 2 and 3 only

13. The presence of 79 % Nitrogen by volume in the blast restricts the temperature generated in the combustion zone. This can be overcome by:

(a) Increasing the fuel in the charge

(b) Oxygen enrichment in the blast

(c) Increasing the air blast flow

(d) Increasing the Sulphur content of the charge

14. The output of the blast furnace is limited by:

(a) Appearance of flooding in the bosh

(b) Hot blast temperature

(c) High top pressure

(d) Maximum heating temperature attained

15. The sudden sinking of the stock in the blast furnace caused by collapse of scaffolding**,** wedging etc. is called:

(a) Pillaring

(b) Hanging

(c) Scaffolding

(d) Breakout

16. Heterogeneous reaction involves:

(a) More than one phase

(b) Entirely within one phase

(c) Reaction occurs in bulk

(d) Rate of chemical reaction is proportional to the volume of the phase

17. The Zeroth law of thermodynamics is applicable to:

(a) Bodies which are in equillibrium

(b) Energy conservation

(c) Irreversible nature of spontaneous heat

(d) Measurement of randomness

18. Copper melts at $1083^{\circ}C$ and its heat of fusion is $12.971\ kJ/mol$. The change of entropy at melting point of copper is, nearly:

(a) $6.9\ J/K\ mol$

(b) $7.7\ J/K\ mol$

(c) $9.6\ J/K\ mol$

(d) $8.4\ J/K\ mol$

19. Fugacity indicates:

(a) Escaping tendency of the component or substance

(b) The tendency of component or substance to bond together

(c) The solid inherent bonding between the components or substances

(d) Selective escaping of the component

20. Catalyst is a substance which:

(a) Alters the rate of reaction but remains unchanged in amount at the end of the reaction

(b) Alters the rate of reaction by reacting and then evaporates

(c) Dissolves in the solvent and monitor the reaction

(d) Decreases the temperature of the reaction

21. Crevice corrosion occurs:

(a) On the surface of the metal

(b) In the concealed surfaces of metals

(c) On the metals not protected by films

(d) At inter-granular level

22. Pitting is a form of:

(a) Uniform corrosion

(b) Galvanic corrosion

(c) Localized corrosion

(d) Inter granular corrosion

23. In case of soil corrosion:

(a) Dry soil act as an electrolyte

(b) The moist soil act as an electrolyte

(c) The moisture in air act as an electrolyte

(d) The dry air act as an electrolyte

24. In Cathodic protection:

(a) The surface to be protected is made completely cathodic, with respect to some other metal

(b) The surface to be protected is completely anodic, with respect to some other metal

(c) The two surfaces are separated by a thin film

(d) The anode surface is coated with plastic

25. An inhibitor is a substance which:

(a) accelerates the corrosion process

(b) retards or slows down the corrosion process

(c) is not very popular method of combating corrosion

(d) is added in large amounts to the electrolyte

26. Killing of steel is removal of:

(a) Dissolved/residual oxygen

(b) Slag

(c) Sulphur

(d) Phosphorous

27. Ferro silicon is added to the molten steel ladle to:

(a) Carburize

(b) Deoxidize

(c) Cool

(d) Solidify slowly

28. Double slag practice of EAF steel making process decreases the

(a) Yield

(b) Heat-time

(c) Blow-time

(d) Impurities

29. Hot top is provided in the ingot mould to avoid:

(a) Pipe formation in the steel ingot

(b) Oxidation of ingot

(c) Chances of sticker formation

(d) Cooling of steel ingot

30. In electric arc furnace of steel making; use of oxygen helps in accelerating the rate of:

(a) Carbon removal

(b) Sulphur removal

(c) Slag oxidation

(d) Coke combustion

31. Large floor and pit moulds are packed with sand with the help of:

(a) Jolt machines

(b) Sand slingers

(c) Simple squeezer

(d) Jolt squeezer

32. According to Chvorinov's rule, the metal solidification time t of volume V and surface area A, is proportional to:

(a) $\frac{V^2}{A^2}$

(b) $\frac{A^2}{V^2}$

(c) $\frac{A}{V}$

(d) $\frac{V}{A}$

33. In hot chamber method of die casting:

(a) Die is kept hot by electric heating

(b) Only low melting point metals can be cast

(c) Melting pot is separate from the die casting machine

(d) High melting point metals can be cast

34. The main purpose of baking core is to:

(a) Remove moisture

(b) Harden the core

(c) Fuse silica grains

(d) Burn carbonaceous material

35. Method normally employed for the precision of casting is:

(a) Green sand casting

(b) Pressure Die casting

(c) Centrifugal casting

(d) Continuous casting

36. In hydrometallurgy though the reaction is thermodynamically feasible, it may not proceed, because:

(a) Kinetics is very slow

(b) Kinetics is very fast

(c) Gaseous intermediates are present

(d) Diffusion is difficult

37. Hydrometallurgy involves:

(a) Furnace treatment at high temperature for extraction of metal

(b) Leaching of metal value selectively in an aqueous solvent and subsequent recovery by several other processes

(c) The extraction and refining of metal by application of electrical energy

(d) Final refining of metal

38. In chemical dissolution, there will be:

(a) An electron transfer

(b) An oxidation state of metal which has to be increased to activate the dissolution

(c) Leaching with reduction dissolution technique

(d) No electron transfer

39. In precipitation method

(a) The impure phase is separated from the metal by increasing the temperature

(b) The impure phase is separated from the metal by lowering the temperature

(c) The system is kept at constant temperature for phase separation

(d) Separation of phase is carried out by additional stirring

40. Solvent extraction is a

(a) Separation from a liquid, one or more components by preferential dissolution in extractive solvent

(b) Separation of components by preferential filtration

(c) Separation of components by preferential sublimation

(d) Separation of components by differential density

41. In hexagonal metals the basal glide involves very little strain hardening in case of:

(a) High temperature and very slow strain rate

(b) Low temperature and very high strain rate

(c) High temperature and very high strain rate

(d) Low temperature and very slow strain rate

42. In high carbon steel, the spheroidized Cementite structure is formed at:

(a) First stage of tempering

(b) Second stage of tempering

(c) Third stage of tempering

(d) Hardening

43. Addition of 0.6 % Cr in alloy cast iron has a microstructure consisting of:

(a) Ferrite and coarse graphite

(b) Fine graphite and Pearlite

(c) Fine graphite, Pearlite and small carbide

(d) Fine carbide

44. In isothermal transformation diagram the retardation of transformation is due to increase in:

1. Carbon content
2. Grain size of austenite
3. Alloy content

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

45. Low-angle grain boundary is:

(a) Line defect

(b) Point defect

(c) Surface defect

(d) Volume defect

46. Endurance may be defined as the property of metal by virtue of which it can withstand:

(a) Compression

(b) Tension

(c) Varying stresses

(d) Uniform external force without rupture

47. Ductility is measured in terms of:

(a) Ultimate tensile strength

(b) Percentage elongation

(c) Modulus of toughness

(d) Modulus of resilience

48. The tensile test of metal is generally performed to determine:

(a) The brittleness

(b) The impact resistance

(c) The proportional elongation, elastic limit and Young's modulus

(d) The shear strength

49. Which hardness test can be used to measure exceptionally high hardness of metal plate?

(a) Rockwell

(b) Knoop

(c) Vickers

(d) Shear

50. Forging is a process where the deformation is induced by localized:

(a) Tensile forces

(b) Impact forces

(c) Compressive forces

(d) Fatigue forces

51. Lattice parameter can be measured by:

(a) Optical microscope

(b) Metallurgical microscope

(c) *X*-ray diffraction studies

(d) Electron microscope

52. What is the rate of reduction ($\frac{df}{dt}$), if fraction of reduction f are 0.6 and 0.2 at the time t of 180 s and 50 s respectively?

(a) $3.08 \times 10^{-1}/s$

(b) $3.08 \times 10^{-2}/s$

(c) $3.08 \times 10^{-3}/s$

(d) $3.08 \times 10^{-4}/s$

53. The equilibrium concentration of vacancies in Nickel at $300\,K$ and $\Delta H_t = 168\,kJ/mol$, is nearly

(a) 4.5×10^{-30}

(b) 5.6×10^{-30}

(c) 6.7×10^{-30}

(d) 7.8×10^{-30}

54. Which one of the following relations is the combined expression of the 1^{st} and 2^{nd} laws of thermodynamics in terms of energy?

(a) $dH = TdS + VdP$

(b) $dE = TdS - PdV$

(c) $dE = \delta q - PdV$

(d) $dS = TdS$

55. The largest diameter of an atom which could be fitted interstitially without disturbing the edge of FCC unit cell for copper of edge length 3.61 A°, is nearly

(a) 1.7 A°

(b) 2.6 A°

(c) 3.5 A°

(d) 4.4 A°

56. In the physical methods of refining, the parent metal is separated from impurities by unit operation which involves:

(a) No chemical reaction

(b) Chemical reaction

(c) Physical change and chemical reaction

(d) Production of complex compounds

57. Which one of the following is the correct sequence of operation in pyrometallurgy?

(a) Calcination, Roasting, Smelting and Refining

(b) Roasting, Calcination, Smelting and Refining

(c) Calcination, Smelting, Roasting and Refining

(d) Roasting, Smelting, Calcination and Refining

58. In fractional distillation refining of zinc, the retorts are made of

(a) Carborundom (SiC)

(b) Graphite

(c) Silicon nitride

(d) Titanium alloy

59. Which one of the following is the common form of ore roasting?

(a) Oxidizing roasting

(b) Chlorodizing roasting

(c) Suspension roasting

(d) Sulphatizing roasting

60. If the gangue in ore is basic, then

(a) An acid flux is required

(b) A basic flux is required

(c) Either an acid flux or basic flux is required

(d) No flux is required

61. An ideal metal lubricant under ideal metal working conditions should provide:

(a) Boundary or hydrodynamic lubrication at high pressure

(b) Maximum surface friction

(c) Conservation of heat generated during metal working process

(d) Adhesion between workpiece and metal working tool

62. The choice of a leaching agent depends on:

1. Chemical and physical character of the materials
2. Cost of reagent
3. Corroding action of the reagent
4. Ability to be regenerated

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

63. The requirement of roll material is:

(a) Corrosion resistance and impact strength

(b) Strength and resistance to wear

(c) Surface roughness and thermal conductivity

(d) Corrosion resistance and thermal conductivity

64. Impact extrusion is used for making

(a) Thick walled tubes

(b) Thin walled tubes for collapsible containers

(c) Uneven wall thickness tubes

(d) Irregular tubular shapes

65. Alloying elements are added to steels to improve the properties:

1. Strength
2. Toughness
3. Wear resistance
4. Corrosion resistance

Which of the above are correct?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

66. Bipolar junction transistors are used in:

(a) Storing data in computer memories

(b) Central processing units of computer

(c) Rectifiers

(d) Data display

67. The superconductivity of material depends on:

1. Temperature
2. Magnetic field
3. Current density

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

68. Boron fibers are produced by a process of:

1. Chemical vapour deposition
2. Pyrolizing
3. Wire drawing

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

69. Additional polymerization:

(a) is kinetic chain reaction

(b) requires two unlike molecules

(c) involves inter molecular reaction

(d) is very slow and takes days to complete

70. Ceramic materials are defined as those containing phases that are composed of:

1. Metallic and non metallic elements
2. Organic materials
3. Organic and inorganic compounds mixture

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

71. Methods used in the production of High Nitrogen Steel are based on:

(a) Pyrometallurgy

(b) Electrometallurgy

(c) Hydrometallurgy

(d) Hydro and Pyrometallurgy

72. High Nitrogen Steel has a potential to replace:

1. Nickel in austenitic steel
2. Tungsten in tool steel
3. Chromium in stainless steel

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

73. Alloy steels are made by:

(a) Primary steel making by melting scrap and rapid refining

(b) Liquid steel from primary steel making units and further refining with alloying elements in ladle after tapping

(c) Removal of harmful impurities in primary steel making process

(d) Non addition of requisite alloying elements at primary steel making stage

74. The objective of an Inert Gas Purging is:

(a) To stir the bath; homogenize temperature and composition of the melt

(b) To in-homogenize the temperature and composition of the melt

(c) To enhance the oxidation

(d) To include the dissolution

75. The dissolved oxygen level in molten steel is lowered by:

(a) Addition of strong oxide formers (Mn, Si, Al)

(b) Addition of chlorides

(c) Addition of reducing agents like carbon

(d) Stirring the molten metal vigorously

76. Martensite transformation in steel has:

(a) Low rate of nucleation and crystal growth at low temperature

(b) High rate of nucleation and crystal growth at low temperature

(c) Unlimited crystal growth

(d) Slow crystal growth initially

77. Critical cooling rate is:

(a) The minimum cooling rate at which all the austenite is super cooled at a temperature and is transformed to martensite

(b) Maximum rate of cooling at which all austenite is transferred to ferrite

(c) The magnitude of transformation not depending on the stability of austenite

(d) Less for lower stability of austenite

78. Martempering involves:

(a) Less volume change

(b) Wrapping

(c) Only thick articles having thickness above 6 mm

(d) Danger of quench cracks

79. Which one of the following phases cannot be obtained during continuous cooling in plain carbon steel?

(a) Pearlite

(b) Ferrite

(c) Bainite

(d) Martensite

80. Age hardening is achieved due to:

(a) Precipitation of supersaturated phase in the solid state at low temperature or room temperature

(b) Precipitation of supersaturated phase in the liquid state above the liquidus temperature

(c) Dissolution of hard phase

(d) Dissolution of soft phase

81. In Scanning Tunneling Microscopy tip-to-sample distance is controlled by measuring:

1. Tunneling current
2. Voltage applied between them

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

82. Advantages of charging by Bell Less Top (BLT) system in BF are:

1. Productivity increase
2. Coke rate decrease
3. Lower Si content in hot metal
4. Dust emission decrease

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

83. The accuracy of measurement in X-ray image analyzing can be improved by:

(a) Number of test measurements

(b) Sample preparation

(c) Care in polishing and etching

(d) Systematic positive approach for precise measurement

84. Requirement of mould powder in continuous casting of steel are, to:

1. Insulate the surface of the mould
2. Prevent oxidation of steel
3. Act as lubricant
4. Absorb inclusions from steel

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

85. Carbon supported grid for powder specimen is prepared in Vacuum evaporator. If d is diameter of carbon rod, l is length of carbon rod and r is the distance between arc and substrate, then the carbon film thickness t is:

(a) $\frac{d^2 l}{16\, r^2}$

(b) $\frac{d^3 l}{16\, r^2}$

(c) $\frac{16\, r^2}{d^2 l}$

(d) $16\, r d^2 l$

86. Why powder testing is essential in powder metallurgy?

(a) To ensure that the powder is suitable for the subsequent processing

(b) For quality assurance

(c) As a routine industrial practice

(d) To determine the impurities in the powder

87. The principal powder constituents of cemented carbides are:

(a) Metal and carbide

(b) Non metal and carbide

(c) Metal and nitride

(d) Metal and metal oxide

88. Which of the following welding process uses a non-combustible electrode?

(a) $LASER$ welding

(b) MIG welding

(c) TIG welding

(d) Ion beam welding

89. In resistance welding, pressure is released:

(a) Just at the time of passing the current

(b) After completion of passing the current

(c) After the weld cools

(d) During the heating period

90. Metal deposited on workpiece from electrode:

(a) is forced across the arc

(b) falls because of gravity

(c) is attracted towards the workpiece due to positive polarity of the workpiece

(d) is attracted towards the workpiece due to negative polarity of the workpiece

91. Most of the metals are produced by reducing their oxides by carbon. Then:

(a) The reduction reaction is endothermic

(b) The reduction reaction is exothermic

(c) The reduction reaction involves no heat exchange

(d) The reduction reaction requires catalyst

92. Hot working is performed under conditions of temperature where:

(a) Solidification occurs simultaneously with the deformation

(b) Recrystallization occurs simultaneously with the deformation

(c) Strengthening occurs simultaneously with the deformation

(d) Toughening occurs simultaneously with the deformation

93. Ferro Silicon, Ferro Manganese and Ferro Chrome are directly manufactured from their ores as:

(a) These ores have high content of the elements to be reduced

(b) These have very low content of the element to be reduced

(c) Absence of iron oxide can facilitate some reaction

(d) These have high percentage of S and P

94. The reducing agent that is used most commonly for the manufacture of Ferro Silicon is:

(a) Coke breeze

(b) Charcoal with pitch

(c) Petroleum coke

(d) Anthracite and coke

95. The least stable oxide is:

(a) Calcium

(b) Aluminium

(c) Iron

(d) Molybdenum

96. Nanophase materials have a potential to solve

(a) Unique biological challenges

(b) Everyday common problem

(c) Critical mechanical problem

(d) Machine parts failure

97. Single-wall nanotubes behaviour is:

(a) Not specific

(b) Specific

(c) Objects of advance physics

(d) Not studied by experimental chemistry

98. Nanotubes are:

(a) Resistance to electricity

(b) Very good conductors of electricity

(c) Thermally not stable

(d) Chemically reactive

99. Suspension properties of nanoparticles are possible because:

(a) The interaction of particle surface with the solvent is strong enough to overcome density difference

(b) The inter-reaction of particle surface with the solvent is weak to overcome density difference

(c) The particles are heavy and conducting

(d) The particles are in long tube form

100. In nanocrystals, the particle surface is increased, due to which:

(a) Dissolution rate increases

(b) Dissolution rate decreases

(c) Saturation solubility decreases

(d) Concentration gradient increases