1. The concept of the natural domain of the functions of one variable concerns:

a) a domain which covers the entire set of real numbers
b) a set for which the function formula makes sense
c) the domain, which is a subset of the set of natural numbers

2. To what limit is the sequence an = [π / n] converging?

a) π
b) 0
c) 1

3. Provide a pair of functions inverse to each other:

a) f (x) = x and g (x) = -x
b) $f(x) = e^x$ and g(x) = ln(x)
c) f(x) = sin(x) and g(x) = cos(x)

4. The result of the multiplication of two complex numbers $z_1 = 1 + i$ and $z_2 = -2i$ is:

a) 2 - 2i
b) 1 - i
c) -2 - i

5. Please indicate the correct definition of matrix rank:

a) it is the maximum number of linearly independent columns of the matrix
b) it is the maximum from the sum of rows and columns in the matrix j
c) it is the largest value in the matrix

6. The distribution of functions into partial fractions is used to integration of function:

a) exponential
b) trigonometric
c) logarithmic

7. Which of the following statements is correct:

a) Taylor's and Maclaurin's formulas are synonymus
b) Taylor's formula is used for integration of trigonometric functions
c) Taylor's and Maclaurin's formulas allow finding approximate values of functions

8. If the differential equation can be presented in the form: dy/dx = f (x) ·g(y), then we are dealing with the equation:

a) differential exact
b) differential with distributed variables
c) differential Riccatie

9. To determine multiple integrals, we use the same formulas that are used for the singular integral, for this purpose the method is used:

a) iteration
b) the power of integrals solutions
c) separation of variables

10. The vector field div operator is:

a) the matrix quantity
b) the scalar quantity
c) the vector quantity

11. Cauchy's initial problem is the simplest mathematical model used to describe physical processes, composed of:

a) the gradient of functions of the three variables and the divergence of the vector field gradient
b) ordinary differential equation together with the initial condition
c) an equation composed of an elementary logarithmic or exponential function with an initial condition

12. The chromium atom has the following electronic configurations: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$. Valence electrons are electrons located on the orbitals:

a) only 4s
b) only 3d
c) 4s, 3d

13. Elements in the same main group of the periodic table do not have:

a) the same number of valence electrons
b) similar chemical properties
c) the same number of electron shells

14. Reaction $Fe + CuSO_{4(c)} = FeSO_{4(c)} + Cu$ is:

a) a displacement reaction
b) a double exchange reaction
c) a homogenic reation

15. Solubility of gases in liquids:

a) increases with increasing temperature
b) decreases with increasing temperature
c) does not depend on the temperature

16. For complete combustion of 2 dm^3 of methane CH_4 is needed:

a) 1 dm^3 of O_2
b) 0,5 dm^3 of O_2
c) 4 dm^3 of O_2

17. A bond in which one of the atoms gives up and the other receives the electron is called:

a) ionic bond
b) donor-acceptor bond
c) polarised covalent bond

18. A bond in which one of the atoms is a donor and the other accepts an electron pair is called:

a) ionic bond
b) coordinative bond
c) polarised covalent bond

19. Metallic sodium can be obtained in the process of:

a) electrolysis of trolizy aqueous NaCl solution
b) desalination of seawater
c) electrolysis of molten NaCl

20. In the process of electrolysis of aqueous solutions of salts can be obtained:

a) sodium, chlorine, cupper, oxygen
b) oxygen, hydrogen, potassium, bromine
c) cupper, hydrogen, oxygen, chlorine

21. Which metals displace hydrogen in reaction with hydrochloric acid:

a) Zn, Cu, Mg, Fe
b) Fe, Zn, Al, Mg
c) Mg, Pb, Ag, Al

22. Corrosion inhibitors are:

a) compounds that increase the rate of corrosion
b) substances added to the corrosive environment decreasing the rate of corrosion
c) metal alloying components lowering the rate of corrosion

23. Protectors are:

a) special additives for corrosive environments that reduce the rate of corrosion
b) noble metals, used as coatings
c) insulating coatings on metal

24. Intergranular corrosion:

a) occurs between grains of salt
b) causes deformation inside the metal grains
c) occurs at grain boundaries in a metallic alloy

25. Hydroxyl group is characteristic for:

a) alcohols

b) ketons
c) aldehydes

26. pH is defined as:

a) paremetr characteristic only for acids
b) acidity factor of solutions
c) negative logarithm of hydroxyl ion concentration

27. Esterification reaction is:

a) reaction of organic acid with aldehyde
b) reaction of organic ester decomposition
c) reaction of acid with alcohol

28. Thermoplastic polymers have a topology (physical construction):

a) crosslinked
b) linear
c) ladder

29. Mark the correct sentence defining the fluid viscosity:

a) intermolecular forces responsible for the clinging of the fluid to the walls of the vessel
b) the internal friction of the fluid
c) kinematic viscosity can be defined as the sum of dynamic viscosity and fluid density

30. Mark the correct sentence referring to the Reynold's number (Re):

a) the greater the number Re, the flow is more turbulent
b) density of the fluid does not affect the value of the Re number
c) the value of Re number decreases with the decrease of the dynamic viscosity of the fluid,

31. Synthetic polymers can be divided as:

a) chain polymers and co-polymers
b) poly-exchange polimers
c) polyinductive polymers

32. A polymer formation reaction is not:

a) chain polymerisation
b) copolymerisation
c) plastomerisation

33. Polymers, for reasons of mechanical properties, are divided into:

a) plastomers and elastomer
b) monomers and duromers
c) polystyrens and caoutchoucs

34. Natural polymers are not:

a) polisacharides
b) polipeptides
c) policarbonates

35. The by-product of zinc production is:

a) sodium hydroxide
b) sulfuric acid
c) nitric acid

36. The main minerals of lead are:

a) galman and galenite
b) polytheite, galenite
c) galman and hematite

37. Bauxites are the minerals from which they are obtained :

a) aluminium
b) copper
c) magnesium

38. In the process of alumina electrolysis the following separation processes take place on the anode and cathode:

a) cathode: Al, anode: carbon monoxide
b) cathode: carbon monoxide, anode: Al
c) cathode: Al, anode: oxygen

39. Which of the listed minerals is used to produce magnesium:

a) dolomite
b) olives
c) chalcopyrite

40. Metallic titanium is produced from:

a) $TiCl_4$
b) TiO_2
c) $CaTiO_3$

41. Exposing bentonite to high temperature of the liquid casting alloy leads to the separation of water from the casting alloy, which is an irreversible process. The thermal destruction of the montmorillonite takes place and the transition to the inactive binder phase. Its main part forms a very tight layer on the grains of sand, which is called a layer:

a) active
b) passive
c) zoolitised

42. With the increase in the growth rate in eutectic v eutectic the interphase distance of the λ-structure of the alloy:

a) does not change
b) be reduced
c) be increased

43. A monocrystalline shape is formed during movement:

a) dendritic front of crystallisation
b) a flat front for crystallisation
c) cellular crystallization front

44. Mark the correct phrase for convection:

a) a movement of mass is necessary for convection to take place
b) convective flows are accompanied by an electric field (so-called convective current)
c) convection occurs only in solids

45. Mark the correct phrase for the cooling curves of metal alloys:

a) the reclassification observed on the curves concerns only numerical modelling (so-called numerical instability) and does not occur in the case of real processes
b) the so-called 'stops' observed on the curves are related to the presence of an internal heat source
c) the initial nucleation temperature shall always be the same as the liquid temperature

46. Mark the correct phrase for the real fluid concept:

a) a real fluid is a viscous and compressible fluid
b) the actual fluid is viscous and non compressible fluid
c) the term refers only to gases

47. Tolerance limits are the limits imposed by:

a) standards
b) control borders
c) the variability of the process

Answer: Ait has a heat loss compensator
e) it has two separate but identical furnaces in which the samples are contained
f) has one furnace and the temperature difference between the test sample and the reference sample is measured in it

48. Microcalorimeters are divided into:

a) compensatory and differential
b) compensatory and conductive
c) conductive and differential

49. Differential scanning calorimetry is the technique by which measurement is made:

a) the difference in heat
b) a change in the difference in the thermal flux between the test sample and the reference sample
c) change of energy of the sample compared to the heat in the kiln of the compensation microcalorimeter

50. Polimers are divided into:

a) flexible and fragile
b) natural and synthetic
c) transparent and matt

51. What is the most popular technology for the manufacture of plastic castings?

a) gravity casting
b) injection moulding
c) centrifugal casting

52. The input material for the production of plastic products by means of injection moulding machines is most often:

a) liquid polymer
b) plastic powder
c) granules or cuttings

53. The temperature gradient is a vector:

a) is perpendicular to the isothermal surface
b) having a curve in the direction of temperature drop
c) is parallel to the isothermal surface

54. Heat conduction is a phenomenon:

a) is the transfer of energy within or from a material medium to another medium upon direct contact from a location with a higher temperature to a location with a lower temperature
b) occurring when individual particles of the body in which heat is transferred change their position and this type of transfer of energy is characteristic of liquids and gases
c) consisting in the transmission of energy by electromagnetic vibrations of different wavelengths and such transmission does not require the presence of a material medium in which this energy could be transmitted

55. Intensive state parameters do not depend on the mass (size) of the system and do not have additive properties. Intensive parameters include:

a) T, p, c
b) V, n, E
c) T, p, m

56. The thermodynamic status functions can be included:

a) U - internal energy, F - free energy, T - temperature
b) U - internal energy, H - enthalpy, G - free enthalpy
c) U - internal energy, V - volume, S - entropy

57. The student in her thesis undertook a study of polymeric material (solid form) in order to determine the progress of its degradation under the influence of UV radiation over time. After reflection she chose a group of techniques:

a) infrared spectrometry, scanning electron microscopy, coulometry
b) atomic absorption spectrometry, potentiometry, dilatometry
c) infrared spectrometry, scanning electron microscopy, dilatometry

58. Scanning probe microscope for testing the surface properties of materials in which the deflection of a lever (beam) with a measuring blade is analysed under the forces of interaction between the blade atoms and the atoms forming the surface being studied. Beam bending is the processing of a current signal by a detector, which is then used to generate a sample image. It is a microscope:

a) Atomic Force Microscope (AFM)
b) Scanning Tunneling Microscope (STM)
c) Scanning Electron Microscope (SEM)

59. Lyophilisation is proces based on:

a) drying of solids at elevated temperature under reduced pressure
b) drying of solid materials at room temperature or below freezing under increased pressure
c) drying of solid materials at room temperature or below zero under reduced pressure

60. Thermal differential analysis (DTA):

a) a technique which consists in recording the difference in temperature between the test substance and the reference substance, relative to time or temperature
b) is the technique by which the difference of the thermal fluxes to the reference sample is measured as a function of temperature
c) technique to measure the difference between the test sample and the reference sample of the thermal fluxes under the influence of temperature changes imposed on them.

61. A system is a certain part of the universe that is the subject of given considerations, and the environment is all that is outside the system. If we consider an open system, then:

a) between the system and the environment there is an exchange of matter but not energy
b) energy flows between the system and the environment and no matter is exchanged
c) there is an exchange of matter and energy between the system and the environment

62. Provide technologies used in precision casting:

a) Shaw technology
b) full-form technology
c) technology in permanent forms

63. Using templates, it is possible to produce:

a) in artistic foundry technology
b) for mechanised (automated) moulding
c) for manual moulding

64. Moulding with loose parts of the mould is used:

a) for mechanised (automated) moulding
b) for manual moulding (artistic)
c) in precision casting

65. Which of the listed stresses are tangential:

a) compressive
b) twisting
c) tensile

66. An example of a direct connection is a connection:

a) rivets
b) propeller
c) welded

67. An example of an indirect connection is a connection:

a) rivets
b) injected
c) glued

68. What kind of cast iron would you choose as material for work in conditions of a stroke:

a) grey
b) white
c) nodular

69. As a result of recrystallization in the microstructure of an alloy:

a) a grain density decreases
b) a grain density increases
c) recrystallization does not affect grain density

70. An example of a line defect is:

a) a vacancy
b) a screw dislocation
c) a twin boundary

71. Metal alloys forming a solid solution of an unlimited mutual solubility are:

a) plastic
b) brittle
c) high tensile strength

72. Alloys for working at high temperatures (above 600 °C) are:

a) aluminium and silicon alloys
b) iron and chrome alloys
c) iron and manganese alloys

73. Which of the given elements belongs to the group of refractory metals:

a) magnesium
b) tin
c) molybdenum

74. Which of the given elements belongs to the so-called rare-earth metals:

a) zinc
b) cerium
c) manganese

75. An example of a zinc mineral is:

a) calamine
b) olivine
c) hematite

76. The characteristics of copper are:

a) very good castability
b) a melting point above 1180 °C
c) good electrical conductivity

77. Hydrogen in aluminium alloys:

a) increases elongation
b) reduces the specific gravity of the castings
c) makes it possible to strengthen castings by heat treatment

78. Metallographic examination enables:

a) analysis of properties of metal materials
b) understanding the microstructure of metals and alloys
c) a precise assessment of impact strength based on microscopic image

79. Zinc alloys are most commonly cast in the following foundry engineering process:

a) sand moulds
b) cold-chamber die casting
c) hot-chamber pressure casting

80. Brass is an alloy:

a) copper with tin
b) copper with zinc
c) copper with tin and zinc

81. Bronze is an alloy:

a) copper with tin
b) characterized by a lower price per kilogram compared to aluminium alloys
c) with much better thermal and electrical conductivity than copper

82. The Young's modulus is a material constant which defines:

a) the ratio of shear stress to elongation
b) the ratio of normal stress to relative strain
c) the ratio of the non-dilatational strain to the relative strain

83. A clay binder is a binding material for the making of moulding sand with:

a) with furfuryl resin
b) phenolic resin
c) bentonite

84. The most commonly used material for the matrix of moulding sands with resins is:

a) alkali resin
b) chromite sand
c) high-silica sand

85. Liquid metal is transported to the pouring station of the casting moulds by using:

a) a monorail ladle
b) a crane
c) an ingot stripper

86. An optimal device for the making classic moulding sand with bentonite is:

a) a continuous whirl mixer
b) an edge runner mixer
c) a fluidized-bed dryer

87. The process of regeneration of used mass is aimed at:

a) recovering a sand matrix from used moulding sand
b) the separation of metal impurities from used moulding sand
c) recovering binder from used moulding sand

88. Materials for a sand matrix should be characterized by:

a) resistance to high temperature
b) high thermal expansion
c) occurrence of polymorphic changes

89. A moulding sand refreshing process is used for:

a) moulding sand with furfuryl resin
b) coated sand
c) moulding sand with bentonite

90. The group of moulding sand with organic binders includes:

a) moulding sand with waterglass
b) moulding sand with bentonite
c) moulding sand with alkyd binder

91. During the inoculation of silumin, the degree of undercooling ΔT during the eutectic solidification:

a) does not change
b) decreases
c) increases

92. During the inoculation of cast iron, the degree of undercooling ΔT during the eutectic solidification:

a) does not change
b) decreases
c) increases

93. With the increase of the eutectic growth rate, the tensile strength R_m of a casting:

a) does not change
b) decreases
c) increases

94. The dispersion in statistics is:

a) the difference between the largest and the smallest measurement
b) the quotient of the largest and the smallest measurement
c) the average of measurements

95. What does calorimetry deal with:

a) temperature measurement
b) measurement of temperature difference
c) measurement of heat

96. The solidification temperature of an alloy can be determined by:

a) the first derivative dT/dt
b) a cooling curve
c) the area under a cooling curve

97. The thermocouple is:

a) two different materials connected at one end, such as pure metals, alloys, non-metals
b) a temperature sensor using the phenomenon of electrical resistance
c) a metal wire with different thermal conductivity

98. The temperature range of using a "K" type thermocouple is:

a) from 200 to 900°C
b) from 25 to 1500°C
c) from 200 to 1200°C

99. Temperature sensors do not use the following phenomenon to measure temperature:

a) changes in pressure
b) changes in electric voltage
c) changes in resistance

100. If the function describing the temperature field depends on time, then this field is called:

a) non-stationary
b) stationary
c) source field

101. According to Fourier's theory, the density of a heat flux is:

a) inversely proportional to the temperature gradient
b) directly proportional to the temperature gradient
c) equal to the temperature gradient

102. The casting inclination on a casting pattern allows:

a) to remove a casting from the mould
b) to remove a core from the mould
c) to remove a pattern from the mould