list of questions - exam on second-cycle studies- Chemical Technology WEiP

1. Absorption methods of separating natural gasoline from natural gas involve:
   A) natural gasoline removal from natural gas by means of its absorption in methanol, and next its desorption methanol with steam at a temperature of 150-160 ℃
   B) natural gasoline removal from natural gas by means of its absorption in wash oil, and next its desorption from used oil with steam at a temperature of 100-110 ℃
   C) natural gasoline removal from natural gas by means of its absorption in wash oil, and next its desorption in steamed oil at a temperature of 150-160 ℃
   D) stabilized gasoline removal from natural gas by means of its absorption in wash oil, and next its desorption in steamed oil at a temperature of 150-160 ℃
2. Specific heat of gas is dependent on:
   A) type of gas only
   B) gas pressure
   C) gas temperature
   D) all listed factors
3. The period of a half-transition of a second-order process (2A = two products) is:
   A) independent of the initial concentration A
   B) inversely proportional to the initial concentration A
   C) directly proportional to the initial concentration A
   D) logarithm of the initial concentration A
4. The metallic character of elements in the same group increases together with the atomic number because:
   A) nuclear charge increases, which intensifies interaction between nucleus and electrons
   B) greater atomic number indicates increased number of electrons and higher electronegativity
   C) the number of valence electrons increases
   D) atomic radii of elements grow, which facilitates ionization
5. A thermodynamic system is adequately described by:
   A) chemical composition
   B) extensive parameters
   C) temperature, pressure, the number of system components:
   D) intensive parameters
6. The velocity constant of a second-order reaction can be expressed in :
   A) [mol · m-3 · s-1]
   B) [cm3 · molecule-1 · s-1]
   C) [dm3 · mol-1 · min-1]
   D) [molecule · cm-3 · s-1]
7. The calorimetric combustion temperature refers to:
   A) stoichiometric combustion not taking into account the exhaust gas dissociation
   B) surplus air combustion taking into account the heating of air and fuel
   C) surplus air combustion
   D) stoichiometric combustion taking into account the exhaust gas dissociation
8. Under conditions of the commercial coking chamber, heated charge exerts the greatest force on the chamber walls:
   A) after 2/3 of coking time, when two plastic layers meet in the tar seam axis
   B) after 1/3 of the coking time, as a result of the total moisture evaporation
   C) directly after charging the chamber with the coal blend
   D) directly before discharging coke from the chamber
9. The ammonia synthesis process:
   A) the correct answers are: [entails a decrease in the volume, so it is advisable to conduct the process at an increased pressure] and [is an endothermic reaction and therefore it is conducted at a high temperature]
   B) entails a decrease in the volume, so it is advisable to conduct the process at an increased pressure
   C) is catalyzed by Cu-ZnO-Al2O3
   D) is an endothermic reaction and therefore it is conducted at a high temperature
10. Special-risk work posing a threat to human health and life should be performed by:
    A) minimum 3 persons
    B) one person
    C) minimum 2 persons
    D) only brigades of specialized companies
11. The proper assembly of machinery and equipment with regard to obtaining an increasing reduction ratio is:
    A) a jaw crusher, an air jet mill, a tumbling mill
    B) a jaw crusher, a tumbling mill, an air jet mill
    C) a jaw crusher, a roll crusher, a colloid mill
    D) a ball-and-race-type pulverizer mill, a roll crusher, a jaw crusher
12. Sankey’s graph is a:
    A) scheme of the exchange of mass and heat in a technological process
    B) scheme of a technological installation

C) graphic display of the cost of manufacturing 1 kilo of the product
D) mass and/or energetic balance of a technological process shown as a stream graph

13. Temperature sensors which require the electric power supply directly to the sensors are:
A) resistance temperature sensors [for example PT100]
B) thermistors [for example NPC]
C) electronic sensors [such as DS18S20, LM35]
D) thermocouples [K type]

14. Which of metallic nitrides is characterized by very high hardness, very good electrical conductivity and gold colour?:
A) titanium nitride [TiN]
B) aluminum nitride [Al N]
C) silicon nitride [Si3N4]
D) indium nitride [InN]

15. A spark-ignition combustion cycle is referred to as:
A) Otto cycle
B) Ericson cycle
C) Brayton cycle
D) Linde cycle

16. Avogadro's law specifies:
A) universal gas constant
B) the number of a molecule's degrees of freedom
C) gas volume under normal conditions
D) the number of molecules in one mol of substance

17. It can be assumed that in an axial machine, unlike in a radial one:
A) the relative velocity between the rotor inlet [1] and the rotor discharge [2] increases W1=W2
B) the relative velocity between the rotor inlet [1] and rotor discharge [2] is constant: C1=C2
C) the relative velocity between the rotor inlet [1] and discharge [2] decreases: W1=W2
D) the relative velocity between the rotor inlet [1] and discharge [2] is constant: W1=W2

18. In practice, mass transfer coefficients are calculated :
A) as the inverse of the convection resistance coefficients
B) the transfer coefficients cannot be calculated
C) as a sum of the diffusion coefficient and the coefficient of convection transmission proportionality
D) from criterion equations

19. Vapour pressure over a drop of liquid is:
A) higher than over a flat surface
B) does not depend on the shape of a surface
C) lower than the one over a flat surface
D) the same as the one over a flat surface

20. An ammonium ion can be detected using:
A) water
B) acetone
C) Nessler's reagent
D) it can not be detected

21. Benzene can be visually distinguished from cyclohexene by reactions:
A) of combustion, with hydrazine, with a solution of bromine in tetrachloromethane
B) of ozonolysis, with sodium hydroxide, with a solution of potassium manganate[VII]
C) with a Grignard reagent, with a solution of bromine in tetrachloromethane, with sulphuric[VI] acid
D) of combustion, with a solution of potassium manganate[VII], with a solution of bromine in tetrachloromethane

22. Atomic emission spectroscopy [AES] is one of the methods:
A) qualitative and quantitative methods
B) neither qualitative nor quantitative determination is possible
C) qualitative only
D) quantitative only

23. Steady-state heat exchange in a combined process applies to:
A) heat transfer on both sides of the barrier
B) heat penetration through barriers
C) accumulation and giving up heat by the barriers
D) heat conduction through barrier elements

24. The solid sodium hydroxide is hygroscopic, which means that:
A) it is highly soluble in water and the dissolution process is endoenergetic
B) it absorbs water vapor from the air very well
C) it is highly soluble in water
D) it is highly soluble in water and the dissolution process is exoenergetic

25. The flammable properties of a gas include:
A) the gross calorific value, the net calorific value and the relative density of the gas
B) the gross calorific value, the net calorific value and the normal combustion rate of the gas
C) the gross calorific value and the net calorific value of the gas as well as the theoretical demand for air necessary for combustion to take place
D) the flammability limits, the flash point, the autoignition temperature and the normal combustion rate of the gas

26. The reaction between acetyl chloride and aniline in the presence of a catalyst [iron trichloride] proceeds according to the mechanism of:
    A) electrophilic addition
    B) nucleophilic substitution
    C) electrophilic substitution
    D) nucleophilic addition
27. In order to separate aldehyde from alcohol-ketone solution, it is necessary to use:
    A) hydroxylamine
    B) ammonia
    C) a Grignard reagent
    D) sodium bisulphate[III]
28. 5% sulfated crude oil can be included in:
    A) oils of average content of sulfur
    B) sulfuric oils
    C) high-sulfuric oils
    D) low-sulfuric oils
29. Atomic ratio of hydrogen to oxygen [in the presence of heteroatoms of O and N] for coal and liquid fuels is equal to:
    A) in H/C coals about 2 ÷ 2.5 while in crude oil and petrol 1 ÷ 1.5
    B) in H/C coals about 1 ÷ 1.5 while crude oil and petrol 2 ÷ 2.5
    C) in H/C coals about 1.75 ÷ 1.95 while in crude oil and petrol 0.7 ÷ 0.8
    D) in H/C coals about 0.7 ÷ 0.8, while in crude oil and petrol 1.75 ÷–1.95
30. One of heating/cooling methods is the use of heat regenerators. A heat regenerator is a :
    A) solid which continuously receives and releases thermal energy
    B) material which absorbs or releases the excess heat as a result of phase transition
    C) expedient flowing through a membrane heat exchanger, and bringing about cooling or heating
    D) substance which absorbs and releases heat as a result of a chemical reaction
31. Van der Waals forces are:
    A) dipole-dipole interactions
    B) inductive interactions
    C) dispersive interactions
    D) ion-ion interactions
32. For natural gas distributed via high-pressure natural gas network, the maximum permissible moisture content according to the Polish norms:
    A) is defined by means of the dew point at a pressure of 5.5 MPa separately for the periods from 1 April to 30 September and from 1 October to 31 March
    B) is not defined
    C) is defined by means of the dew point at a pressure of 5.5 MPa for the period 1 October to 31 March and for the period from 1 April to 30 September is not defined
    D) is defined by means of the dew point at a pressure of 101.325 kPa separately for the periods from 1 April to 30 September and from 1 October to 31 March
33. The CO-shift process is:
    A) none of the answers is correct
    B) afterburning of carbon monoxide to carbon dioxide
    C) obtaining carbon monoxide from methane
    D) steam conversion of carbon monoxide to hydrogen and carbon dioxide
34. A degree of conversion is a:
    A) ratio of the amount of the substrate after the reaction to the initial amount of this substrate
    B) total efficiency of this process
    C) temporary efficiency of this process
    D) ratio of the amount of the product to the final amount of the product
35. One of the cooling/heating methods is the application of heat regenerators. The term “heat regenerator” may refer to:
    A) a solid absorbing and emitting thermal energy
    B) a material that absorbs or emits surplus heat as a result of a phase transition
    C) a medium that flows through a membrane heat exchanger causing cooling or heating
    D) a substance that absorbs or emits heat as a result of a chemical reaction
36. The BET adsorption isotherm makes it possible to calculate:
    A) the amount of adsorbate creating a monolayer
    B) adsorption warmth
    C) volume of the adsorbent’s micropores
    D) the specific surface of the adsorbent
37. The NSC (Nippon Steel Co.) method determines:
    A) CSR index, defining coke strength, after the reaction with CO2, CRI index, defining the the reactivity, and the size distribution of the examined coke
    B) CRI index, defining coke strength after the reaction with CO2, CSR index, defining the examined coke reactivity, and its sieve composition
    C) CSR index, defining coke strength after the reaction with CO2, and CRI index, defining the examined coke reactivity
    D) CRI index, defining coke strength after the reaction with CO2, and CSR coefficient, defining the examined coke reactivity
38. Heat transfer by natural convection in open space is described by equation:

A) Nu=f[Re, Pr]
B) Nu=f[Gr, Pr]
C) Nu=f[Re, Gr, Pr]
D) Nu=f[Re, Gr]

39. There is a dependence for heat penetration in conditions of forced convection:
A) Nu = f [Re, Pr]
B) Nu = f [Gr, Pr]
C) Nu = f [Re, Gr]
D) Nu = f [Re, Gr, Pr]

40. It is true that the rectification process:
A) occurs in all types of distillation stills
B) requires that the substances undergoing this process do not mix with one another
C) takes place in evaporators
D) consists in steam enrichment in a more volatile component during a counter-current contact of the liquid with the steam, with a simultaneous exchange of mass and heat

41. An open system interacts with its surroundings through:
A) transport of mass, heat and work
B) volume change
C) temperature change
D) work or heat

42. What does not favour the formation of pure metal nitrides from oxide precursors [change of strong M – O bond into M – N, M = metal]:
A) the presence of equilibrium amounts of the forming water vapour
B) reactions occurring in a flow reactor with the displacement of gaseous products
C) the presence of coal in the system, because of its reduction properties
D) the presence of hydrogen of strong affinity for oxygen

43. Which of the below mentioned is not a stage of mass penetration according to the two bordering layers theory:
A) convection from the gaseous phase core to the laminar border layer, diffusion through the border layer, conduction through the mirror, diffusion through the border layer of the liquid phase, convection to the liquid phase core
B) mass penetration to the surface of the interface contact , mass conduction through the surface of the interface contact, mass penetration into the second phase core
C) diffusion from the phase core to the contact phase surface, convection through the mirror, diffusion to the second phase core
D) convection from the liquid phase core to the laminar border layer, diffusion through the border layer, conduction through the mirror, diffusion through the border layer of gaseous phase, convection to the gaseous phase core

44. The dwell time of coal inside a gasifier is the shortest in case of :
A) an entrained bed
B) it is independent of the type of bed
C) a moving bed
D) a fluidized bed

45. A mer is:
A) a name for a group of chemical compounds which create polymers
B) a name for an element of polymeric chain
C) a product of depolymerization
D) a conventional name for a particle creating a colloid

46. In order to distinguish different bond orders of alcohols, are used:
A) reaction with sodium hydroxide, etherification, oxidation
B) a Grignard reagent, esterification, reaction with sodium
C) Lucas test, Tollens' test, reaction with sodium hydroxide
D) Lucas test, esterification, reaction with sodium

47. Mass transfer is the transport of mass between:
A) any two chosen layers in one phase
B) the core of the liquid and the interface surface
C) gaseous phase core and liquid phase core
D) the cores of two contacting liquids

48. The oxidation methods utilizing oxidants stronger than oxygen in atmospheric air for the purposes of regenerating the spent cleaning solution include:
A) the Vetrocoke and Stretford methods
B) the Takahax and Perox methods
C) the Stretford and Takahax methods
D) the Stretford and Perox methods

49. An element is a collection of atoms of:
A) different atomic number
B) the same mass number
C) the same number of neutrons
D) the same electric charge of the nucleus

50. Repairs of gas pipelines can be performed by:
A) any personnel member of a company

B) only specialized external companies
C) a person holding suitable qualifications obtained in a state certification exam
D) only a trained person

51. Which of the following statements concerning convective mass transfer are true:
A) Forced convection takes place when liquid particles are given velocity in a mechanical way, e.g. using pumps
B) Convective mass transfer in liquids and gases may occur as a result of particles being lifted by the velocity field
C) Natural convection takes place when movement is the result of physical phenomena, e.g. gravitation
D) Convective transfer is essential for diffusion processes.

52. Which of the following reactions does not require the use of catalysts?:
A) fat hardening
B) ammonia synthesis
C) oxidation of SO2 to SO3
D) obtaining soda with Solvay's method

53. The adsorption methods for gaseous fuels desulphurization include:
A) desulphurization processes over bog iron and preliminary separation
B) desulphurization over activated carbon and the Perox process
C) all dry methods and the Rectisol process
D) desulphurization processes over bog iron and activated carbon

54. The most reactive non-metal is:
A) fluorine
B) oxygen
C) iodine
D) carbon

55. A catalyst is a substance which:
A) changes the course of a reaction
B) accelerates a reaction
C) reduces a reaction velocity
D) changes a constant of a reaction balance

56. The overall vapour pressure of an ideal solution is related to vapour composition by:
A) is not related
B) a nonlinear dependence
C) a linear dependence
D) an exponential dependence

57. Gases A and B in a gas mixture have the same molar fraction and the ratio of their mole mass is MA/MB=2. What is the ratio of their gas constants RA/RB=?
A) RA/RB=2
B) RA/RB=1
C) RA/RB=1/2
D) RA/RB=2/3

58. During heating of a cylinder of a diameter of 5cm and a height of 7cm, for the first 15 minutes of the process there was a change of non-dimensional temperature of about 0,25 in the centre of the base. Will a subsequent change be of the same value?:
A) it can't be determined only on the basis of these data
B) longer than 15 min.
C) also 15 min.
D) shorter than 15 min.

59. When gas absorbs thermal energy of 200 J and expands by 500 cm3 against constant pressure 2*105 [N/m2], the change of internal energy equals:
A) + 300 J
B) – 100 J
C) + 100 J
D) – 300 J

60. A production installation is:
A) all the answers are correct
B) an assembly of basic manufacturing equipment and instruments intended to conduct a technological process which interact with one another according to a particular plan
C) an assembly of equipment and instruments [usually located at a separate lot] intended to conduct a technological process in accordance with a particular technical concept
D) an organized group of activities called unit operations or unit processes as a result of which a given raw material is transformed into a desired product

61. 1-butanol can be distinguished from 2-methyl-2-propanol by:
A) oxidation together with Tollens' test
B) sulfonation
C) oxidation by potassium manganate[VII]
D) nitration

62. An upper-tier establishment is a facility:
A) which performs activities that are life- and health-threatening to the employees
B) which exceeds the upper threshold of the hazardous substances inventory specified by the EU

C) which performs activities that are harmful to the environment
D) whose production volumes of hazardous substances exceed the standards established for it by a competent minister

63. An ionic bond is formed between elements characterized by:
A) electronegativity differences do not affect the ability to form specific types of bonds
B) the biggest electronegativity difference
C) the smallest electronegativity difference
D) identical electronegativity values

64. Acyl derivatives of carboxylic acids include:
A) ethers, amides, acid anhydrides and halides
B) esters, nitriles, acid amides and anhydrides
C) alcohols, esters, acid amides and halides
D) acid halides and anhydrides, acid esters and amides

65. Petroleum fractional content :
A) informs what products can be obtained from it
B) informs about the content of a fraction with a defined range of temperatures of boiling
C) informs about the origin of petroleum
D) can be determined by distillation

66. Volume occupied by 1 mole of helium under pressure 105 [N/m2] at temperature 1000 K is approximately equal to:
A) 83 dm3
B) 108 dm3
C) 770 dm3
D) 22.4 dm3

67. Which mines extract lignite:
A) Turów
B) Halemba
C) Konin
D) Sieniawa

68. The Office of Technical Inspection deals with:
A) supervision of business operations
B) preparation of commissioning documentation for industrial installations
C) admission and supervision of equipment operation posing a serious threat to human life and health
D) supervision of industrial production

69. During thermal cracking of a petroleum fraction, the basic process consists in:
A) reaction of carbocation occurrence
B) all the answers are correct
C) catalytic cleavage of C-C bonds
D) disruption of C-C bonds of hydrocarbons

70. The highest number of electrons of the same principal quantum number is:
A) 2n
B) n/2
C) $2n^2$
D) n

71. Exergy expresses:
A) the system’s ability to perform the maximal work
B) mechanical and thermal energy of a system or a substance
C) properties of a substance in equilibrium with its ambience
D) the system’s ability to overcome the losses

72. To the solvent refining of petroleum products the following are used:
A) solvents of a big dipole point
B) arenes
C) furfural , phenol
D) cycloalkanes

73. Which of the following is a bad conductor of heat:
A) bricks
B) water
C) Styrofoam
D) copper

74. The weight ratio of carbon to hydrogen and oxygen in benzoic acid is:
A) 84:6:32
B) 72:6:16
C) 84:7:2
D) 7:6:2

75. Thermistor whose resistivity decreases with temperature is referred to as:
A) CTR resistor
B) PTC resistor
C) PMV resistor
D) NTC resistor

76. The efficiency of gas compression or expansion is determined in relation to :

A) isotermic process
B) adiabatic process
C) isobaric process
D) isentropic process

77. According to the Renewable Energy Sources Act, biomass does not include:
A) agricultural residues of biological origin which undergo biodegradation
B) biodegradable part of sewage sludge
C) biodegradable waste from fishing
D) bioliquids used for energy purposes other than transportation

78. The Nusselt number is:
A) a number used for calculating the coefficient of heat penetration
B) a name for the product of Re and Pr
C) a determining number
D) an analog of the Biot number for the processes of heat penetration

79. Efficiency of the counter-clockwise process represents:
A) the values of evaporation and condensation temperature
B) thermal efficiency of the cycle
C) work or power output of the plant only
D) efficiency of the heating or cooling process

80. The homologues of benzene are:
A) phenol
B) toluene
C) aniline
D) naphthalene

81. In the case of natural gas desiccation for the purposes of its pipeline transport under high pressure, the following methods are commonly used:
A) ethylene glycol absorption methods, since they ensure the highest level of gas desiccation
B) methods involving gas cooling
C) adsorption methods
D) ethylene glycol absorption methods, since they ensure sufficient gas desiccation

82. A PCA (Polish Centre for Accreditation) auditor is:
A) a person performing an advisory role at the workplace
B) a person authorized to audit companies, employed by the Management Board of the audited company
C) a freelance specialist auditing a company at the request of an accrediting authority
D) a person auditing the company at the request of the Management Board

83. The simultaneity factor for gas delivery:
A) is an indicator describing the gas-flow uniformity of in particular rings of the distribution network per day
B) expresses the ratio of the actual gas delivery to the amount of gas resulting from the efficiency of the installed appliances
C) denotes the number of consumers receiving gas from the distribution network at the same time
D) is an indicator describing the gas-flow uniformity in particular rings of the distribution network per year

84. In the production process of nitric acid [V], the expected product of ammonia oxidation is:
A) NO2
B) NO
C) N2O
D) N2

85. Ionic strength of a water solution of barium chloride of a concentration of 0.1 [mole·kg-1] is equal to :
A) 0.3 [mole · kg-1]
B) 0.1 [mole · kg-1]
C) 0.15 [mole · kg-1]
D) 0.2 [mole · kg-1]

86. A transport number t+= 0 in:
A) semiconductors
B) metallic conductors
C) complex conductors
D) ionic conductors

87. When several pumps are connected in parallel it can be assumed that:
A) the head [H] remains constant, but the capacity of the system [Q] increases
B) the capacity of the system [Q] and the head remain the same
C) the capacity of the system [Q] remains constant, but the head [H] increases
D) the capacity of the system [Q] increase, but the head [H] decreases

88. In the processes of hydrofining of petroleum products the following are mainly removed:
A) combinations S, O, N
B) naphthenes
C) paraffins
D) aromas

89. Having available appropriate fluxes and concentrations, mass flux of component A can be represented as:
A) a product of a molar fraction of the component A and the mixture molar flow rate
B) a product of a mass fraction of the component A and the mass rate of the mixture flow

C) a product of the mass ratio of the component A and the inert molar flow rate
D) a product of the component A volume fraction and the mass rate of the inert flow

90. Toluene in reaction with chlorine in the presence of $FeCl_3$ yields predominantly:
A) 3-chlorotoluene
B) 2-chlorotoluene
C) a mixture of 2-chlorotoluene and 3-chlorotoluene
D) a mixture of 2-chlorotoluene and 4-chlorotoluene

91. The separation of suspended solids from liquids takes place in the following devices:
A) filter presses, sedimentation tanks, fabric filters
B) filter presses, sedimentation tanks, centrifugal separators
C) electrostatic precipitators, absorbers, fabric filters
D) fabric filters, cyclones, dust sedimentation chambers

92. Choose the best heat conductor from the list:
A) peat
B) graphite
C) brown coal
D) hard coal

93. On the basis of Newman's rule one measures:
A) absolute temperature or temperature in Celsius degrees
B) non-dimensional temperature
C) absolute temperature
D) only temperature in Celsius degrees

94. The remnants of plant fragments from which coal was formed, differing in chemical, physicochemical and mechanical properties, are called:
A) carbominerytes
B) microlithotypes
C) macerals
D) lithotypes

95. Petrol of high octane content is obtained in the process of:
A) crude oil distillation
B) cracking of crude oil fraction
C) hard coal coking
D) pyrolysis of crude oil fraction

96. 2-pentene can be distinguished from 1-pentene by:
A) ozonolysis
B) oxidation with atmospheric oxygen
C) the differences in miscibility with water
D) reaction with the solution of bromine in tetrachloromethane

97. The most accurate evaluation of petroleum quality can be conducted on the basis of :
A) technological classification
B) geological classification
C) basic physicochemical designations
D) classification based on density

98. Ash is:
A) a solid residue after the combustion of a solid fuel under temperature and time conditions specified by Polish or ISO standards, expressed in % of the initial mass of the sample
B) a synonym of coal mineral substance
C) solid residue after the pyrolysis of a solid fuel under temperature and time conditions specified by Polish or ISO standards, expressed in % of the initial mass of the sample
D) the mass loss of a sample after the combustion of a solid fuel under temperature and time conditions specified by Polish or ISO standards, expressed in % of the initial mass of the sample

99. The calculated value of the linear coefficient of heat penetration for a cylindrical wall is equal to 10W/[mK] and the difference between temperatures of expedients is equal to 100oC. In this case, thermal waste will be:
A) about 3140 W/m
B) 1000 W/m
C) 10 W/m
D) about 31.4 W/m

100. The process of carbothermal reduction/ nitriding of obtaining metal nitrides uses:
A) a mixture of hydrogen and ammonia
B) atmosphere of pure ammonia in equilibrium with hydrogen and nitrogen
C) a mixture of hydrogen and nitrogen
D) a mixture of coal or its compound and a nitriding factor

101. The term "distribution pressure drop" refers to:
A) a pressure drop during the flow of gas through a pipe of the unit diameter
B) a difference between the main supplying point and the first branching in the network
C) a pressure drop in a network section of the unit length
D) a difference between the design maximum pressure and the design minimum pressure in the network

102. A mixture of fats decomposing at the boiling point can be separated by:

A) simple [atmospheric] distillation
B) liquid chromatography
C) water extraction
D) steam distillation

103. According to the Lambert-Beer law, intensity of light passing through a medium with the concentration c:
A) decreases linearly with concentration
B) increases linearly with concentration
C) decreases exponentially with concentration
D) increases exponentially with concentration

104. The highest theoretical cycle efficiency applies to:
A) engine cycle with heat regeneration
B) a gas turbine in a combined heat and power plant
C) a supercritical cycle in a steam power station
D) the clockwise process in the Carnot cycle

105. According to the optimal use of potential difference principle, each stage of a process should be conducted:
A) at a state which is the furthest from the equilibrium state
B) at an increased temperature and high pressure
C) at a state close to the equilibrium state
D) the answers “at a state close to the equilibrium state” and “at an increased temperature and high pressure” are both correct

106. Conductometry:
A) is an electrochemical method
B) is a selective method
C) is used to determine the pH of solutions
D) is a non-selective method

107. The notion of safety means:
A) proper operation of the relevant MSW services
B) a state of confidence in undertaken proceedings assuming a certain degree of risk
C) a state of confidence in undertaken proceedings which does not lead to hazards or waste
D) proper work station organization

108. For the data set Re=1000, Nu=10, Pr=5, I=0.1m, thermal conductivity coefficient= 0.1 W/[mK], the value of the heat transfer coefficient in W/[m2K] equals:
A) 10
B) 0.1
C) 5
D) 0.001

109. Ideal gas:
A) has a constant internal energy
B) it is a water vapour or water
C) it is gas inside a closed container
D) satisfies the fundamental gas laws

110. The dipole moment of a nitrogen molecule is equal to zero because atoms of nitrogen:
A) undergo sp2 hybridization
B) are not very reactive
C) have equal electronegativity
D) form one sigma bond and two weak pi bonds

111. The distances between gas compressor stations in a gas trunkline (main gas line) are:
A) 80-200 km
B) 5-10 km
C) more than 500 km
D) 30-60 km

112. Heat pump is also referred to as:
A) a refrigerator operated in the heating mode
B) a condensate pump in a steam turbine
C) a pump for handling hot geothermal waters
D) a heat water pump in a heating installation

113. The titration point at which a marked component reacted quantitatively stoichiometrically with titrant added from a burette, is called:
A) equivalence point
B) endpoint
C) quantitative point
D) stoichiometric point

114. The products of an important industrial catalytic combustion of ammonia in oxygen [Pt] are:
A) Dinitrogen monoxide [N2O] and water
B) hydrazine and water
C) nitric oxide NO and water
D) nitrogen and water

115. Van der Waals equation of state describes:

A) properties of gas only
B) the state of a semi-ideal gas
C) properties of liquids and gases
D) properties of liquid only

116. A decrease in the coefficient value of surplus air flow will cause:
A) a decrease in the combustion temperature
B) an increase in the combustion temperature
C) does not have any effect on the combustion temperature
D) for gaseous fuels: an increase in the combustion temperature, while for solid fuels: a decrease in the combustion temperature

117. An atom which gained a certain number of electrons to create an 8-electron valance shell is:
A) a nucleon
B) an anion
C) a cation
D) an electron

118. An industrial method of obtaining metallic sodium is:
A) an electrolysis of NaCl solution
B) a fused-salt electrolysis of NaCl
C) an electrolysis of the fused NaOH
D) an electrolysis of NaOH solution

119. Which of the mentioned below is not a flow machine:
A) piston displacement compressor
B) centrifugal compressor
C) jet pump
D) radial fan

120. Atomic absorption spectroscopy [AAS] is used for:
A) neither qualitative nor quantitative determination
B) qualitative determination
C) quantitative and qualitative determination
D) quantitative determination

121. Which of the following is not a structural variation of liquid crystals:
A) peritectic variation
B) cholesterin variation
C) smectic variation
D) nematic variation

122. The group of positive displacement pumps may include:
A) piston, gear and sliding vane pumps
B) piston, propeller and screw pumps
C) impeller, piston and gear pumps
D) plunger, sliding vane and gear pumps

123. An ester hydrolysis in the presence of a diluted HCl occurs according to the kinetics of the first-order reaction because:
A) a hydrolysis velocity does not depend on concentration of hydrogen ions
B) there is a big excess of water
C) the concentration of hydrogen ions is generally constant during the reaction
D) acid works as a catalyst

124. Formation of one-size (1structures of the type coal/ nitride/ carbide/various metal or silicon nanotubes/nanowires is catalyzed by:
A) free radicals
B) typical oxide impurities in substrates
C) trace amounts of oxygen in reaction gases [nitriding or constituting inert gas atmosphere]
D) metals, like e.g. iron Fe, cobalt Co, or nickel Ni

125. If the increase in pressure shifts the equilibrium to the right, it can be assumed that:
A) the volume of reactants during a reaction decreases
B) the volume of reactants during a reaction is not changed
C) activation energy increases
D) the volume of reactants during a reaction increases

126. If the composition of vapours leaving the distillation column ymolA=0.822and that of the raw material = xmolA=0.5, and the equilibrium line equation y*molA = 0.311xmolA+0.7707, then the composition of the liquid used up in the equilibrium distillation is:
A) 0.5 kmolA/kmolmix
B) 0.165kmolA/kmolmix
C) 0.392 kmolA/kmolmix
D) 0.027 kmolA/kmolmix

127. In which of the following compounds occur simultaneously covalent polarized, coordinate, and ion bonds:
A) NH_4Cl
B) $MgCl_2$
C) H_2O
D) NaOH

128. Elevation of boiling point is the result of addition of one of the following substances to the solvent:
A) volatile substance
B) Non-volatile substance
C) surface-active substance
D) insoluble substance

129. For positive azeotropes, phase diagrams of the equilibrium of the vapour-liquid systems reveal the presence of:
A) minimum in the isothermal process
B) maximum in the isobaric process
C) minimum in the isobaric process
D) maximum in the isothermal process

130. An example of one-dimensional material is:
A) nanotubes and nanowires
B) none of the above mentioned
C) nano-metre- thin layers
D) quantum dots

131. Indicate which of the sentences is true:
A) Crude oil and natural gas are renewable sources of energy but starch and geothermics are not
B) Ethanol and natural gas are renewable sources of energy but crude oil and biomass are not
C) Starch and wind belong to renewable sources of energy but crude oil and natural gas do not
D) Starch and natural gas belong to renewable sources of energy but crude oil and wind do not

132. In order to evaluate the homogeneity of a coal blend for coke production, the following parameters are used:
A) the mean standard deviation of moisture content in the point samples taken from the cross-section of the layer of coal blend on the conveyor belt
B) the mean value of the volatile matter content in the point samples taken from the cross-section of the layer of coal blend on the conveyor belt
C) the mean standard deviation of volatile matter content in the point samples taken from the longitudinal section of the layer of coal blend on the conveyor belt
D) the mean standard deviation of the volatile matter content in the point samples taken from the cross-section of the layer of coal blend on the conveyor belt

133. The layer-type of the coking process in a commercial chamber represents the following sequence:
A) wet coal blend > dry coal blend > plastic layer > semi-coke > coke
B) dry coal blend> plastic layer > semi-coke > coke
C) wet coal blend > dry coal blend> semi-coke > plastic layer > coke
D) wet coal blend > dry coal blend > semi-coke > coke > plastic layer

134. Among the principles of a technological process performance there is no:
A) principle of energy recovering
B) principle of the most efficient use of materials
C) principle of technological moderation
D) principle of the most effective use of the difference of potentials

135. Thermal conductivity of diamond is:
A) 2000 W/m.K
B) 48 W/m.K
C) 125 W/m.K
D) 20 W/m.K

136. The role of gas stations is to:
A) increase gas pressure prior to its further transmission
B) refuel vehicles powered by CNG [Compressed Natural Gas]
C) measure the amount of gas and reduce its pressure to lower levels
D) prepare gas for its transmission via a gas trunkline [main gas line]

137. A disaster is a result of the following sequence of events:
A) risk -? initiating event -? peak event -? disaster
B) risk -? peak event -? initiating event -? disaster
C) risk -? initiating event -? failure -? disaster
D) initiating event -? peak event -? risk -? disaster

138. The smallest possible fullerene is:
A) C44
B) C60
C) C32
D) C24

139. Which of the following measurements are not taken when determining the thermal comfort parameters and PMV/PPD indicators:
A) radiant temperature measurements with a black ball
B) airflow velocity measurements taken with a thermal anemometer
C) relative humidity of air measurements with a hytherograph
D) solar radiation level measurements taken with a pyrometer

140. In liquids, natural convection:
A) does not occur when forced convection takes place
B) does not occur on the moon

C) occurs, provided that it is simultaneously accompanied by conduction
D) always occurs

141. On the basis of which conductors do we build structures of mixed nitrides for blue light emitters, which are used e.g. in Blue-ray or blue diode technologies?
A) passivation of nanograin surface
B) large relative share of particles/atoms in the surface layer of nanocrystalite
C) strong inter-grain interactions
D) instability of the nanocrystalite structure

142. Which of the following compounds is the strongest acid:
A) $HClO_3$
B) $HClO_4$
C) HClO
D) $HClO_2$

143. Which of the following unit operations can be performed in industrial conditions using counter-current flow:
A) drying
B) sublimation
C) centrifugation
D) sedimentation

144. Apparent density of expanded graphite is in the range of:
A) 4 - 5 kg/m3
B) 5 – 8 kg/m3
C) 0.5 – 2kg/m3
D) 8 – 10 kg/m3

145. The temperature of one edge of a flat wall is equal to 530oC, and in half of the distance between two edges the temperature is of 520oC. The thickness of the wall is equal to 0.1m. Density of the material used for the wall is equal to 1000kg/m3, the coefficient of thermal conduction is 1W/[mK]. Thermal waste is in [W/[m2K]] and in this case it is equal to:
A) 200
B) 100
C) 20
D) 10

146. The dual-pressure nitric acid manufacturing process means that:
A) the adsorption process takes place in two columns at different pressures
B) the installation is suitable for operating at two different pressures depending on the expected output from the manufacturing process
C) the oxidation process takes place in two reactors at different pressures
D) the oxidation process and the adsorption process take place at different pressures

147. Which of the statements concerning the distillation process are true:
A) The change of phase composition enables the mixture separation through distillation
B) Distillation is the separation of a liquid mixture by means of a selective solvent
C) Addition of a selective solvent is essential during the process
D) The difference of the boiling points of the mixture components undergoing distillation is essential for their separation

148. The main source of sulphur dioxide responsible for acid rains are fuel exhausts. The
A) diesel oil
B) city gas
C) hard coal
D) heating oil

149. Acid rains are caused by:
A) carbon dioxide
B) carbon monoxide
C) nitrogen oxides
D) sulphur oxides

150. The role of boiling chips in heating mixtures in a flask is:
A) ensuring uniform heat transfer
B) forcing the appearance of gas bubbles in order to improve mixing
C) protection against decomposition of organic substances
D) protection against overheating of a liquid and ejection from the flask

151. In a high-pressure pipeline, the average pressure:
A) is lower than the arithmetic mean of the initial pressure and the final pressure
B) is equal to the geometric mean of the initial pressure and the final pressure
C) is equal to the arithmetic mean of the initial pressure and the final pressure
D) is higher than the arithmetic mean of the initial pressure and the final pressure

152. Solutions of hydrochloric acid of pH 2 and pH 4 have been prepared. Which of the following statements is true? H^+ ion concentration in the solution:
A) of pH 2 is two times higher than in the solution of pH 4
B) of pH 2 is 100 times higher than in the solution of pH 4
C) of pH 2 is two times lower than in the solution of pH 4
D) of pH 2 is 100 times lower than in the solution of pH 4

153. In a given coal basin, moving from the upper coal beds to the lower coal beds, one can observe:

A) an increase in ash, sulfur, phosphorus, chlorine and alkalies content
B) an increase in coal rank, expressed by a decrease in carbon content and an increase in volatile matter content
C) a decrease in ash, sulfur, phosphorus, chlorine and alkalies content
D) an increase in coal rank, expressed by an increase in carbon content and a decrease in volatile matter content.

154. The speed of a contact-catalyzed reaction does not depend on:
A) the period of the substrates' stay on the catalyst surface
B) specificity of catalyst
C) the catalyst surface
D) the period of the products' stay on the catalyst surface

155. The Quality Book in a chemical laboratory does not specify:
A) the laboratory norms and procedures
B) the manner of documenting the quality system
C) the quality system functioning in a laboratory
D) financing rules and mutual financial settlement requirements for contactors

156. The set of machines co-working with a top charging coke oven battery includes:
A) a charging car, a guide car and a coke quenching car
B) a pushing machine, a charging car, a guide car and a coke quenching car
C) a stamp coal charging machine, a guide car and a coke quenching car
D) a stamp coal charging machine, a charging car, a guide car and a coke quenching car

157. Metals of positive electrochemical potentials react with:
A) concentrated acids, of no oxidizing properties
B) anaerobic acids
C) concentrated acids, of strong oxidizing properties
D) diluted acids, of no oxidizing properties

158. The spontaneous ignition temperature of a fuel gas-air mixture is:
A) the lowest temperature of the container walls at which the mixture will ignite
B) lower than the forced ignition temperature
C) the lowest temperature of an external source of ignition
D) the lowest temperature of this mixture at which its spontaneous ignition can take place

159. Maxwell's law describes the case of:
A) determined convection
B) determined diffusion of a component diffusing through " other" components which can either diffuse in different directions or not move at all
C) only of a component diffusing through "other" , nonmoving components
D) transient diffusion

160. In order to separate a crystallized product from a solution, it is necessary to apply:
A) simple distillation
B) extraction
C) percolation at lower pressure
D) chromatography

161. Three molecules of gas have the velocities: 100, 200, 300 [m/s]. The mean square molecular velocity equals:
A) 216 [m/s]
B) 190 [m/s]
C) 400 [m/s]
D) 200 [m/s]

162. The cryoscopic constant value is dependent on:
A) solute
B) solvent and solute
C) neither solvent nor solute
D) solvent

163. An adiabatic process:
A) is a constant-enthalpy process
B) is a process involving no friction
C) is a process involving no heat exchange
D) is a process when the energy of the system remains constant

164. Indicate the appropriate ending of the sentence: A process of diminishing scale of a technological process is applicable to:
A) hydrodynamic parameters calculation
B) testing the resistance of the apparatus under pressure
C) determination of initial economic indicators of a technological process
D) testing changes/ improvements of a technological process

165. Caloric value depends on the fuel content of:
A) CO, Pb, Ar
B) C, H, O
C) C, He, Po
D) C, Si, Mg

166. Nitrogen at an oxidation state of -3 occurs in combination with:
A) oxygen and hydrogen
B) lithium and hydrogen

C) chlorine and bromine
D) oxygen and chlorine

167. Which is the basic equation describing the operation of turbomachines?:
A) Bernoulli's principle
B) Euler's turbomachinery equation
C) continuity equation
D) otherwise Newton's Law

168. The thermodynamic equilibrium involves:
A) thermal equilibrium [no heat transfer]
B) all listed factors
C) chemical equilibrium [absence of chemical reactions]
D) mechanical equilibrium [of forces and moments of force]

169. The equation of state for an ideal gas at high temperature and under high pressure [taking into account the specific volume of molecules expressed with the factor b) is given as:
A) pV= RT –b
B) pV= RT +b
C) pV=RT+bp
D) pv=bRT

170. Asphaltene-resinous substances can be extracted from petroleum or its fractions by:
A) heating the solution
B) two answers are correct
C) the use of light paraffin solvents
D) the use of aromatic solvents

171. Resolutions of an optical microscope and of a transmission electron microscope (TEM) are:
A) optical 200 nm, TEM 2 nm
B) optical 400 nm, TEM 1.5 nm
C) optical 0.5 µm, TEM 10 nm
D) optical 1µm, TEM 0.22 nm

172. the classes of hard coke for the coking process are denoted by a double-digit code number describing:
A) the lower and upper size limit of coal grains
B) the ash content in dry coal [Ad] and the total moisture content in coal as received [Wrt]:
C) (the Roga index [RI] and the swelling index [SI]
D) the ash content in coal as received and the total moisture content in dry coal [Wdt]

173. Removal of water hardness using soda involves removing from the solution the ions of:
A) sodium
B) calcium
C) sulfate
D) chloride

174. Molar density of the component A diffusion flux is:
A) the number of the component A moles which diffuse in a unit of time through unitary surface, perpendicular to the direction of the component's movement
B) the number of the component A moles that diffuse in any time through unitary surface perpendicular to the direction of the component's movement
C) the number of the component A moles which diffuse in a unit of time through the surface perpendicular to the direction of the component's movement
D) the number of the component A moles which are transferred in a unit of time, in the convection manner, through elementary surface perpendicular to the direction of the component's movement.

175. Devitrificate is:
A) glass of high refractive index
B) tempered glass
C) stained glass
D) partly crystallised glass

176. A chemical hazard is:
A) a hazard related to materials and installations which causes fires, explosions, toxic contaminations and corrosivity
B) a hazard related to terrorist activity
C) a hazard related to incompetent use of chemical substances
D) a hazard related to inhaling chemical substances vapours

177. The essence of a metallic bonding consists in:
A) electrostatic interaction between metal cations and electron gas formed from free electrons
B) electrostatic interaction of ions of opposite signs
C) binding of metal atoms by the magnetic field generated by electron transfer
D) formation of shared electron pairs by valence electrons of metal atoms

178. The gas compressibility factor is used:
A) to characterize gas behavior in the compression process
B) as an adjustment approximating a gas behaviour to an ideal gas behavior
C) to characterise the ability of a gas to reduce the gas pressure in reducers
D) to specify changes in gas composition at gas stations

179. Along with the increase in coal rank:

A) the carbon content increases significantly , while the content of oxygen and hydrogen decreases
B) the carbon and hydrogen content increases significantly , while the oxygen content decreases
C) the content of carbon, oxygen and hydrogen increases significantly
D) the carbon and oxygen content increases significantly, while the hydrogen content decreases

180. Temperature measurements with a thermocouple consist in:
A) measurements of electromotive force on the metal-metal interface
B) measuring the change of electric resistance of the metal-metal interface
C) measuring the intensity of current flow through the junction between the two metals
D) measuring the differences of thermal expansion of the two metals

181. What is the structure of graphite's basic unit cell:
A) tetragonal
B) rhombohedral
C) regular
D) hexagonal

182. At present, the most important industrial way of obtaining ethylene is :
A) hard coal gasification
B) methane conversion
C) pyrolysis of petrols
D) petroleum refining

183. The task of the coke oven battery [COB] binding is to:
A) protect the refractory against excessive emission of heat into the atmosphere
B) protect the refractory during starting-up and operating of the COB
C) protect the refractory against the influence of high temperature
D) transfer thermal and mechanical stresses to the ground

184. The process of disintegration of long hydrocarbon chains into shorter ones, which happens at a high temperature, is called:
A) pyrolysis
B) isomerization
C) depolymerization
D) decarboxylation

185. A criterion of the technological processes division into periodical and continuous processes is :
A) the principle of energy retaining
B) own costs of the product
C) no heat exchange with the surroundings
D) organization of the process

186. According to the Polish norms, the reference conditions for the gaseous fuels combustion process are:
A) the flame temperature of a gaseous fuel and the pressure at which the process takes place
B) the temperature and pressure of the substrates and combustion products
C) the temperature and pressure of the combustion products
D) the temperature and pressure assumed for the purposes of determining the fuel volume which is used as a reference for the declared gross heating value or the net heating value of a gas

187. Which of the following compounds can be used to neutralize hydrochloric acid:
A) oxygen
B) nitric acid
C) hydrosulphuric water
D) potassium hydroxide

188. The Zero law of thermodynamics enables the measurement of:
A) temperature
B) pressure
C) specific heat
D) internal energy

189. Propanal can be distinguished from the propanone by reaction with:
A) water
B) chloric[I] acid
C) ammonia
D) hydrocyanic acid

190. Accreditation of a measurement laboratory is:
A) recognition by the Accreditation [or Licensing] Body of the laboratory's competence to conduct specific activities
B) the permit for conducting business activity by a superior unit
C) recognition by the relevant ministerial Council of the laboratory's competence to conduct specific activities
D) recognition by a superior unit of the laboratory's competence to conduct specific activities

191. Gaseous fuels desulphurization with the Rectisol process is conducted by:
A) adsorption removal of hydrogen sulphide, hydrogen cyanide, organic compounds of sulphur, carbon dioxide, moisture and higher hydrocarbons from a gas, using methanol at a temperature of approx. -70℃ and at a pressure above 1MPa
B) adsorption removal of hydrogen sulphide, hydrogen cyanide, organic compounds of sulphur, carbon dioxide, moisture and higher hydrocarbons from a gas, using methanol at a temperature of approx.-70℃ and at a pressure below 1MPa
C) adsorption removal only of hydrogen sulphide from a gas, using methanol at a temperature of approx. -70℃ and at a pressure above 1MPa

D) adsorption removal of hydrogen sulphide, hydrogen cyanide, organic compounds of sulphur, carbon dioxide, moisture and higher hydrocarbons from a gas, using ethanol at a temperature of approx. -70℃ and at a pressure above 1MPa

192. A typical technological system of a coking coal preparation plant is represented by the following sequence:
A) crushers > flotation -> jig washer -> dense medium washer
B) dense medium washer -> crushers -> jig washer -> flotation
C) crusher -> jig washer -> dense medium washer-> flotation
D) crushers-> dense medium washer -> jig washer -> flotation

193. A typical catalyst used in the synthesis of sulphur acid anhydride [VI] is:
A) oxygen
B) sulphur trioxide
C) sulphur dioxide
D) divanadium pentaoxide

194. Hybridization of atomic orbitals is:
A) delocalisation of electrons over an entire molecule, as in e.g. a benzene molecule
B) a change in the shape of atomic orbitals due to electronegativity differences between atoms forming a bond
C) a purely mathematical treatment leading to calculation of spatial distribution of electrons in molecules
D) mixing wave functions of the atoms forming a bond

195. A typical composition of biogas obtained in fermentation process comprises:
A) methane, argon, carbon dioxide, helium
B) methane, nitrogen, ammonia, carbon dioxide
C) methane, carbon monoxide, carbon dioxide, hydrogen, hydrogen chloride
D) methane, carbon dioxide, ammonia, nitrogen, hydrogen sulfide

196. A commercial process of monomer obtainment for the production of polyethylene is:
A) pyrolysis of petrols
B) conversion of petrols
C) conversion of benzene
D) pyrolysis of benzene

197. The term “recuperator” may not be applied to:
A) a co-current extractor
B) packed absorption column
C) a membrane heat exchanger
D) a membraneless heat exchanger

198. The combustion of 2 m3 of ethane releases:
A) 6 m3 of CO2
B) 1 m3 of CO2
C) 2 m3 of CO2
D) 4 m3 of CO2

199. The boundary pressure value distinguishing low and medium pressure networks is:
A) 1 kPa
B) 0.4 kPa
C) 1 Mpa
D) 10 kPa

200. Controlling the combustion process with the Ostwald triangle enables to:
A) determine the amount of the air for combustion and the composition of the exhaust gases
B) determine the composition of the exhaust gases
C) determine the calorimetric combustion temperature and the exhaust gas dissociation
D) determine the CO2 concentration in the exhaust gases and the coefficient of surplus air flow

201. Thermodynamic cycle stands for:
A) duty cycle of an engine or a heat pump
B) water heating and cooling
C) operation of a heat exchanger
D) a number of subsequent processes

202. The second law of thermodynamics:
A) defines entropy
B) defines efficiency
C) defines heat
D) defines enthalpy

203. According to the classification of gaseous fuels which is applied in Poland, the classification parameters are:
A) the gross heating value, the net calorific value or the Wobbe index
B) the gross heating value, the main constituents content or the Wobbe index
C) the gross heating value, the Wobbe index or the pressure before the customers’ appliances using gaseous fuels
D) the gross heating value, the Wobbe index or the major contaminants content

204. A separatory funnel is used for:
A) separation of two immiscible liquids
B) crystallization
C) decantation
D) separation of two miscible liquids

205. For most liquids, the molar entropy of vaporization at normal boiling temperature equals:

A) 20 [JK-1 mol-1]
B) 25 [JK-1 mol-1]
C) 8.3 [JK-1 mol-1]
D) 85 [JK-1 mol-1]

206. The following layout describes a typical arrangement of a by-products department:
A) a gas collecting main -› a primary cooler -› exhausters -› an electrofilter -› an ammonia recovery plant -›a final cooler -› a crude benzol recovery plant -› a desulphurization installation,
B) a gas collecting main -› a desulphurization installation -› exhausters -› an electrofilter -›an ammonia recovery plant -› a final cooler -› a crude benzol recovery plant -› a primary cooler
C) a gas collecting main -› a primary cooler -› exhausters -› an electrofilter -› an ammonia recovery plant -› a desulphurization installation -› a crude benzol recovery plant -› a final cooler
D) a gas collecting main -› a primary cooler -› exhausters -› an electrofilter -› a final cooler -› an ammonia recovery plant -› a crude benzol recovery plant -› a desulphurization installation

207. Basic laws of flow include:
A) continuity equation
B) the law of conservation of angular momentum
C) all the laws mentioned below
D) energy equation

208. 2-chlorobutane can be obtained from butane in the reaction of:
A) radical addition
B) electrophilic addition
C) radical substitution
D) electrophilic substitution

209. An adiabatic process:
A) is a process when the energy of the system remains constant
B) is a constant-enthalpy process
C) is a process involving no friction
D) is a process involving no heat exchange

210. According to Polish classification , solid fuels are described by a two-digit code number, and:
A) the first digit denotes the group of the fuel and the second one the position of the fuel in the group
B) the first digit denotes the group of the fuel and the second one is connected with the ash content in the fuel
C) the first digit denotes the position of the fuel in the group and the second one the group of the fuel
D) the first digit denotes the group of the fuel and the second one is connected with the gross calorific value of the fuel

211. The structure of one-wall carbon nanotubes consists of:
A) amorphous structural fragments, similar to the ones present in carbon black
B) folded surface obtained from the transformation of a 3D C60 fulleren [incomplete hybridization sp2with the participation of sp3]
C) folded surface of coal atom tetrahedrons – typical structural elements of regular coal grade, like diamond [sp3] hybridization
D) folded surface of one-layer graphite of sp2 [graphen's] hybridization

212. A risk is:
A) the possibility of a threat event occurrence
B) the probability of harmful agent occurrence
C) the possibility of an accident in the workplace
D) the probability of occurrence of one or a combination of events leading to a dangerous situation and negative impacts for human life of health, the natural environment and operating resources, and the frequency of such events [$R = P \cdot F$]. P – probability, F – frequency

213. In which of the following compounds are ionic bonds present:
A) CsBr
B) $AsCl_2$
C) Cl_2O
D) NI_3

214. When a given element has high electron affinity, it means:
A) the element in question is not very reactive
B) a considerable amount of energy is emitted when an atom of the element in question gains an electron
C) a large amount of energy is required to obtain an anion of the element in question
D) the removal of one valence electron requires little energy

215. Analyzing the position of the main group elements in the periodic table, one can specify:
A) the numerical value of ionization energy
B) the number of isotopes of a given element
C) the number of valence electrons
D) the number of compounds with oxygen

216. Distillation and rectification are:
A) industrial methods of organic synthesis
B) unit process
C) unit operations
D) reactions leading to obtainment of high-molecular compounds

217. The term "mass exchanger" does not apply to:

A) a vacuum pump and a dispenser
B) an adsorber and an absorber
C) an extractor and a rectifying column
D) a mill and a crusher

218. Which of the following are not carbon nanostructures:
A) graphenes
B) graalians
C) nanotubes
D) fullerens

219. N-fenyloacetamid is a product of acetylation of aniline proceeding according to the mechanism of:
A) nucleophilic addition
B) electrophilic substitution
C) nucleophilic substitution
D) radical addition

220. The solubility of hydrogen chloride in water under normal conditions is high because the compound:
A) is a gas heavier than air
B) forms diatomic molecules
C) contains hydrogen in its composition
D) undergoes electrolytic dissociation in water

221. A monomolecular reaction may occur according to the mechanisms of the second-order reactions:
A) for big particles of complex construction
B) at a high temperature
C) at high pressures
D) at low pressures

222. Liquified natural gas transport:
A) is less expensive than natural gas transport through pipelines
B) may be less or more expensive than natural gas transport through pipelines, depending on the distance
C) with regard to costs is comparable to natural gas transport through pipelines
D) is more expensive than natural gas transport through pipelines

223. Proportioning of bulk materials can be done:
A) only by volume
B) bulk materials cannot be proportioned
C) by volume and by weight
D) only by weight

224. A histogram is:
A) a pie chart representing the distribution of statistical data of a controlled process
B) a bar graph representing the median
C) a bar graph representing the standard deviation distribution
D) a bar graph representing the frequency distribution

225. A simultaneous exchange of mass and heat may not occur in:
A) membrane heat exchangers
B) membraneless heat exchangers
C) electrostatic precipitators
D) fabric filters

226. III-V materials are compounds :
A) containing metal on the +III oxidation level and nonmetal on the +V oxidation level
B) of elements from the third and fifth group of periodic table [according to the former group demarcation]
C) of atoms contained between the third and the fifth group of periodic table
D) containing three to five atoms of different kind

227. In four test tubes were solutions containing the enumerated ions. After adding excess NaOH, the precipitate will remain in the tube containing ions of:
A) Mg^{2+}
B) Al^{3+}
C) Cr^{3+}
D) Zn^{2+}

228. Which group of compounds contains exclusively amphoteric compounds in aqueous environments:
A) $Zn[OH]_2$, $CO[NH_2]_2$, CH_3COOH, MnO_2
B) $Cr[OH]_3$, SiO_2, SO_3, $HOCH_2COOH$
C) $Al[OH]_3$, Na_2O, CuO, ZnO
D) $Al[OH]_3$, $Cr[OH]_3$, ZnO

229. Acid-base titration consists in:
A) a reaction in which complex compounds are created
B) an acid-base reaction
C) a reaction in which a sparingly soluble precipitate is formed
D) oxidation and reduction reactions

230. The capacity and the delivery head of the centrifugal [rotodynamic] pump can be increased by combining pumps into assemblies:
A) the capacity: for pumps connected in series, the pump delivery head: for pumps connected in series

B) the capacity : for pumps connected in parallel, the pump delivery head: for pumps connected in parallel
C) the capacity : for pumps connected in parallel, the pump delivery head: for pumps connected in series
D) the capacity : for pumps connected in series, the pump delivery head: for pumps connected in parallel

231. The total moisture content in solid fuels is in the range:
A) up to 90% in fresh peat, up to 50% in fresh wood, up to 55% in soft brown coal and up to 20% in hard coal
B) Up to 90% in fresh wood, up to 50% in fresh peat, up to 55% in soft brown coal, and up to 20% in hard coal
C) up to 50% in fresh peat, up to 30% in fresh wood, up to 15% in soft brown coal, and up to 5% in hard coal
D) Up to 50% in fresh wood, up to 30% in fresh peat, up to 15% in soft brown coal, and up to 5% in hard coal

232. Differential thermal analysis [DTA]:
A) analyses the mass changes in the function of temperature
B) allows the examination of clays and illite
C) allows the investigation of exothermic and endothermic effects during the sample heating
D) does not allow the investigation of polymorphous processes

233. After adding a small amount of solution containing compound X to a dilute solution of calcium chloride, a white precipitate was formed. The compound in question could be:
A) ammonium nitrate[V]
B) ammonium oxalate
C) sodium chloride
D) ammonium chloride

234. The second law of thermodynamics:
A) defines efficiency
B) defines entropy
C) defines heat
D) defines enthalpy

235. A hygrometer is device for measuring:
A) light intensity
B) temperature
C) noise level
D) relative humidity

236. The Wobbe index (number) is connected with the following combustion performance criteria:
A) heat load stability and the amount of primary air sucked in by injection gas burners
B) heat load stability, combustion hygiene and the amount of primary air sucked in by injection gas burners
C) heat load stability and the stability of the flame on the burner
D) heat load stability

237. The two-stage natural distribution system is characterized by the fact that:
A) gas is supplied to both households and industrial customers
B) gas is supplied to customers' installations from a medium-pressure pipeline via a domestic gas reducer
C) it combines pipelines of two different diameters
D) it combines pipelines at two different pressure levels

238. In the process of preparing natural gas for its pipeline transport, natural gasoline is separated from natural gas:
A) mostly in the process of natural gasoline stabilisation
B) in the processes of: preliminary separation, natural gas degasolination and natural gasoline stabilisation
C) in the processes of: preliminary separation and natural gas degasolination
D) exclusively in the process of natural gas degasolination

239. The SEM of a cell is positive when:
A) on the left electrode there is an oxidation reaction
B) on the right electrode there is an oxidation reaction
C) the normal potential of the left electrode is higher than that of the right one
D) on the left electrode there is a reduction reaction

240. What are biomorphous ceramic materials:
A) coal-inorganic or inorganic materials , obtained using templates of biological origin [wood, shells etc.]
B) inorganic materials used in organ transplantations
C) pure coal materials , obtained through pyrolysis of materials of biological origin
D) inorganic materials in composite arrangement with organic materials of biological origin

241. The reaction co-ordinate expresses:
A) heat of reaction
B) the rate of reaction
C) irreversibility of reaction
D) equilibrium state of reaction

242. Structural unit cells in metals are:
A) regular and rhombohedral
B) trigonal and rhombohedral
C) trigonal and hexagonal
D) regular and hexagonal

243. According to the classification of coal ranked by assortments, the correct order of the assortments starting from the biggest to the smallest is as follows:
A) rounds of coal, cobble, fine coal, nut coal, coal dust
B) rounds of coal, cobble, nut coal, fine coal, coal dust

C) rounds of coal, nut coal, cobble, fine coal, coal dust
D) nut coal, rounds of coal, cobble, fine coal, dust

244. The overall efficiency of a coke screen is calculated based on a formula which includes:
A) the theoretical energy demand and its real consumption to spread 1 Mg of coke
B) the content of the required grain size in the feed, sifted coke and screened coke
C) the content of the undesired grain size in sifted coke and screened coke
D) the content of the required grain size in sifted coke and screened coke

245. Conventional (mercury- or alcohol-filled) thermometers utilise:
A) change of the medium's colour with increasing temperature
B) the phenomenon of linear expansion with increasing temperature
C) concentration change with increasing temperature
D) the phenomenon of volume expansion with increasing temperature

246. The potential of the glass electrode depends on the activity of :
A) H+ ions
B) OH- ions
C) Cl- ions
D) Na+ ions

247. Synthesis gas is:
A) the gas used as raw material for chemical syntheses
B) the waste gas produced in industrial synthesis
C) any synthetic gas
D) the gas used for the process of direct coal liquefaction

248. Magnetic quantum number expresses:
A) the value of the orbital angular momentum of an electron
B) the shell on which the electron is found
C) spin
D) position of the orbital angular momentum in space

249. One of the best nitrogen fertilizers is urea containing 46% nitrogen. On the commercial scale urea is obtained from the reaction:
A) ethylenediamine with water
B) thermal decomposition of natural compounds
C) ammonia with carbon dioxide
D) nitric acid with ammonium salts

250. In the process of atmospheric distillation one can obtain:
A) dry and liquefied petroleum gas
B) vacuous distillates
C) kerosene and diesel oil
D) products boiling under 350 ^{o}C

251. For natural gas supplied to communal customers and households via the gas distribution network, the maximum permissible moisture content according to the Polish norms:
A) is not defined
B) is defined by means of the dew point at a pressure of 101.325 kPa separately for the periods from 1 April to 30 September and from 1 October to 31 March
C) is defined by means of the dew point at a pressure of 5.5 MPa for the period 1 October to 31 March and for the period from 1 April to 30 September is not defined
D) is defined by means of the dew point at a pressure of 5.5 MPa separately for the periods from 1 April to 30 September and from 1 October to 31 March

252. Indicate the appropriate ending of the sentence: Heat convection is a process:
A) of heat exchange connected with gas or liquid motion
B) consisting in transferring heat in the vacuum
C) consisting in heat transfer as a radiation energy
D) running against the gradient of temperatures

253. A molecule of carbon dioxide does not have a dipole moment because:
A) it has symmetrical linear structure
B) carbon and oxygen are not different in terms of electronegativity
C) there exists a covalent bond between carbon and oxygen atoms
D) it consists of atoms of different elements

254. The rate of a chemical reaction does not depend on:
A) a catalyst
B) activation energy
C) temperature
D) equilibrium constant

255. A Safety Data Sheet for a hazardous substance includes:
A) the manufacturing procedures of a substance
B) the identity of the producer of a substance and their the contact details
C) the handling and storage rules for a substance
D) the first aid rules

256. According to the Polish norms, the classification of gaseous fuels into subgroups refers to:

A) low-methane natural gases, and its criterion is the lower Wobbe index
B) all gaseous fuels, and its criterion is the lower Wobbe index
C) low-methane natural gases, and its criterion is the upper Wobbe index
D) all natural gases, and its criterion is the upper Wobbe index

257. One-dimensional transient processes of thermal conduction can be described by equation:
A) Y=XBiFo
B) Z=F[X, Y, Bi]
C) Y=Y[X, Bi, Fo]
D) Y=Y[Bi, Fo]

258. For liquid solutions A and B, positive deviations from the Raoult's law are caused by molecular interactions:
A) A-A<B-B
B) A-A=B-B
C) A-A>B-B
D) A-A>A-B

259. For biofuels, the maximum permissible sulphur content according to the Polish norms:
A) is determined by specifying only the total sulphur content
B) is determined by the user of a gaseous fuel
C) is determined by specifying both the total sulphur content and the hydrogen sulphide content
D) is determined by specifying only the maximum permissible content of hydrogen sulphide

260. The first Fick's law can be applied to describe:
A) only equimolar convection
B) unidirectional diffusion through inert
C) equimolar diffusion
D) transient diffusion

261. Favourable conditions for the formation of methane hydrates in natural gas transmission pipelines are:
A) low temperature, high pressure, high moisture content and low hydrogen sulphide content in a gas
B) low temperature, low, high moisture content and high hydrogen sulphide content in a gas
C) low temperature, high pressure, high moisture content and high hydrogen sulphide content in a gas
D) low temperature, low pressure, high moisture content and low hydrogen sulphide content in a gas

262. For natural gas supplied to communal customers and households via the gas distribution network, the maximum permissible sulphur content according to the Polish norms:
A) is determined by consumers of a gaseous fuel
B) is defined by specifying the total sulphur content
C) is defined by specifying the total sulphur content and hydrogen sulphide content
D) is defined by specifying the total sulphur content, mercaptan sulphur content and hydrogen sulphide content

263. The Claus process can be used in conjunction with:
A) all adsorption methods of gaseous fuels desulphurization
B) adsorption methods of gaseous fuels desulphurization relying only on the phenomenon of chemical adsorption
C) all wet methods of gaseous fuels desulphurization
D) all methods of gaseous fuels desulphurization

264. Which of the described phenomena are chemical, not physical changes:
A) formation of a layer of ice on freezer walls in a refrigerator
B) white smoke formation in a container with hydrochloric acid into which ammonia vapors were introduced
C) neon glow on a light advertisement
D) formation of red tarnish on an iron nail dipped in a solution of $CuSO_4$

265. Structural [functional] isomerism is an aspect of:
A) stereoisomerism
B) constitutional isomerism
C) configurational [geometric] isomerism
D) spatial isomerism

266. While selecting an organic liquid [which is insoluble in water] for the process of extraction from the water phase, one should mainly take into account:
A) the rule of Gibbs' phases
B) density of this liquid
C) size of the division coefficient
D) Oswald's law of solutions

267. Which of the following substances should a zinc metal be treated with so that hydrogen is displaced:
A) sodium chloride
B) a solution of calcium chloride
C) hydrochloric acid
D) distilled water

268. Which of the following unit operations can be performed in industrial conditions using counter-current flow:
A) extraction
B) crystallization
C) filtration
D) electrolysis

269. Conductometry consists in measurements of the following:
A) current voltage

B) current intensity and voltage
C) conduction
D) current intensity

270. The combustion of 1 kg of clean coal at the air surplus coefficient equal to 2, it is necessary to supply:
A) 8.5 kg of oxygen
B) 2.7 kg of oxygen
C) 5.3 kg of oxygen
D) 4.4 kg of oxygen

271. If Y1 , Y2 denote mass ratio of the component absorbed in the gas flow at the adsorber inlet and outlet respectively, X1, X2 – the mass ratio of the component absorbed in liquid flow at the adsorber outlet and inlet respectively, LiGi- the mass flow of liquid and gas inert , then the correct formula for the material balance of a counter-current absorber [ideal piston flow of both phases] is :
A) Gi · [X1 - X2] = Li · [Y1 - Y2]
B) Li · [X2 - X1] = Gi · [Y1 - Y2]
C) Li · [X1 - X2] = Gi · [Y1 - Y2]
D) Li · [X1 - X2] = Gi · [Y2 - Y1]

272. The technological classification of steam coal for the purpose of power production specifies :
A) classes [depending on the lower caloric value and the ash content in coal as received], sorts [depending on the class and the size of grains] and forms [depending on the transport ability of fine coals and coal slurries]
B) classes [depending on the lower calorific value and ash content in coal as received], sorts [depending on the transport ability of fine coals and coal slurries] and forms [depending on the class and the size of grains]
C) classes [depending on the lower calorific value and the total moisture content in coal as received], sorts [depending on the ash content in coal as received] and forms [depending on the class and the size of grains]
D) classes [depending on the ash content in coal as received], sorts [depending on the class and the size of grains]and forms [depending on the transport ability of fine coals and coal slurries]

273. Two-dimensional nanomaterial consists of particles that have:
A) two dimensions on the nano-scale and one dimension on the microscale
B) two identical dimensions on the nano-scale
C) two dimensions on the micro-scale and one dimension on the nano-scale
D) two identical dimensions on the micro-scale

274. Which of the below listed terms are synonymous:
A) thermal conduction and heat transmission
B) heat transfer and heat transmission
C) thermal conduction and taking up the heat
D) heat transfer and taking up the heat

275. In the case of thermal conduction through a wall consisting of 1cm thick steel layer [the heat conduction coefficient is 45W/[mK]], 10cm copper layer [384 W/[mK]], 10cm aluminium layer [203 W/[mK]], 1cm tin layer [63 W/[mK]], the biggest fall of temperature will take place on the layer of:
A) aluminium
B) steel
C) copper
D) tin

276. Light petrol belongs to the products of rig-piping distillation known as:
A) light [pale]
B) dark
C) mazout
D) soft asphalt

277. An open system interacts with its surroundings through:
A) volume change
B) temperature change
C) work or heat
D) transport of mass, heat and work

278. For compressing natural gas in gas compressor stations, we use the following:
A) centrifugal compressors and Root compressors mostly driven by electric motors and gas turbines
B) reciprocating and rotary compressors mostly driven by spark-ignition gas engines and gas turbinest
C) reciprocating and rotary compressors mostly driven by compression-ignition engines and gas turbines
D) reciprocating and rotary compressors mostly driven by electric motors and gas turbines

279. The commercial diameter of the pipe is specified by:
A) the inside pipe diameter plus the doubled thickness of the wall
B) the outside pipe diameter
C) the pipe diameter selected from the manufacturer’s catalogue
D) the effective pipe diameter, i.e., taking into account its dimension tolerances

280. Chemical analysis of a certain compound shows mass ratio C:H:O = 7:14:2. The compound in question can be:
A) carboxylic alkano-acid
B) alkanodione
C) alkanone
D) alkanal

281. When several pumps are connected in series:

A) the head [H] remains constant, but the capacity of the system [Q] increases
B) the capacity of the system [Q] remains constant, but the head [H] increases
C) The capacity of the system [Q] and the head remain constant
D) The capacity of the system [Q] decreases, but the head does not change

282. In accordance with general principles of reactions occurring in the gas phase, the synthesis of ammonia: $N_2 + 3H_2 <-> 2NH_3 + Q$ proceeds most effectively if:
A) temperature is raised and pressure lowered
B) temperature is lowered, and pressure raised
C) both pressure and temperature are lowered
D) volume hydrogen-to-nitrogen ratio is 2:1

283. Which reaction is positively affected by an increase in pressure and a decrease in temperature:
A) CH4 + H2O <-> CO + 3H2
B) C + CO2 <-> 2CO
C) CO+H2O <-> CO2 + H2
D) C+ 2H2 <-> CH4

284. Underground gas reservoirs in salt caverns are used to:
A) ensure the continuity of imported gas supply
B) guarantee proper conditions for the optimal exploitation of a gas transport system as well as to ensure the continuity of gas supply and off-take from the system during repair and maintenance works of particular elements of the system
C) ensure the continuity of gas supply for industrial gas customers
D) ensure energy security of the country

285. A thermodynamic system is adequately described by:
A) extensive parameters
B) intensive parameters
C) chemical composition
D) temperature, pressure, the number of components

286. The efficiency of Rankine cycle can be increased through:
A) reduction of H2O pressure in the boiler
B) burning of larger amounts of fuel or a better quality fuel
C) pressure increase in the condenser
D) increase of the fresh stream parameters [before the turbine]

287. To the group of band conveyors we can include:
A) screw, oscillating and vibrating conveyors
B) chute, vibrating and screw conveyors
C) drag, bucket and belt conveyors
D) pneumatic, vibrating and screw conveyors

288. $C_6H_{11}OH$ can be distinguished from C_6H_5OH by reaction with:
A) phenylhydrazine
B) benzo-diazine chloride in a solution of NaOH
C) propanone
D) methoxybenzene

289. The working principle of impeller pumps is:
A) as a result of a centrifugal force, liquid particles are displaced towards the outside perimeter of the rotor, which causes the inlet pressure of the pump to decrease and the liquid to be sucked in
B) as a result of a gravitational force, liquid particles are displaced towards the outside perimeter of the rotor, which causes the inlet pressure of the pump to decrease and the liquid to be sucked in
C) as a result of a centrifugal force, the kinetic energy and the pressure of the liquid increase, which causes the inlet pressure of the pump to decrease and the liquid to be sucked in as well as an increase in the outlet pressure of the pump
D) as a result of a centrifugal force, liquid particles are displaced towards the outside perimeter of the rotor, which causes the inlet pressure of the pump to decrease and the liquid to be sucked in

290. Electrodehydrators are an element of installation for:
A) vacuous distillation of petroleum
B) degassing of petroleum
C) forcing petroleum down the installation
D) drying and desalination of petroleum

291. The origin of crude oil (petroleum) can be best explained by:
A) organic theory
B) presence of chlorophyll and hemin derivatives
C) inorganic theory
D) presence of methane

292. Ideal gas:
A) it is a water vapour or water
B) it is gas inside a closed container
C) satisfies the fundamental gas laws
D) has a constant internal energy

293. Neutralization reactions take place between:
A) metals and acids

B) metal oxides and acids
C) metal and non-metal oxides
D) bases and acids

294. An aluminium magnesium alloy was dissolved in hydrochloric acid. Excess NaOH was added to the obtained solution. What is the form of aluminium after the reaction has been completed:
A) in the solution, aluminium chloride
B) in the precipitate, Al[OH]3
C) in the solution, sodium aluminate NaAlO2
D) an aluminium magnesium alloy is insoluble in aqueous solutions of HCl and NaOH

295. Any extensive function of state of a closed system in which a reaction of n components takes place will be the function:
A) of two variables
B) of three variables
C) of one variable
D) of n variables

296. Turbidimetric analysis is an analytical method utilising:
A) light absorption
B) light diffraction
C) light refraction
D) light dispersion

297. The aqueous solution of carbon dioxide and aqueous ammonia are poor conductors of electrical current. How will the conductivity change after mixing these solutions?
A) it will decrease
B) it will increase
C) it will significantly decrease
D) it will not change

298. In a molecule of sulphuric acid[VI] there is no:
A) polarized bond
B) coordinate bond
C) single bond
D) hydrogen bond

299. Coal homogenization in a coking plant is based on:
A) the crushing and grinding of coals as well as the proportioning of coal blends according to the strictly determined recipes
B) a proper way of stacking and unstacking of heaps, as well as crushing and grinding of coals
C) the use of so-called two heaps economy and the crushing and grinding of coals
D) the use of so-called two heaps economy and a proper way of stacking and unstacking of heaps

300. The thermal conductivity coefficient of insulating materials is not dependent on:
A) dimensions of insulating material
B) moisture content of insulating material
C) density of insulating material
D) the type of insulating material

301. Mazout is a residue after the following stage of rig-piping distillation:
A) stabilization
B) vacuous distillation
C) atmospheric distillation
D) seasoning

302. Reactivity of metals belonging to a given main group increases together with increasing atomic number. This is mainly caused by:
A) an increase in the total number of elementary particles in an atom
B) an increase in the number of electrons and neutrons in nuclei of atoms
C) an increase in the number of valence electrons
D) an increase in the distance of valence electrons from the nucleus

303. Cracking of hydrocarbons is conducted in order to:
A) arrive at isomerization of paraffins hydrocarbons
B) isolate olefins hydrocarbons from petroleum
C) obtain liquid gas in the process of thermal decomposition of crude oil
D) increase the participation of light ends

304. In order to perform volume-pressure work upon the surroundings while maintaining the constant internal energy, the system:
A) raises temperature
B) does not exchange energy with the surroundings
C) gives up heat to the surroundings [Q<0]
D) takes up energy from the surroundings [Q>0]

305. The height equivalent to a theoretical plate is:
A) a hypothetical place in a column, where the equilibrium between the concentrations of the flows leaving the place is established
B) the height of the filling built into the column after taking into account the coefficient of surface utilization
C) the height of the filling layer in the column, which in action [mass exchange] is equivalent to one theoretical plate
D) the height of the filling layer equal to the height of the liquid on the plate

306. Which of the following is not a polymer decomposition reaction?:
A) depolymerization
B) destabilisation
C) destruction
D) degradation

307. Diffusion is a process which consists in:
A) spontaneous equalization of concentrations of solutions being a result of movement of substances from an area of higher concentration to the area of lower concentration
B) neutralization of the charge outside of the micelles caused by addition of a strong electrolyte
C) increasing solution concentration by movement of substances from precipitate to the solution caused by increased temperature
D) reducing solution concentration by spontaneous precipitation of a supersaturated solution

308. The calculated gas stream for municipal use and household purposes [meals preparation and domestic hot water] is:
A) the same as the space heating demand
B) larger than the space heating demand
C) lower than the space heating demand
D) constant and independent of the degree of urbanization

309. At temperature 400 K the vapour pressure of liquid A is 4 *10 4 [Nm-2] and of liquid B- 6 *10 4 [Nm-2]. Liquids A and B form an ideal solution. The molar fraction B in vapour remaining in equilibrium with the solution in which the molar fraction B is 0.6 will be equal to:
A) 0.50
B) 0.31
C) 0.69
D) 0.40

310. In order to extract solid paraffins from a petroleum fraction, presently the following are used:
A) rinsing the fraction with distilled water at a temperature of 40-50 ^{o}C
B) filtering of a petroleum fraction heated to an appropriate temperature
C) additive crystallization with the use of carbamide
D) crystallization from a solution by temperature lowering with the use of appropriate solvents

311. Equilibrium step of mass exchange is a term:
A) used when calculating stepping column plates apparatus
B) used to calculate the density of the diffusing mass flow
C) referring to the cross-section of an apparatus where the concentrations of leaving flows are in equilibrium
D) used to calculate the coefficients of mass transfer

312. Graphite melts :
A) at 4100 oC
B) at 3800 oC
C) at 4500 oC
D) does not melt at all

313. Which of the following is not a light metal?:
A) beryllium
B) zinc
C) titanium
D) magnesium

314. A cetane index is a measure of the following fuel qualities:
A) ability of self-ignition
B) content of lead tetraethyl
C) viscosity
D) resistance to self-ignition

315. The cause of an explosive course of the reaction is:
A) the occurrence of many parallel reactions
B) the presence of a catalyst
C) the occurrence of follow-up reactions
D) the temperature increase

316. Conveyors are devices whose basic function is to:
A) convey, dispense and pack a material
B) dispense a material
C) convey a material
D) convey and dispense a material

317. Work generated by 1 mol of monoatomic ideal gas within the closed process cycle is 418 J. Heat transferred by gas during those processes is equal to:
A) –418 J
B) zero
C) cannot be specified
D) 418 J

318. The ash content in air-dried coal is:
A) lower than in coal as received
B) higher than in coal as received

C) higher than in dry coal
D) equal to the ash content in dry coal

319. Which unit operation can be carried out with the use of material counter-current?:
A) electrolysis
B) extraction
C) crystallization
D) filtration

320. During vulcanization the following process takes place:
A) tiol groups are created
B) disulfide bridges emerge, similar to the ones in proteins
C) sulphur catalyzes free-of-radicals polymerization of isoprene
D) S8 take shape of chains [S]x>8 which occupy the space between the polyisoprenoid chains

321. Extraction is a process, during which:
A) solid mixture is separated by means of a selective solvent
B) liquid mixture is separated by means of a selective solvent
C) the original solvent vapours become enriched in a more volatile component
D) one of the gas components passes to the selective solvent

322. Which of the below mentioned systems requires the smallest number of crushers to grind the same amount of coking coal:
A) single-component grinding
B) grinding of a groups of components
C) coal blend grinding
D) selective grinding

323. According to petrographic definition, coal is:
A) a combustible metamorphic rock , formed from plant residues compressed by a cover layer
B) a combustible sedimentary rock, formed from plant residues compressed by the cover layer
C) a combustible magmatic rock, formed from animal and plant residues compressed by a cover layer
D) not a rock

324. A driving force in the processes of heat exchange is:
A) value of the division coefficient
B) a number of degrees of freedom of the system
C) concentration gradient of the reagents
D) difference of temperatures between the exchanging heat factors

325. Oxidation products of 2-methylpropan-1-ol can be:
A) 2-methylpropional or 2-methylpropanoic acid
B) 2-methylpropanoyl or 2-methylpropanoic acid
C) 2-methylpropional or butanoic acid
D) 2-methylpropan-2-ol or 2-methylpropanoic acid

326. Which of the items below is not included in a gas installation:
A) a waste gas duct that carries away flue gases from a bathroom heater
B) a household gas reducer
C) a gas cooker with an oven
D) a gas meter

327. Molecule dipole moments of F_2, Cl_2, Br_2, I_2 are:
A) different from zero, and their values increase from F2 to I2
B) in all cases equal to zero
C) in all cases different from zero and have similar values
D) different from zero, and their values decrease from F_2 do I_2

328. Sodium salts cause burner's flame to turn:
A) yellow
B) carmine
C) yellow-green
D) brick red

329. During the reaction described by the equation X + NaOH -› Z+Y, from one ton of X substance [of a mole mass 100g/mole] 125 kilo Y substance [of a mole mass 50g/mole] were obtained. What is the percentage efficiency of the Y product synthesis?:
A) 25%
B) 12,5 %
C) No information about the mass of Z product, therefore it is not possible to calculate the efficiency
D) 50%

330. Industrial minerals are:
A) anhydrite, coal, precious metal ores
B) barite, gypsum, strontium salts
C) pyrite, apatite, marble
D) radioactive elements, fluorite, rock salt

331. Parameters on the saturation line H2O for x=0 include:
A) v”- specific density of saturated dry steam
B) h’- enthalpy of boiling water
C) r- heat of vaporization of water

D) T- water temperature

332. The term ‘confusor [K]’ and ‘diffuser [D]’ refers to the shape of:
A) the ventilator’s rotor [K] and the spiral collector [K]
B) the ventilator’s rotor [K] and the spiral collector [D]
C) the ventilator’s rotor [D] and the spiral collector [D]
D) the ventilator’s rotor [D] and the spiral collector [K]

333. The coalification degree can be determined by:
A) the carbon content, the volatile matter content and the intertinite content
B) the carbon content, the volatile matter content and the vitrinite content
C) the carbon content, the volatile matter content and the organic matter content
D) the carbon content , the volatile matter content and the reflectance of vitrinite R

334. If 60% pale products were obtained in the process of rig-piping distillation, then petroleum refining is determined as:
A) shallow
B) deepened
C) deep
D) quite deep

335. Coal dust in a water suspension is dosed into a gasifier based on the method of:
A) Texaco
B) Koppers-Totzek
C) Siemens
D) Shell

336. In the process of electrolytic dissociation of ammonium sulfate are created:
A) ammonia and sulphur dioxide
B) ammonium cations and sulfate anions
C) ammonia molecules and bisulfate ions
D) ammonium anions and sulphuric acid residue

337. According to the classification of gaseous fuels which is applied in Poland, the family of gaseous fuels refers to:
A) gaseous fuels containing the same flammable components
B) gaseous fuels characterized by a classification parameter value falling within a fixed range
C) gaseous fuels being of similar origin and characterized by a classification parameter value falling within a fixed range
D) gaseous fuels being of similar origin and containing the same flammable components

338. The reference point on the absolute temperature scale is:
A) temperature of water freezing
B) liquid nitrogen temperature
C) temperature at which the thermal movement of particles ceases
D) temperature of liquid oxygen

339. Ring distribution networks are used :
A) in the case of expanding the gas supply system in rural areas with scattered housing
B) in the case of expanding the gas supply system in non-industrialised regions
C) in cities with a population above 1 million inhabitants
D) in the case of expanding the gas supply system in a densely built up area

340. To 20 cm^3 of 0.01M $Ca[OH]_2$ solution were added 20 cm^3 of HCl solution of the same concentration and a few drops of phenolphthalein. The solution after the experiment:
A) showed a yellow colouration
B) was colourless
C) showed a raspberry-red colouration
D) showed a blue colouration

341. Raoult’s law states that:
A) partial pressure of a liquid mixture component over this mixture equals the product of a molar fraction of this component in the solution and its saturated vapour pressure
B) partial pressure of a liquid mixture component over the mixture is inversely proportional to a molar fraction of this component in the solution
C) partial pressure of a liquid mixture component over this mixture equals the sum of partial pressures of all the components
D) partial pressure of a liquid mixture component over this mixture equals the product of Henry’s constant and a molar fracture of this component in the solution

342. The boiling point of products from the rig-piping distillation of crude oil increase in the row:
A) petrol < kerosene < diesel oil < mazout
B) mazout < diesel oil < kerosene < petrol
C) diesel oil < kerosene < petrol < mazout
D) kerosene < diesel oil < petrol < mazout

343. Polarimetric analysis is one of:
A) thermal methods
B) refractometry methods
C) diffractometry methods
D) electrochemical methods

344. During heat penetration in the condition determined by a multi-layer flat wall [5 layers of a thickness of 10 cm each, the heat conduction coefficients : 0.1W/[mK], 0.2 W/[mK], 50 W/[mK], 0.2 W/[mK], and 0.1 W/[mK]. From water [the coefficient of heat penetration of 250 W/[m2K]] to air [the coefficient of heat penetration of 25 W/[m2K]] . The heat penetration coefficient in W/[m2K] will be equal to:
A) between 25 and 250
B) certainly bigger than 250
C) the data are insufficient to evaluate
D) less than 25

345. Most thermal cracking reactions happens:
A) carbonium ion, carbo-cation
B) by the use of a catalyst
C) according to the radical mechanism
D) in temperatures of over 800 ^{o}C

346. The Zero law of thermodynamics enables the measurement of:
A) internal energy
B) specific heat
C) temperature
D) pressure

347. Cycle efficiency of a heat engine expresses:
A) the ratio of supplied heat to the engine's work [or power output]
B) the amount of supplied heat
C) work or power output of an engine
D) the ratio of work [or power output] of an engine to the amount of supplied heat

348. Impeller pump characteristic is unequivocally defined by:
A) geometric dimensions [rotor diametr D] and pump weight
B) rotary speed n [rev/min] and the pump power N[kW]
C) dependence of the head on the capacity H[Q]
D) volumetric capacity Q [m3/h] and the head H [m H2O]

349. The code numbers of Polish brown coal classification for the purpose of power production refer to:
A) the ash content and the lower calorific value of coal as received, the total sulfur content in dry coal, the sand content, the fibrous xylith content and the melting temperature of coal ash
B) the ash content and the lower calorific value of coal as received, the content of total sulfur, the content of phosphorus, chlorine and alkalis in dry coal as well as the yield of low temperature tar
C) the ash content and the lower calorific value of coal as received , as well as the content of total sulfur, the content of phosphorus, chlorine and alkalis in dry coal
D) the moisture content, the lower calorific value of coal as received, the total sulfur content in dry coal and the melting temperature of the coal ash

350. According to Polish standards the volatile matter content is defined as:
A) the mass loss of a solid fuel sample after pyrolysis under the conditions specified in Polish and ISO standards, expressed in % of the initial mass of the sample and reduced by the moisture content in the analytical state of the sample
B) the mass loss of a solid fuel sample after pyrolysis under conditions specified in Polish and ISO Standards, expressed in % of the initial mass of the sample
C) the mass loss of a solid fuel sample after pyrolysis under conditions specified in Polish and ISO Standards, expressed in % of the initial mass of the sample and reduced by the ash content in the analytical state of the sample
D) the difference between the fixed-carbon content and the ash content under conditions specified in Polish and ISO Standards

351. Clay components do not include:
A) halloysite
B) kaolin
C) illite
D) limonite

352. Polish classification of hard coals by types:
A) is based on the so-called secondary features of coal
B) is based both on the primary and secondary features of coal
C) is based neither on the primary nor on the secondary features of coal
D) is based on the so-called primary features of coal

353. For any thermodynamic process:
A) internal energy is constant
B) the change of internal energy of the system is path independent
C) heat absorbed by the system is path independent
D) work performed by the system is path independent

354. Factors contributing to the oxidation of coals in the stock are i.a.:
A) a low coal rank, its mall grain size , low pyrite content
B) a high coal rank, small grain size, high pyrite content
C) a high coal rank, its large grain size, low pyrite content
D) a low coal rank, its small grain size, high pyrite content

355. Which coal types are thermal coals:
A) 37

B) 31
C) 33
D) 35

356. The product of Claisen condensation between ethanal and butan-2-one is:
A) 5-hexanol-2-one
B) 5-hexanol-3-one
C) 3-methyl-1-pentanal-3-ol
D) 3-methyl-4-pentanol-2-one

357. The relationship between frequency of gas molecule collisions Z and thermodynamic temperature T is given as:
A) Z-exp[-const/T]
B) Z is not related to T
C) Z-T1/2
D) Z-T

358. Which of the following compounds are substances which reduce water surface tension?:
A) glycerol esters
B) sodium salts of fatty acids
C) magnesium salts of fatty acids
D) lime salts of fatty acids

359. A safety report must be prepared and submitted by:
A) operators of all facilities
B) upper-tier establishment and high-risk facility operators
C) operators of all heavy industry facilities
D) high-risk facility operators

360. A spinneret is:
A) a hole for profiling fibre
B) a device for splicing fibre
C) a device for winding fibre
D) a set for stretching fibre

361. Sulphur foam as a product of the desulphurization of gaseous fuels is obtained:
A) only in oxidation methods
B) in all dry methods
C) in oxidation methods and in the Rectisol process
D) in all desulphurization processes

362. The great industrial disaster which took the highest death toll was:
A) Texas City [USA]
B) Vajont [Italy]
C) Bhopal [India]
D) Chernobyl [USSR]

363. Which of the following is not a structural form of liquid crystals:
A) cholesteric form
B) peritectic form
C) smectic form
D) nematic form

364. Synthetic polymers are conglomerates of chemical bonds:
A) covalent- secondary bonds
B) ionic- secondary bonds
C) metallic-covalent bonds
D) metallic- secondary bonds

365. The bonds occurring between water molecules are the result of:
A) the existence of a shared electron pair between hydrogen and oxygen atoms
B) electrostatic interaction between hydrogen atoms belonging to different molecules
C) association and interaction between the dipoles of water
D) interaction between strongly electronegative oxygen atoms

366. A certain process [e.g. an ammonia synthesis] runs its course with the use of a contact [solid] catalyst as well as a recirculation of the reagents which haven't undergone a reaction yet. Indicate which sentence is true:
A) Final efficiency of the process does not depend on the degree of conversion affecting the agent
B) A degree of conversion on the catalyst [agent] is equal to the total efficiency of the process
C) Total efficiency depends on the velocity of the process affecting the agent
D) Total efficiency on the size of change of the balance constant on the contact agent

367. Coal rank (coalification degree) means:
A) the loss of coal mass during the coalification process, expressed as % of the mass of the plant material from which coal was formed
B) the place of coal in the coalification range from soft brown coal to anthracite, indicating its geological stage , as well as physical and chemical qualities resulting from it
C) a synonym of the volatile matter content in coal
D) quantitative measure of the organic matter content in coal

368. Catalytic cracking reactions happen:
A) through radicals

B) by the use of a catalyst of acid character
C) through a carbo-cation
D) in temperatures of over 800 ^{o}C

369. The following compounds A: 1-chloro-1-butene, B: 3-chloro-1-butene, C: 4-chloro-1-butene, D: 1-chlorobutane were ranked by increasing reactivity of the halide, which is shown by notation:
A) A < C = D < B
B) D < B < A < C
C) B < D < C < A
D) A < B < C = D

370. Can a workstation be equipped with a device without certified safety marking:
A) yes
B) yes, but only after placing a warning board
C) yes, if it holds a certificate of conformity
D) no

371. In solutions of the same concentration the increase in the length of a hydrocarbon chain in the homologous series of organic acids brings about:
A) lowering of the surface tension
B) increase of the surface tension
C) the increase of acid solubility
D) does not affect the surface tension

372. Indicate which of the following products contains a vinyl polymer obtained as a result of free-radicals polymerization:
A) an electric socket [phenol-formaldehyde resin, the so called bakelite]
B) nylon tights
C) a scarf containing 50% polyacrylonitrile [ACN] and 50% cotton
D) a shopping bag made of PET [polyethylene terephthalate]

373. According to the optimal use of resources principle, we should:
A) recycle non- or incompletely reacted substrates and rationally use by-products and waste products
B) maximally reduce side reactions [appropriate catalyzer, reactor, process parameters]
C) use the required excess of reagents in relation to the stoichiometry
D) all the answers are correct

374. Laboratory organic waste is sorted out into a group containing halogen derivatives
A) probability of reacting of halogen derivatives' compounds with other organic compounds
B) necessity of recovery of waste containing halogenorganic compounds
C) other kinds of chemical regeneration of both kinds of waste
D) another way of chemical utilization of both kinds of waste

375. According to the principle of maximum use of materials , a process should be carried out so that occurrence of side products is minimized. Which method of obtaining chloromethane is compliant with this principle?:
A) none of these methods
B) reaction of chloride excess [e.g. 5 kilomoles] with 1 kilomole methane and recovery of the excess chloride which has not undergone the reaction
C) reaction of 1 kilomole chloride with 1 kilomole methane
D) reaction of methane excess [e.g. 5 kilomoles] with 1 kilomole chloride and recovery of the excess methane which has not undergone the reaction

376. A decrease in carbon dioxide emissions when burning coal can be achieved by:
A) replacing coal with natural gas
B) replacing hard coal with lignite
C) increasing energy generation efficiency
D) co-firing of biomass

377. In cold crystallization of organic substances, the solvent is chosen so that:
A) both contaminants and a formulation are dissolved hot
B) both contaminants and a formulation are dissolved cold
C) contaminants are dissolved hot and a formulation cold
D) contaminants are dissolved cold and a formulation hot

378. In the process of gaseous fuels desulphurization using activated carbon, the used adsorbent regeneration is conducted by:
A) stripping sulphur from the activated carbon surface with superheated steam
B) oxidizing roasting of the used adsorbent
C) the elution of sulphur from the activated carbon surface with ammonium sulphite
D) adsorbent roasting in anaerobic conditions

379. The process of the thickening of solutions in industrial conditions takes place in:
A) sedimentation tanks, centrifuges
B) crystallisers, tank mixers
C) filters, filter presses
D) evaporators, evaporator batteries

380. The degree of electrolytic dissociation is determined by:
A) the ratio of ion concentration to dissociated molecule concentration
B) the algebraic sum of charge of ions into which the electrolyte molecule dissociates
C) the number of ions into which the electrolyte dissociates

D) the ratio of the number of moles of the electrolyte which has undergone dissociation to the initial number of moles of the electrolyte

381. The theoretical combustion temperature takes into account:
A) heat loss to the environment and the exhaust gas dissociation
B) the heating of air and fuel as well as the exhaust gas dissociation during surplus air combustion
C) all of the above
D) heat loss to the environment during surplus air combustion

382. During heating a sphere for the first 2 minutes of the process there has been an increase of the temperature by 2oC in its centre. Will the increase by 2oC last?:
A) The problem is too complicated to provide one unambiguous answer
B) for longer than 2 minutes
C) 2 minutes
D) shorter than 2 minutes

383. What does the term degree of absorption denote:
A) the ratio of a liquid inert flow to a gas inert flow
B) coefficient describing to what extent an interface formed on the surface of the absorber filling
C) the ratio of the active surface filling to the surface filling
D) the ratio of the concentration change of the component absorbed in the gas to the concentration of the component adsorbed in the incoming flow

384. Amonothermal synthesis of single GaN crystals according to the latest f-my AMMONO method from Warsaw, follows the reaction of:
A) ammonolysis/deamination of gallium amide in gaseous phase
B) metallic gallium with nitrogen at high pressure and high temperatures
C) recrystallization of powdered GaN in the temperature gradient conditions in supercritical ammonia, in the presence of basic mineralizer addition
D) metallic gallium with ammonia in gaseous phase

385. A flat wall made of material of the heat conduction coefficient 0.3 W/[mK] is 0.6 m thick. Resistivity of heat conduction through this wall in [[m2K]/W] will be:
A) 5
B) 10
C) 2
D) 0.5

386. The VLS mechanism of creating one-dimension carbon and non-organic nanostructures is based on significant participation of precursors' reaction in:
A) liquid phase
B) specified temperature and pressure conditions and an appropriate type of gaseous atmosphere
C) solid, liquid and gaseous phase
D) solid and liquid phase

387. Chlorine is more reactive than bromine because of its:
A) smaller atomic radius
B) lower electron affinity
C) lower ionization energy
D) lower number of neutrons in the nucleus

388. During cooling after 25 minutes of the process, the non-dimensional temperature of a body is equal to 0.3. Initially the body had a temperature of 120oC, the temperature of the surroundings is constant and is equal to 20oC. What is the temperature of the body measured in Celsius degrees?:
A) 50
B) 70
C) 60
D) 30

389. For a more precise characterization of hazardous substances alphanumeric symbols S and R are used. They denote:
A) the procedure and hazards arising from its properties
B) the procedure applied in the event of uncontrolled leaks to the natural environment
C) the procedure applied during handling
D) the way of transportation and precautions used during handling

390. The vaporizer is a device for:
A) steam distillation
B) removing contaminants from the gas stream
C) pre-concentrating solutions
D) removing particulates from solutions

391. An increase in the combustion temperature can be achieved by:
A) all the answers are correct
B) decreasing the amount of the surplus air
C) increasing the amount of oxygen in the air used for combustion
D) heating the air used for combustion

392. The outstanding achievement of Polish science, consisting in the first ever successful attempt at harnessing the technology for the creation of single GaN crystals for modern optoelectronics , took place :

A) at the Faculty of Electrical Engineering, Automatics, Computer Science and Electronics of the AGH University of Science and Technology in Krakow
B) at the Chemistry Faculty of Warsaw Polytechnics
C) in the Experimental Physics Institute at the Physics Faculty of Warsaw University
D) in the PAN Institute of High Pressures in Warsaw

393. Agglomeration of particulate materials may take place through:
A) granulation, sintering, briquetting
B) pressure compacting small particles of a particulate material
C) pouring a moisturized powder material in appropriate devices
D) sieving particulate materials

394. Heat transfer, also referred to as heat exchange, is a natural phenomenon occurring when there is a difference in temperature. Which mode of heat flow is incorrect in terms of physical mechanisms?:
A) radiation
B) convection
C) transmission
D) conduction

395. The overall energy of an isolated system in which a process proceeds at a finite rate:
A) will always decrease
B) may increase or decrease
C) remains constant
D) will always increase

396. The occurrence of oil-water emulsions in petroleum is facilitated by:
A) heating of the water – petroleum system
B) the viscosity increase
C) the presence of surface-active substances
D) slight lowering of the temperature of petroleum containing dissolved water

397. The critical carbon content distinguishing between steel and cast iron is:
A) 0.77%
B) 3.40%
C) 4.30%
D) 2.11%

398. Energy gap of the modern broadband semiconductor – gallium nitride, GaN, equals:
A) 6.2 eV
B) 3.4eV
C) 1.1 eV
D) 0.5 eV

399. Vapour pressure of liquid A in a presence of immiscible liquid B is:
A) logarithmic function of temperature
B) independent of the molar fraction A in the system
C) linear function of temperature
D) proportional to the molar fraction A in the system

400. The maximum useful capacities of underground gas reservoirs are of the order of:
A) less than 10 million m3
B) millions m3
C) billions m3
D) less than 1 million m3

401. An octane number is a percentage content in a model mixture (composition) of:
A) 1-n-octanol
B) isooctane
C) n-butane
D) benzene

402. Thermistor is a temperature-measuring device in which:
A) capacity decreases with increasing temperature
B) electromotive force increases with increasing temperature
C) resistivity changes with increasing temperature
D) electromotive force decreases with increasing temperature

403. Conductometry method is used for:
A) quantitative and qualitative determination
B) neither qualitative nor quantitative determination
C) quantitative determination
D) qualitative determination

404. Crude oil (petroleum) is a source of:
A) raw materials for petrochemical synthesis
B) diesel liquid and energetic fuels
C) petrol, kerosene, diesel oil
D) natural gas and brown coal

405. Dust particulates separation takes place in:
A) cyclones, fabric filters, foam dust collectors

B) sedimentation tanks, fabric filters, centrifugal separators
C) fabric filters, settling chambers, electrostatic precipitators
D) cyclones, filter presses, centrifugal separators

406. The molecular formula $C_4H_{10}O$ includes constitutional isomers in the number of:
A) 4
B) 5
C) 7
D) 9

407. Which of the options of petroleum refining distinguishes itself with the widest range
A) fuel option
B) fuel-oil
C) fuel with deepened petroleum refining
D) petrochemical

408. Mole conductivity of a solution is a:
A) product of electrolytic conductivity and solution concentration
B) difference of electrolytic conductivity and a solution concentration
C) sum of electrolytic conductivity and a solution concentration
D) quotient of electrolytic conductivity and solution concentration

409. The net calorific value of a fuel is determined on the basis of:
A) subtracting the formation heat of nitric and sulphuric acids in the flue gas/exhaust gas from the heat of combustion
B) adding the formation heat of nitric and sulphuric acids in the flue gas/exhaust gas to the heat of combustion
C) subtracting the vapourisation heat of water contained in the flue gas/exhaust gas from the heat of combustion
D) adding the vapourisation heat of water contained in the flue gas/exhaust gas to the heat of combustion

410. Compounds $C_nH_{2n+2}O$, $C_nH_{2n+1}NO_2$, $C_nH_{2n+1}CHO$ belong to the following groups:
A) alkanols, amino alkanes, alkanons
B) alkanols or alkoxy alkanes, nitroalkanes, alkanals
C) alkanols, nitroalkanes, alkano-acids
D) alkoxy alkanes, nitroso-alkanes, alkanals

411. The change of internal energy is equal to heat transferred in a closed system during the following process:
A) an adiabatic process
B) an isochoric process
C) an isobaric process
D) an isentropic process

412. Water hardness by the occurrence of the following compounds in water:
A) lime and magnesium salts
B) ferric and manganese salts
C) potassium and sodium salts
D) phosphates

413. Which of the following is a psychrometric mixture:
A) water vapour and water
B) atmospheric air
C) water and ice mixture
D) exhaust gas

414. In the container holding liquid water, steam, and ice in equilibrium, the system is:
A) homogeneous
B) inhomogeneous
C) single phase
D) multiphase

415. STEL (Polish: NDSCh) is:
A) the maximum permissible short-term chemical concentration – the weighted average of chemical substances concentrations [vaporous or gaseous] per shift with no negative health impact
B) the maximum permissible short-term concentration – the maximum, but occurring at the work station for 60 minutes [2x30 minutes with a minimal break of 0.5 hours per shift]
C) the maximum permissible short-term concentration – 2 x 1 hour per day
D) the maximum permissible short-term concentration occurring in the air at the work station for the period of 30 minutes [2x max 15 minutes with a minimal break of 1 hour per shift]

416. The Stirling engine is:
A) a pneumatic motor
B) an external combustion engine
C) a reciprocating internal combustion engine
D) an electric motor

417. Butane can be visually distinguished from 1-butyne by reactions of:
A) combustion, with hydroxylamine, with sulphuric[VI] acid, with a solution of bromine in tetrachloromethane
B) combustion, with sodium, with a solution of bromine in tetrachloromethane, with a solution of potassium manganate[VII]
C) ozonolysis, with hydrogen iodide, with sodium, with sulphuric[VI] acid
D) hydrogenation, with sodium hydroxide, with hydrogen bromide, with a solution of potassium manganate[VII]

418. A magnesium ion, Mg^{2+} differs from an atom of magnesium in that:
A) it has no valence electrons in the outer shell whereas an atom has 8

B) it has 2 electrons in the outer shell whereas an atom has 8
C) it has two electrons more than an atom
D) it has 8 electrons in the outer shell whereas an atom has 2

419. The salt which is sparingly soluble is:
A) NaCl
B) K_2SO_4
C) $Pb[NO_3]_2$
D) AgCl

420. High calorific gases manufactured by means of industrial methods include:
A) coal gas and methane-rich refinery gases
B) firedamp and methane-rich refinery gases
C) methane-rich refinery gases
D) producer gas generated from coal and gases obtained by means of industrial methods

421. Guidelines for safe machine and equipment design:
A) are included in the Labour Code
B) are included in applicable national standards
C) are included in the guidelines of the Office of Technical Inspection
D) result from specificity of a place and their functioning

422. The main difference between a cell and an electrolytic cell consists in the fact that:
A) in a cell, a reaction is forced by an externally applied voltage, whereas in an electrolytic cell, the process occurs spontaneously causing the flow of current
B) in an electrolytic cell occur only oxidation processes, whereas in a cell - only reduction processes
C) in a cell, a reaction takes place spontaneously causing a flow of electrons in an external circuit, whereas in an electrolytic cell, the process is forced by an externally applied voltage which causes the movement of electrons in the opposite direction
D) during electrolysis occur processes which generate potential difference

423. The currently effective Polish Environmental Protection Law is strictly connected with:
A) the EU Green Paper
B) the Seveso I Directive
C) the Seveso II Directive
D) the EU White Paper

424. The elements in the same group of the periodic table do not vary in terms of:
A) the atomic radius
B) the number of protons in the nucleus
C) the number of neutrons in the nucleus
D) configuration of valence electrons

425. Graphite melts:
A) at temperature 4100
B) does not melt
C) at temperature 4500
D) at temperature 3800

426. For the reaction CO(g) + H2O(g) = H2(g) +CO2(g):
A) Kp is equal to one
B) Kp<Kc
C) Kp>Kc
D) Kp=Kc

427. Which of the following methods will you propose as the most suitable for obtaining 100% ethanol on the commercial scale? :
A) fractional distillation in the environment of dry nitrogen
B) distillation in the presence of calcium chloride
C) addition of benzene and rectification in the system : water- ethanol – benzene
D) rectification in the copper column in the hermetic apparatus

428. Electrophoresis is:
A) liquid motion under the influence of the electric field
B) motion of colloidal particles under the influence of the electric field
C) motion of dipoles in the electric field
D) flow of ions under the influence of the electric field

429. IR radiation is absorbed by:
A) all diatomic molecules
B) all molecules in which the dipole moment is changed as a result of vibration
C) SO2
D) all molecules

430. The formation of solid crystals in industrial crystallizers may be caused by:
A) mixing the solution intended for crystallization with a solvent
B) intensive mixing of the solution
C) cooling the solution or heating the solution with a simultaneous decrease in the pressure
D) cooling the solution or solvent evaporation

431. Which of the following is a pass heat exchanger:

A) a building wall accumulating solar heat
B) a steam engine in a municipal thermal power plant
C) an electric-heated water- storage boiler
D) freon evaporator in a compression refrigerator

432. Ozone is:
A) an allotrope of oxygen
B) an isomer of oxygen
C) a homologue of oxygen
D) an isomorphic form of oxygen

433. To burn 1 m^3 of methane, should be delivered approximately:
A) 16.5 m^3 of air
B) 37 m^3 of air
C) 32.5 m^3 of air
D) 22 m^3 of air

434. Instrumental methods of pH measurement use the following:
A) a calomel electrode
B) a golden or lead electrode
C) a hydrogen electrode
D) a glass electrode

435. The flame stability on the gas burner depends on:
A) the calorific value of the gas and the quantity of air sucked in through the injector
B) the relative density of gas and the overpressure of the gas before the gas burner [relative to the pressure of the environment]
C) the heat load of the gas appliance and its efficiency
D) the flame velocity and the linear velocity of the flow rate of gas through the outflow nozzle

436. For transient processes of thermal conduction, flux density is directly proportional to:
A) average temperature of the system
B) grad T
C) the difference between the bodies' temperature
D) –grad T

437. For the complete combustion of 1 m3 of methane, it is necessary to supply at least:
A) 6.5 m3 of air
B) 4 m3 of air
C) 12 m3 of air
D) 9.5 m3 of air

438. Gas cylinders for flammable gases are painted:
A) blue
B) red
C) yellow
D) green

439. A radius of ionic atmosphere is:
A) inversely proportional to the ionic strength
B) proportional to the ionic strength
C) the exponent of the ionic strength
D) does not depend on the ionic strength

440. The calorific value of natural gas:
A) among other things, depends on ethane and propane content in its composition
B) is comparable to the calorific value of LPG and lower than the calorific value of coke oven gas
C) in the case of high-methane natural gas, does not exceed 20 MJ/m^3
D) is greater than its heat of combustion

441. Dislocations are crystal lattice defects:
A) zero-dimensional
B) one-dimensional
C) three-dimensional
D) two-dimensional

442. In polarography, the characteristic quantity identifying ions is:
A) limiting current
B) diffusion current
C) residual current
D) half-wave potential

443. Bi- or multimodal type of the reflectance diagram of coking coal delivered to a coking plant indicates that:
A) it is coal of a low rank
B) it is a blend of coals from two or more mines
C) the coal comes from one coal bed
D) this is coal of a high rank

444. From which oxide can $HClO_4$ acid be obtained:
A) Cl_2O_3
B) Cl_2O_7

C) Cl_2O
D) Cl_2O_5

445. If contaminants do not dissolve hot, while a formulation of interest does, it is required that:
A) a mixture is cooled and filtered cold
B) components of a mixture are separated in a separatory funnel
C) a mixture is passed through a deposit of a high surface area substance
D) a clear solution is decanted hot

446. The Pareto principle says that:
A) each error has its cause
B) one cause can lead to several related errors
C) 20% of the errors come from 80% of the causes
D) 80% of the errors come from 20% of the causes

447. If adding a substance to water lowers its surface tension, then:
A) adsorption of this substance is positive
B) it does not have anything in common with adsorption
C) adsorption of this substance is negative
D) adsorption of this substance occurs

448. Which is the lattice system of fullerens:
A) fulgurite
B) *fulcryft
C) fullerite
D) *fullite

449. The border between the gas distribution network and the gas installation is:
A) a separate line that branches off to supply gas to a household from the main network
B) the gas meter at the customer’s house
C) the home reducer
D) the master valve

450. Preventive and countering services for effects of major industrial accidents in Poland do not include:
A) State Fire Service
B) State Aviation Agency
C) The Office of Technical Inspection
D) The National Labour Inspectorate

451. Liquid viscosity at increased temperatures:
A) increases exponentially
B) decreases exponentially
C) increases linearly
D) decreases linearly

452. Proportioning of gases can be done:
A) by volume
B) by volume and by weight
C) gases cannot be proportioned, they can only be injected
D) by weight

453. A multiple bond between atoms always consists of:
A) only sigma bonds
B) one pi bond and the remaining sigma bonds
C) one sigma bond and the remaining pi bonds
D) only pi bonds

454. Is the wave number a measure of energy?:
A) it depends on the electromagnetic wave frequency
B) yes
C) no
D) it depends on the actual energy value

455. At present, the raw material used to obtain petrol is :
A) coal tar
B) brown coal
C) natural gas
D) petroleum

456. Langmuir’s adsorption isotherm is based on the assumption of:
A) flat constant surface
B) ideal gas behaviour
C) constant warmth of adsorption
D) activation energy of adsorption and desorption processes which is equal to zero

457. The time of drops fall in the oil-water emulsion division is proportional to:
A) temperature
B) the square of the diameter of a drop
C) the medium viscosity
D) electric field intensity

458. The ammonia synthesis occurs according to the equation N2 + 3H2 <->2NH3 and is carried out with the use of a contact catalyst. It leads to the conclusion that , in order to obtain the maximum efficiency of the process of ammonia synthesis in the possibly shortest time, the process should be conducted:
A) under lowered pressure and possibly high temperature
B) under increased pressure and possibly high temperature
C) under increased pressure and possibly low temperature
D) under lowered pressure and possibly low temperature

459. Orthocoking coal is not used for combustion in grate furnaces because:
A) its calorific value is too low
B) it requires too much air for combustion
C) it agglomerates on a grate and losses of the fuel due to incomplete combustion are very high
D) furnace black is formed during combustion

460. In a correctly operated coke battery , the gas pressure in ovens is:
A) always positive and towards the end of the coking process its value measured below the oven ceiling should not be lower than ± 5 Pa
B) always negative and towards the end of the coking process its value measured next to the oven floor should not be higher than ±5 Pa
C) always positive and towards the end of the coking process its value measured next to the oven floor should not be lower than ±50 Pa
D) always positive and towards the end of the coking process its value measured next to the oven floor should not be lower than than ±5 Pa

461. Interference occurs in the case of waves which:
A) propagate in the same direction
B) have a time-constant phase-shift
C) have identical frequency
D) have identical amplitude

462. Which parameter does not describe graphite crystallite parameters:
A) La – the diameter of the crystallite
B) Lc - the height of the crystallite
C) Ld – the width of the crystallite
D) d002 – interlayer distance

463. Contact-free temperature measurements consist in:
A) measurements of light intensity
B) measurements of IR radiation intensity
C) analysing the convective gas flow
D) measurements of thermal properties of a test object upon heating it with laser radiation

464. The Dalton's law for ideal gases determines:
A) density of a gas mixture
B) volume of a gas mixture
C) the proportion of a mixture component
D) pressure of a mixture component

465. The bulk density of the coal charge in the oven increases according to the following sequence:
A) the traditional top charging system > top charging of the pre-heated coal charge > top charging of the partially briquetted coal charge > stamping of the pre-heated coal charge> stamping of the wet coal charge
B) the traditional top charging system > stamping of the wet coal charge > top charging of the pre- heated coal charge >top charging of the partially briquetted coal charge > stamping of the wet coal charge
C) the traditional top charging system >stamping of the wet coal charge > top charging of the pre-heated coal charge >s tamping of the pre-heated charge > top charging of the partially briquetted coal charge > stamping of the wet coal charge
D) the traditional top charging system> top charging of the pre-heated coal charge > top charging of the partially briquetted coal charge >stamping of the wet coal charge > stamping of the pre- heated coal charge

466. TLV-C (Polish: NDSP) is:
A) the maximum permissible short-term chemical concentration – the weighted average of chemical substances concentrations [vaporous or gaseous] per shift with no negative health impact
B) the maximum permissible short-term concentration – 2x 1 hour per day
C) the highest permissible threshold concentration – the highest concentration which may occur at a work station and which may be exceeded only temporarily
D) the maximum permissible threshold concentration – the maximum concentration which may occur at a work station and which must not be exceeded at any time

467. For athermal solutions:
A) HE =0, GE><0, SE =0
B) HE =0, GE=0, SE ><0
C) HE =0, GE><0, SE ><0
D) HE >=0, GE=0, SE ><0

468. Heat of combustion is the amount of heat released during:
A) complete and perfect combustion involving a release of water in the liquid form
B) perfect combustion involving a release of water in the liquid form
C) complete and perfect combustion involving a release of water vapour
D) complete combustion involving a release of water vapour

469. The coefficient of heat conduction:
A) is opposite of the conduction resistance
B) determines susceptibility of a liquid to a convectional heat transport
C) can be used as a criterion of division of materials into conductors and non-conductors
D) is always smaller than a unit

470. The aim of catalytic reforming is to:
A) obtain high aroma petrol fractions
B) mainly dehydrogenation of cycloalkanes to aromas
C) refining of petroleum fractions in the boiling temperature over 200 ^[o}C
D) catalytic decomposition of C-C combinations

471. After addition of a few drops of phenolphthalein to the aqueous solution of barium hydroxide [a.k.a. barium water], the solution will show raspberry colouration. After passing a certain gas through the vessel containing the above solution, its discolouration occurred. The in question gas could be:
A) NH_3
B) CO_2
C) NO
D) HCl

472. Which of the following methods can be used to separate ingredients of a uniform mix in industrial conditions:
A) distillation and absorption
B) fluidization and pumping
C) distillation and rectification
D) absorption and adsorption

473. In general, the mass transfer flow can be expressed as a product of the following quantities:
A) the transfer coefficient, the surface of mass exchange and the cross-section of the apparatus
B) the coefficient and the driving force of the mass transfer process
C) the diffusion coefficient, the surface of mass exchange and the height difference of the filling layer
D) The coefficient of mass transfer, surface and the driving force of the mass transfer process

474. Bimetallic thermometer operation is based on the following measurements:
A) extension of the thermo-bimetallic pile
B) extension of the optical path after the mirror is shifted
C) measurements of strain caused by the difference between linear expansions of two metals
D) deformation as a result of material softening

475. The process of ash melting is characterized by the temperatures of:
A) ignition, melting, resolidification
B) softening, maximum fluidity, resolidification
C) initial deformation, softening, melting. flow
D) softening, contraction, dilatation

476. A black body features:
A) low capability of thermal radiation absorption
B) high capability of thermal radiation transmission
C) high capability of thermal radiation reflection
D) high capability of thermal radiation absorption

477. Density of the heat stream conducted through a flat wall is equal to 10 W/m2. The temperature of one edge of the wall is equal to 100oC, and conduction resistivity is 10 [m2K]/W. The temperature [in Celsius degrees] of the second edge will be equal to:
A) -100
B) 50
C) 200
D) 0

478. Heptane can be distinguished from 1-heptane by:
A) reaction with nitric[V] acid
B) leaving both substances in contact with air [oxidation]
C) mixing both substances with alcohol
D) reaction with a solution of potassium manganate[VII]