

Set of questions for the faculty exam/entrance exam for full-time first cycle students of Oil and Gas Engineering, specialization Petroleum Engineering

- 1) The precondition for the formation of a hydrocarbon reservoir is:
 - a) the existence of porous space in the rock, where migration of hydrocarbons may occur
 - b) the existence of a permeable rock with a sufficiently large thickness
 - c) the existence of a porous reservoir rock, which shape and configuration allows for the accumulation of hydrocarbons
 - d) the porous rock is located at depths greater than 1 000 MBSL (meters below sea level)

- 2) The effective porosity of a rock is:
 - a) the ratio of the number of interconnected pores to the volume of the rock
 - b) the ratio of the volume of the rock to the volume of interconnected pores
 - c) the ratio of the volume of all pores in the rock to the volume of the rock
 - d) the ratio of the volume of interconnected pores to the rock volume

- 3) The effective permeability of a rock is:
 - a) the permeability of the rock for a given fluid with the complete saturation of the rock with this fluid
 - b) the ratio of the relative permeability to the absolute permeability
 - c) the ratio of the absolute permeability to the relative permeability
 - d) the permeability of the rock for a given fluid when the rock is saturated with more than one fluid

- 4) From the occurrence of the Klinkenberg effect, it can be deduced that the measured gas permeability of the rock at low pressure is:
 - a) greater than the absolute permeability of the rock
 - b) equal to the absolute permeability of the rock
 - c) equal to the liquid permeability of the rock
 - d) less than the absolute permeability of the rock

- 5) On the P-T phase diagram, the area of unsaturated oil deposits is present:
 - a) to the left of the critical isotherm and above the bubble-point curve
 - b) to the right of the critical isotherm and below the dew-point curve
 - c) between the critical isotherm and the cricodentherm isotherm
 - d) to the left of the critical isotherm and below the bubble-point curve

- 6) The bubble-point pressure is:
 - a) the lowest pressure at which gas begins to release from oil at a given temperature
 - b) the highest pressure of a given hydrocarbon system at which, at a given temperature, oil begins to release gas
 - c) the highest pressure at which the gas is completely dissolved in the oil at a given temperature
 - d) the lowest pressure of a given hydrocarbon system at which, at a given temperature, oil begins to release gas

- 7) The Oil Formation Volume Factor " B_o " describes:
 - a) the ratio of the volume of oil at reservoir conditions to the volume of the same amount of oil at surface conditions
 - b) the ratio of the amount of oil at reservoir conditions to the amount of oil at surface conditions
 - c) the ratio of the volume of oil at reservoir conditions to the amount of oil at surface conditions
 - d) the ratio of the volume of oil at reservoir conditions to the volume of oil at surface conditions

- 8) The production gas exponent "Gas Oil Ratio (GOR)" describes:

- a) the amount of gas being produced in relation to the total amount extracted from the oil reservoir
 - b) the ratio of the amount of gas being produced to the amount of oil being produced at a given moment in the reservoir's exploitation
 - c) the ratio of the amount of produced gas to the amount of produced oil from the reservoir
 - d) the ratio of the amount of produced gas to the amount of oil being produced at a given moment in the reservoir's exploitation
- 9) The van Everdingen-Hurst model of determining the water inflow to the reservoir can be applied for aquifers:
- a) limited and unlimited
 - b) unlimited
 - c) operating only under steady-state conditions
 - d) limited
- 10) The degree of depletion for oil resources with a gas cap depends mainly on:
- a) rock and water expansion, degree of gas resources depletion, oil exploitation efficiency, oil saturation
 - b) the gas cap size, vertical permeability, degree of gas resources depletion, oil exploitation efficiency
 - c) the gas cap size, horizontal permeability, the amount of water inflow to the reservoir, reservoir thickness
 - d) horizontal permeability, the amount of water inflow to the reservoir, thickness and porosity of the reservoir
- 11) Well productivity index for an unsaturated oil field:
- a) is constant, and the well productivity linearly increases with the decrease in the bottomhole pressure
 - b) is constant, and the well productivity linearly decreases with the decrease in the bottomhole pressure
 - c) is constant, and the well productivity decreases with the increase in the bottomhole pressure
 - d) changes, and the well productivity is constant
- 12) The geological resources of a gas reservoir include:
- a) resources determined by the size and quality of the geological structures which may contain gas
 - b) recoverable resources that do not meet the balance criterion
 - c) recoverable resources
 - d) total gas resources in the reservoir
- 13) The gas deposits on the phase diagram are located:
- a) to the left of the critical isotherm
 - b) to the left of the cricodentherm isotherm
 - c) to the right of the critical isotherm
 - d) between the critical isotherm and the cricodentherm isotherm
- 14) The volumetric method allows for:
- a) determination of only initial gas in place in the reservoir
 - b) determination of gas resources in the reservoir at any time during its existence
 - c) determination of recovered gas resources
 - d) determination of recoverable resources
- 15) The main components of the downhole equipment of a gas well include:
- a) casing, tubing, wellhead
 - b) casing, tubing, casing hanger
 - c) tubing, casing hanger, tubing hanger

- d) casing, production packer, casing bushing
- 16) The main components of the surface equipment of a gas well include:
- a) wellhead, separator, restriction orifice
 - b) wellhead, packer, separator
 - c) wellhead, tubing hanger, casing bushing
 - d) wellhead, measuring section, landing nipple
- 17) The potential well efficiency is:
- a) the maximum flow rate of gas to the well
 - b) the allowed capacity of the well
 - c) the initial flow rate of gas to the well
 - d) the flow rate with the permissible reservoir depression
- 18) The nodal analysis allows the determination of:
- a) the well efficiency at a given difference of reservoir and bottomhole pressure
 - b) the well efficiency at a known difference of bottomhole and wellhead pressure
 - c) the well efficiency at a known reservoir pressure and given wellhead pressure
 - d) the potential well efficiency
- 19) Determination of gas resources in a reservoir using the volumetric method requires the knowledge of the following parameters:
- a) surface area and depth of the reservoir, rock porosity, gas composition, reservoir pressure and temperature conditions
 - b) reservoir pore volume, gas saturation, gas composition, reservoir pressure and temperature conditions
 - c) surface area and thickness of the reservoir, rock permeability, water saturation, gas composition, reservoir pressure and temperature conditions
 - d) surface area of the reservoir, rock porosity, depth of the reservoir, water saturation, gas composition, reservoir pressure and temperature conditions
- 20) A production well where the tubing is not equipped with a packer enables the production of gas:
- a) only via tubing
 - b) via tubing and via the annulus
 - c) only via the annulus
 - d) simultaneously from several prospective intervals with different pressures
- 21) What is the main reason for the efficiency decline of the waterdrive system oil reservoir?
- a) high water exponent
 - b) high gas exponent and an increase in oil viscosity
 - c) a decrease in the reservoir permeability
 - d) a decrease in the reservoir pressure
- 22) What is the main reason for the efficiency decline of the gas cap drive oil reservoir?
- a) reduction of the calorific value of the gas
 - b) high water exponent and an increase in gas viscosity
 - c) high gas exponent and low reservoir pressure
 - d) a decrease in the reservoir permeability
- 23) How does the solution gas-oil ratio (GOR) change above bubblepoint pressure as a function of pressure?
- a) increases together with increasing pressure
 - b) decreases together with increasing pressure
 - c) increases logarithmically with increasing pressure
 - d) is constant over this range of reservoir pressure

- 24) How does the oil formation volume factor (B_o) change above bubblepoint pressure as a function of pressure?
- increases logarithmically with increasing pressure
 - is constant over this range of reservoir pressure
 - decreases together with increasing pressure
 - increases together with increasing pressure
- 25) How do secondary oil extraction methods support the exploitation?
- they modify the physical properties of the rock and formation fluids
 - they support the natural processes occurring in the reservoir by providing additional energy
 - they support the natural processes occurring in the reservoir by providing additional energy and modifying bedrock properties
 - they support the natural processes occurring in the reservoir by providing additional energy and modifying oil properties
- 26) Is the electric submersible pump commonly used in operations with a very high gas exponent?
- yes, but only for low-density oil
 - yes, but only in shallow wells
 - no, because the gas may block the pump and prevent exploitation
 - yes, because gas facilitates the flow of oil
- 27) Can a production installation with a gas lift be used in offshore operations?
- yes, but only for wells less than 500 m deep
 - no, as the components of the device cannot be mounted on the wellhead located on the seabed
 - yes, but only for shallow sea depths
 - yes, because the design and operation principle of the device make it possible
- 28) Do the well stimulation treatments (WST) affect the energy conditions of the crude oil reservoir?
- no, they only affect the physical properties of the reservoir in the treatment area
 - yes, the production increases due to the displacement of oil from the reservoir
 - yes, they restore the reservoir energy and improve the physical properties of the reservoir
 - yes, the increase in production occurs as a result of increasing the reservoir energy
- 29) Is underground storage of crude oil and/or petroleum products performed in natural geological structures?
- yes, in salt caverns
 - no
 - yes, in the roadways of disused coal mines
 - yes, in depleted crude oil reservoirs
- 30) The hydraulic shock is only created in the pipeline when:
- the pipe is clogged by precipitating paraffin residue
 - the pipeline is inclined and the medium flows from top to bottom
 - any change occurs in the flow parameters of the transported medium
 - when the pumps are turned off due to a power failure
- 31) During a construction stage of a long-distance transmission pipeline, it is obligatory to:
- test each welded joint
 - test the insulation of the entire outer surface of the pipeline
 - perform the patency and tightness test
 - all answers are correct
- 32) How the pipeline can be protected against the effects of the hydraulic shock:
- via a thickened pipeline wall near the valves
 - via a bypass connection of pump aggregates
 - all answers are correct

- d) via pneumatic shock absorbers near the valves
- 33) Testing the condition of the external corrosion protection of the pipeline consists of:
- there is no need for such a test according to the Polish law regulations
 - visual inspection of the insulation over the entire surface of the pipes
 - leveraging the electrical breakdown at the point where the insulation is damaged
 - using the ultrasonic TOFD method
- 34) How can an oil/petroleum products storage tank be protected against the effects of a liquid leak?
- tank embankment
 - curtain wall
 - all answers are correct
 - insulating geomembrane in the ground on which the tank is placed
- 35) What should be done when the vapour pressure inside the storage tank rises above the allowable overpressure due to solar heating?
- storage tanks are designed and manufactured in such a way (they are so durable) that the daily temperature changes are not able to cause an increase in overpressure and underpressure above the permissible values
 - immediately turn on the sprinkler system to cool the tank down or pour water on the outside of the tank
 - release excess vapours to the atmosphere immediately in the emergency mode
 - force a part of the vapours from the tank to the vapour recovery system
- 36) The individual reservoir fluid collection system is used when:
- all answers are correct
 - the reservoir fluid has unusual properties and its treatment requires an individual approach
 - the well efficiency is large, and it is economically justified
 - the well has high water content
- 37) In the process of the reservoir fluid separation, the following are used:
- gravitational force and/or centrifugal force
 - only the centrifugal force
 - only the gravitational force
 - the temperature difference between the reservoir fluid and the ambient temperature
- 38) The coalescence is:
- the formation of the oil-water emulsion
 - the process of separating the formation fluid into phase components
 - the process of paraffin precipitation from crude oil and the sediment formation
 - the process of fusing small droplets of the dispersed phase into larger droplets
- 39) The purpose of the crude oil stabilisation process is:
- the separation of the water from the oil
 - the separation of gaseous hydrocarbons from oil
 - the separation of light hydrocarbons (gaseous and gasoline) from crude oil and their separate management
 - the purification of crude oil from mechanical impurities
- 40) Multistage separation is carried out when:
- the extracted reservoir fluid contains a lot of mechanical impurities
 - the extracted reservoir fluid is under high pressure
 - the extracted reservoir fluid contains a large amount of water
 - the extracted reservoir fluid contains a lot of heavy paraffinic hydrocarbons
- 41) During the reservoir fluid separation process, the fluid temperature is being raised for the purpose of:
- lowering the viscosity of the liquid components of the reservoir fluid

- b) reducing the surface tension at the oil-water interface
- c) all answers are correct
- d) increasing the vibrations speed of the reservoir fluid's free molecules

42) The downhole separation consists of:

- a) assembling the entire mining installation at the bottom of the well and extracting only crude oil to the surface
- b) the downhole separation is not feasible due to technical reasons
- c) the downhole separation is not allowed because the regulations prohibit the injection of water extracted together with oil into the rock mass
- d) the preliminary water separation from the reservoir fluid and its injection into the productive layer without bringing it to the surface

43) What happens to gasoline hydrocarbons in crude oil?

- a) they are separated from the crude oil and managed separately
- b) there is no such problem as there is no gasoline in the oil fields; gasoline is only found in natural gas deposits
- c) they don't require any action, as these hydrocarbons will quickly evaporate from the oil
- d) are separated from crude oil and used as liquefied petroleum gas (motor fuel)

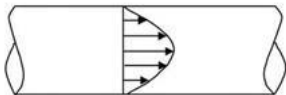
44) The unit of specific weight is:

- a) kg/m^3
- b) m^3/N
- c) m^3/kg
- d) N/m^3

45) Which theory describes the conservation of the total energy density for each fluid point, and is valid for the stationary flow of an incompressible ideal fluid?

- a) Navier-Stokes principle
- b) Euler method
- c) Bernoulli's principle
- d) Reynolds theorem

46) The picture below shows the velocity distribution of the fluid in the pipeline. The flow is laminar. What is the ratio of the maximum speed to the average speed?



- a) 4
- b) 3,14
- c) 2
- d)

47) Specify the type of mazut's flow ($\mu = 5,9 \cdot 10^{-3} \text{ N} \cdot \text{s}/\text{m}^2$, $\rho = 950 \text{ kg}/\text{m}^3$) in a pipe with a diameter $d = 10 \text{ cm}$, if the flow rate $Q = 0,001 \text{ m}^3/\text{s}$.

- a) stationary
- b) turbulent
- c) transitional
- d) laminar

48) The Reynolds number expresses:

- a) the ratio of inertia forces to viscous forces
- b) the ratio of inertia forces to gravitational force
- c) the product of the flow velocity and its kinematic viscosity
- d) the ratio of viscous forces to inertia forces

- 49) Frictional pressure losses of flowing fluid are calculated from:
- Torricelli's theorem
 - Bernoulli's principle
 - the gauge pressure equation
 - Darcy-Weisbach equation
- 50) Perfect gas (nitrogen) is compressed polytropically from pressure $p_1 = 0,2$ MPa and temperature $T_1 = 160$ K to pressure $p_2 = 1$ MPa and temperature $T_2 = 200$ K. Calculate the polytropic exponent ν and technical work l_t of compression for gas mass $m = 1$ kg.
- $\nu = 1,40, l_t = 186$ kJ/kg
 - $\nu = 1,16, l_t = -86$ kJ/kg
 - $\nu = 1,20, l_t = 86$ kJ/kg
 - $\nu = 1,66, l_t = -186$ kJ/kg
- 51) Calculate the work for isothermal compression (L_{12}) of an ideal gas (nitrogen) with mass $m = 2$ kg. The initial pressure $p_1 = 1$ bar, end pressure $p_2 = 10$ bar, temperature $T = 300$ K.
- $L_{12} = -410$ W
 - $L_{12} = -410$ kJ
 - $L_{12} = 1410$ kJ
 - $L_{12} = 420$ kJ
- 52) The normal cubic meter is:
- the quantity of gas contained in a volume of 1 m^3 at a pressure of 0.1 MPa and a temperature of 0°C
 - the quantity of gas contained in a volume of 1 m^3 at a pressure of 1 atm and a temperature of 0°C
 - the quantity of gas contained in a volume of 1 m^3 at a pressure of 1 atm and a temperature of 15°C
 - the quantity of gas contained in a volume of 1 m^3 at a pressure of $0.101325 \cdot 10^6$ Pa, and a temperature of 273,15 K containing 0,044615 kmol of gas
- 53) Heat and work - defined in thermodynamics - are:
- exact differentials because they do not depend on the process path and are Pfaff differentials
 - exact differentials because the formula for dq (heat flow of the system) and dl (work of the system) can be derived
 - exact differentials because they appear in the differential equation of the first law of thermodynamics
 - inexact differentials because they depend on the path of transformation
- 54) The Clapeyron equation $pv=RT$:
- is the ideal gas equation for 1kg of gas, if $R=8314/MM$ MPa·cm³/kg/K, where MM - the molar mass of the gas, ν - specific volume, T - temperature, p - pressure
 - is the ideal gas equation for hydrocarbon gases below 5 bar and at temperatures below 100°C
 - is the ideal gas equation for 1 kg of gas if the gas constant $R = 8,314$ J/mol/K
 - is the ideal gas equation
- 55) Which of the following equations (First Law of Thermodynamics) is valid for any kind of closed-system process:
- $Q_{12c} = U_2 - U_1 - L_{12}$
 - $dq = du + p \cdot dv + T \cdot ds$
 - $Q_{12c} = U_2 - U_1 - L_{12c}$
 - $dq_c = du + p \cdot dv + T \cdot ds$

where:

Q_{12c} – total heat exchanged

U_2 – internal energy in the final state

U_1 – internal energy in the initial state

L_{12} – work
 dq – heat flow of the system
 du – change of the internal energy
 p – pressure
 dv – change of volume
 L_{12c} – total work
 T – temperature
 ds – entropy change

- 56) The cricodentherm point describes (among others):
- the highest temperature of the multi-component system in the event of boiling or condensation
 - the highest dew point temperature of a two-phase multicomponent system
 - the highest boiling point of a two-phase system
 - the highest pressure of a two-phase system corresponding to the dew pressure
- 57) The Carnot engine efficiency:
- is always equal to 1
 - depends on the temperature of the lower and the upper source
 - is a function of the ambient entropy and the lower source temperature
 - depends on the temperature of the lower and the upper source, and the type of gas
- 58) Natural gas purification processes do not include:
- the ethane separation process
 - desulfurization
 - dehydration
 - mercury removal
- 59) The aerosols ranked in order of decreasing droplet diameter are:
- rain, fog, steam, spray
 - fog, rain, spray, steam
 - rain, spray, fog, steam
 - spray, rain, steam, fog
- 60) Amine compounds (MEA - monoethanolamine, DEA - diethanolamine and TEA - triethanolamine) are used for:
- acid gas removal
 - natural gas dehydration
 - only CO₂ removal
 - removing NGL from natural gas
- 61) The Claus process consists of:
- 2 stages (thermal, catalytic)
 - 1 stage (catalytic)
 - the number of stages depends on the H₂S concentration
 - 3 stages (ionic, thermal, catalytic)
- 62) A dew point temperature of -95°C of the dehydrated natural gas can be achieved using:
- absorption methods
 - molecular sieve adsorption
 - only ethylene glycol solutions
 - air cooling
- 63) The chemicals ranked in order of increasing boiling point temperature are:
- methane, nitrogen, butane, helium
 - helium, nitrogen, methane, butane
 - methane, helium, nitrogen, butane

d) helium, methane, nitrogen, butane

64) An oil and natural gas reservoir is:

- a) a natural accumulation of hydrocarbons in a horizontally lying porous rock
- b) a natural accumulation of hydrocarbons in the horizontally situated reservoir
- c) a natural accumulation of hydrocarbons in a reservoir located in a geological trap
- d) a natural accumulation of hydrocarbons in the porous rock forming a geological trap

65) What is the rock porosity coefficient and its range of variation?

- a) it is the ratio of the number of pore spaces and voids in the rock divided by the total volume of the rock. It varies between 0 and 40%
- b) it is the ratio of the volume of pore spaces and voids in the rock divided by the total volume of the rock. It varies between 0 and 90%
- c) it is the ratio of the volume of pore spaces and voids in the rock divided by the total volume of the rock. It varies between 0 and approximately 40%
- d) it is the ratio of the volume of pore spaces and voids in the rock divided by the total volume of the rock. It varies between 0 and 100%

66) Reservoir permeability is:

- a) the ability of a rock medium to pass fluid through itself under the influence of a concentration difference
- b) the ability of a fluid to flow through rock under the influence of a pressure difference
- c) the ability of a rock medium to pass fluid through itself under the influence of a pressure difference
- d) the ability of a rock medium to pass fluid through itself under the influence of a temperature difference

67) What is Darcy's law?

- a) Darcy's law assumes that for a laminar flow of fluid in a porous medium ($Re < 1$), the flow velocity w_{rz} is proportional to the pressure gradient p . The proportionality coefficient is the ratio of the permeability coefficient k and the viscosity coefficient μ . It is expressed as:

$$w_{rz} = -\frac{k}{\mu} \frac{\partial p}{\partial r}$$

- b) Darcy's law assumes that for a laminar flow of fluid in a porous medium ($Re < 1$), the flow velocity w_f is proportional to the concentration gradient C . The proportionality coefficient is the ratio of the permeability coefficient k and the viscosity coefficient μ . It is expressed as:

$$w_f = -\frac{k}{\mu} \frac{\partial C}{\partial r}$$

- c) Darcy's law assumes that for a laminar flow of fluid in a porous medium ($Re < 1$), the filtration speed w_f is proportional to the pressure gradient p . The proportionality coefficient is the ratio of the viscosity coefficient μ and the permeability coefficient k . It is expressed as:

$$w_f = -\frac{\mu}{k} \frac{\partial p}{\partial r}$$

- d) Darcy's law assumes that for a laminar flow of fluid in a porous medium ($Re < 1$), the filtration speed w_f is proportional to the pressure gradient p . The proportionality coefficient is the ratio of the permeability coefficient k and the viscosity coefficient μ . It is expressed as:

$$w_f = -\frac{k}{\mu} \frac{\partial p}{\partial r}$$

68) Steady state is:

- a) hydrodynamic state possible to achieve fully in the laboratory scale
- b) state that can occur in a reservoir in the case of constant pressure on the radius of the well influence zone
- c) state in which the pressure in the reservoir changes along one curve
- d) state which occurrence must be verbally expressed

69) In oil drilling, the elements of the drill string that are tensile during drilling are:

- a) stabilizers, sub-neutral drilling jars, mud pipes
- b) drill collars, bit sub, vibration dampeners

- c) kelly, mud pipes, wire joint
 - d) drill collars, kelly, mud pipes, lower kelly cock, crossover sub
- 70) A carbide insert drill bit, used as a replacement for a steel tooth bit with sealed rolling bearings, intended for soft rocks, will be marked in the IADC code as:
- a) 4-4-7
 - b) 5-5-4
 - c) 2-4-4
 - d) 5-4-4
- 71) Among the bits available on the market, the bearings are present in:
- a) only roller bits
 - b) roller bits, wing bits and diamond bits
 - c) wing bits and roller bits
 - d) diamond bits and roller bits
- 72) In which rheological model parameters of fluid viscosity and yield point are present?
- a) Ostwald-de Waele model
 - b) all rheological models
 - c) Bingham model
 - d) Newtonian model
- 73) The Hedstrom number allows to determine:
- a) the minimum energy necessary to begin the mud flow
 - b) the flow turbulence for any rheological model of drilling fluid
 - c) the critical Reynolds number for a Bingham fluid
 - d) the critical Reynolds number for a Herschel-Bulkley fluid
- 74) The mathematical model of a drilling technology process which accounts for the wear of bearings and drill bit parts is:
- a) Bingham model
 - b) Fullerton model
 - c) Milhoum model
 - d) Galle-Woods model
- 75) Which of the below can be used to close the borehole with the drill string?
- a) annular blowout preventer or ram blowout preventer with blind rams
 - b) annular blowout preventer or ram blowout preventer with pipe rams
 - c) annular blowout preventer only
 - d) ram blowout preventer only
- 76) The swelling of the rock on the borehole wall is not influenced by:
- a) reservoir fluid
 - b) rock mineral composition
 - c) dip angle of the layer
 - d) drilling mud composition
- 77) The compressive strength of brittle rock does not depend on its:
- a) temperature
 - b) depth
 - c) thickness
 - d) porosity
- 78) According to the Kirsch equation, the tangential (hoop) stress in the near-wellbore zone does not depend on:
- a) borehole diameter
 - b) drilling depth

- c) rock cohesion
 - d) distance from the wellbore axis
- 79) The degree of compaction describes:
- a) soil subjected to compaction
 - b) multiphase soil
 - c) anthropogenic soil
 - d) the natural condition of the soil
- 80) If the unitary water absorption is q , then the Lugeon coefficient is described as:
- a) $100 \cdot q$
 - b) $10 \cdot q$
 - c) $0,1 \cdot q$
 - d) $1000 \cdot q$
- 81) The unit of passive earth pressure is:
- a) Pa
 - b) N/m^3
 - c) m^2
 - d) N
- 82) Unitary water absorption (q) is defined as:
- a) the rock's capacity of water absorption (m^3/min) in relation to the 10m length of a given test zone and the test pressure of 0,01 MPa
 - b) the rock's capacity of water absorption (m^3/min) in relation to the 1m length of a given test zone and the test pressure of 0,1 MPa
 - c) the rock's capacity of water absorption (dm^3/min) in relation to the 10m length of a given test zone and the test pressure of 0,1 MPa
 - d) the rock's capacity of water absorption (dm^3/min) in relation to the 1m length of a given test zone and the test pressure of 0,01 MPa
- 83) The unit of water absorption is:
- a) $\text{m}^3/\text{min}/0,01 \text{ MPa}/\text{m}$
 - b) $\text{dm}^3/\text{min}/0,01 \text{ MPa}$
 - c) $\text{dm}^3/\text{min}/0,1 \text{ MPa}/\text{m}$
 - d) $\text{dm}^3/\text{min}/0,01 \text{ MPa}/\text{m}$
- 84) Which of the below can be determined from the water absorption measurements?
- a) soil grain composition
 - b) rock tightness
 - c) soil cohesion
 - d) Poisson's ratio
- 85) The vibro-replacement process yields good results in soils with the following parameters:
- a) clay fraction content below 2% and silt fraction content below 25%
 - b) clay fraction content below 2% and silt fraction content below 5%
 - c) clay fraction content below 5% and silt fraction content below 15%
 - d) clay fraction content below 2% and silt fraction content below 15%
- 86) What determines the severity of soil subsidence?
- a) soil load and groundwater level
 - b) soil compressibility modulus
 - c) soil load and soil depth
 - d) soil load, soil compressibility modulus and stress distribution in the soil

- 87) Which technology consists of the following stages: 1) soil structure destruction using a stream of slurry applied under high pressure, 2) extraction of excess cuttings to the surface, 3) mixing of soil with cement slurry, which results in the formation of the so-called soil-cement.
- jet-grouting
 - dynamic consolidation
 - vibro-flotation
 - vibro-replacement
- 88) The soil replacement method should not be used when:
- the soil consists of humid sand (multi-, medium- or coarse-grained), without clay or organic admixtures
 - the groundwater level is constant, its depth is known, and cohesive soil lies below
 - it is possible to wash out fine fractions of the soil replacement material or silt it with groundwater
 - the groundwater level is constant and its depth is known
- 89) When micropiles are used?
- when the surface layer consists of lithologically differentiated soils and has a constant plasticity index
 - when the surface layer consists of lithologically undifferentiated soils and has a constant plasticity and consistency index
 - when the surface layer consists of lithologically undifferentiated soils and has a constant plasticity index
 - when the surface layer consists of lithologically differentiated soils and has a variable plasticity index
- 90) The drill bit used for boreholes for load-bearing piles is:
- roller bit
 - PDC
 - diamond bit
 - auger bit
- 91) When drilling for load-bearing piles, cuttings are carried by:
- air
 - an auger
 - a bailer
 - clay drilling mud
- 92) Energy piles are used for:
- only to increase the bearing capacity in non-cohesive soils
 - shielding aquifers
 - only to obtain heat from the rock mass
 - to increase the bearing capacity of the soil and to exchange heat with the rock mass
- 93) The addition of graphite to the sealing slurry when creating energy piles aims to:
- increase slurry viscosity
 - decrease the thermal conductivity of the hardened slurry
 - decrease slurry viscosity
 - increase the thermal conductivity of the hardened slurry
- 94) Which of the following should not be used in DIF (Drill-in Fluid)?
- salt
 - bentonite
 - fluid-loss-control materials
 - all answers are correct
- 95) The gel strength of a drilling mud is measured by:

- a) API hydraulic press
 - b) filter press
 - c) rotational viscosimeter
 - d) Marsh funnel
- 96) The Marsh funnel is used for measuring:
- a) the plastic viscosity of drilling mud
 - b) the dynamic viscosity of drilling mud
 - c) the apparent viscosity of drilling mud
 - d) the funnel viscosity of drilling mud
- 97) Drilling mud filtration measurement using a standard filter press is conducted:
- a) for 7,5 minutes, and the obtained filtrate volume is multiplied by 4
 - b) for 15 minutes, and the obtained filtrate volume is multiplied by 2
 - c) for 15 minutes, and the obtained filtrate volume is multiplied by 1,5
 - d) for 30 minutes, and the obtained filtrate volume is multiplied by 1
- 98) In the process of chemical activation of bentonite, the following are used:
- a) CaSO_4
 - b) Na_3PO_4
 - c) Na_2CO_3
 - d) CaCO_3
- 99) To obtain carboxymethyl starch, the starch is treated with:
- a) calcium salt of monochloroacetic acid
 - b) sodium salt of monochloroacetic acid
 - c) sodium salt of formic acid
 - d) calcium salt of acetic acid
- 100) The drilling mud coagulation occurs under the influence of:
- a) flocculants
 - b) fluid-loss-control materials
 - c) surfactants
 - d) electrolytes
- 101) Trenchless technologies are used for:
- a) oil and gas exploration
 - b) overcoming terrain obstacles during the construction of linear underground installations
 - c) pipeline damage detection and removal
 - d) construction of underground gas storage facilities
- 102) The Intersect method consists of:
- a) drilling a pilot borehole simultaneously with two drilling rigs from opposite sides
 - b) drilling with simultaneous widening
 - c) drilling a pilot borehole in sections
 - d) drilling with simultaneous pulling of the pipeline
- 103) The minimum radius of curvature for the HDD technology, calculated according to the Brink formula for a steel pipeline DN 1000 and a wall thickness of 22 mm for loose sands, should not be less than:
- a) 1513 m
 - b) 1022 m
 - c) 1260 m
 - d) 1850 m
- 104) The height of a prepared pipe string in HDD technology is the greater:
- a) the smaller the exit angle

- b) the greater the entry angle
 - c) the smaller the entry angle
 - d) the greater the exit angle
- 105) The basic parameters of a directional drilling trajectory are:
- a) pipeline length, diameter, and wall thickness
 - b) entry and exit angles, minimum radii of curvature, depth under terrain obstacles, straight sections length, prepared pipe string height, total pipeline length
 - c) entry and exit angles, minimum radii of curvature, depth under terrain obstacles, straight sections length
 - d) minimum radius of curvature, depth under terrain obstacles, borehole diameter, entry and exit angles
- 106) Jacking shaft and reception shaft are required for the following technologies:
- a) only HDD
 - b) Direct Pipe, microtunnelling, horizontal drilling, jacking
 - c) HDD, Direct Pipe, microtunnelling, horizontal drilling, jacking
 - d) only microtunnelling
- 107) To install a steel pipeline DN700 MPO 8,4 MPa in the HDD technology over a distance of 1000m, more drilling mud would be needed:
- a) without recycling
 - b) it is irrelevant
 - c) with recycling
 - d) both methods require the same mud volume
- 108) Which of the below are not casing columns:
- a) conductor pipe, drive pipe
 - b) initial pipe, end pipe
 - c) technical column, tubing
 - d) combination column, liner
- 109) During underbalanced drilling, the specific weight of the drilling fluid should be:
- a) less than the formation pressure gradient
 - b) greater than the fracture gradient
 - c) greater than the formation pressure gradient
 - d) greater than the formation pressure gradient but less than the fracture gradient
- 110) For single stage cementing, the correct sequence of actions is:
- a) cement slurry injection, dropping the bottom plug, spacer fluid injection, dropping the top plug
 - b) cushion fluid injection, cement slurry injection, dropping the bottom plug, dropping the top plug, spacer fluid injection
 - c) cushion fluid injection, cement slurry injection, dropping the bottom plug, spacer fluid injection, dropping the top plug
 - d) cushion fluid injection, dropping the bottom plug, cement slurry injection, dropping the top plug, spacer fluid injection
- 111) The most important technical and technological factors influencing the effectiveness of casing cementation in boreholes include:
- a) slurry flow characteristics, the level of pipe column centricity in the borehole
 - b) the level of pipe column centricity in the borehole, type of steel the pipes are made of
 - c) slurry flow characteristics, length of individual pipe sections
 - d) the level of pipe column centricity in the borehole, type of casing
- 112) The density (specific weight) of cushion fluid should be:

- a) greater than the density of drilling mud outflowing from the annular space of the borehole and less than the density of sealing slurry
 - b) greater than the density of drilling mud outflowing from the annular space of the borehole and greater than the density of sealing slurry
 - c) equal to the density of drilling mud outflowing from the annular space of the borehole and the density of sealing slurry
 - d) less than the density of drilling mud outflowing from the annular space of the borehole and the density of sealing slurry
- 113) The technical equipment of the lower part of the cemented casing column may include:
- a) additional check valve, stop collar for the bottom plug, cementing head
 - b) safety joint, stop collar for the bottom plug, liner hanger
 - c) float shoe, additional check valve, safety joint, stop collar for the bottom plug
 - d) additional check valve, safety joint, stop collar for the bottom plug, float collar
- 114) The methods of cementing casing columns are divided into:
- a) single stage, gasket, combined
 - b) single stage, multi-stage, unconventional
 - c) single stage, jet grouting
 - d) unconventional, borehole
- 115) Float collar is used during:
- a) gasket cementing
 - b) cementing using a drill string
 - c) multi-stage cementing
 - d) recementing
- 116) The main ingredients of sealing slurries are:
- a) binder, solvent
 - b) binder, solvent, aggregate
 - c) solver, additive (filler)
 - d) binder, solver, admixture
- 117) The consistency (pumpability) of the sealing slurry is expressed in units:
- a) Pa·s
 - b) cP
 - c) Bc
 - d) Pa
- 118) The initial setting time of a sealing slurry according to API standards is the time that elapses from the moment it is prepared until it reaches the density of:
- a) 30 Bc
 - b) 100 Bc
 - c) 70 Bc
 - d) 20 Bc
- 119) According to the API and EN-ISO 10426 standards, drilling cements are divided into:
- a) eight classes and three types
 - b) eight classes and four letter symbols
 - c) five classes and three grades
 - d) eight classes and three grades
- 120) The main chemical components of Portland cement are:
- a) CaO, SiO₂, Na₂O
 - b) CaO, SiO₂, Al₂O₃, K₂O
 - c) CaO, SiO₂, Al₂O₃, MgO

- d) CaO, SiO₂, Al₂O₃, Fe₂O₃
- 121) The 1st type of chemical corrosion, washing away soluble components of the hardened cement slurry (mainly calcium hydroxide), is caused by:
- hydrogen sulfide
 - magnesium compounds
 - soft waters
 - sulfate ions
- 122) Which of the following admixtures is used to accelerate cement slurry setting time:
- sugar
 - tartaric acid
 - Na₂CO₃
 - KMC (carboxymethyl cellulose)
- 123) A porosimeter is an instrument used to determine:
- the porosity of the hardened slurry
 - the filtration coefficient of the hardened slurry
 - the permeability of the hardened slurry
 - the compressive strength of the hardened slurry
- 124) Toxic monocyclic aromatic hydrocarbons in crude oil are:
- benzene, xylene, ethene, ethylbenzene
 - benzene, toluene, xylene, ethylbenzene
 - benzene, cyclohexane, butane, naphthalene
 - benzene, toluene, naphthalene, methylcyclopentane
- 125) Identify the reaction types represented by the following equations:
- $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3 + \text{Br}_2 \rightarrow \text{CH}_2\text{Br}-\text{CHBr}-\text{CH}_2-\text{CH}_3$
 - $2\text{C}_6\text{H}_6 + 15\text{O}_2 \rightarrow 12\text{CO}_2 + 6\text{H}_2\text{O}$
 - $2\text{CH}_3-\text{CH}_2-\text{CH}_3 + 2\text{Cl}_2 \rightarrow \text{CH}_3-\text{CH}_2-\text{CH}_2\text{Cl} + \text{CH}_3-\text{CHCl}-\text{CH}_3 + 2\text{HCl}$
- 1)-polycondensation reaction, 2)-substitution reaction, 3)-combustion reaction
 - 1)-addition reaction, 2)-combustion reaction, 3)-substitution reaction
 - 1)-substitution reaction, 2)-combustion reaction, 3)-addition reaction
 - 1)-polymerization reaction, 2)-combustion reaction, 3)-substitution reaction
- 126) Match the functional group to the appropriate group of organic compounds:
- COOH
 - OH
 - NH₂
 - CHO
- 1)-esters, 2)-alcohols, 3)-amines, 4)-ketones
 - 1)-ketones, 2)-alcohols, 3)-amines, 4)-carboxylic acids
 - 1)-carboxylic acids, 2)-alcohols, 3)-amines, 4)-aldehydes
 - 1)-carboxylic acids, 2)-alcohols, 3)-amines, 4)-esters
- 127) List the fractions formed during crude oil distillation in the order of their increasing boiling point:
- refinery gases, gasoline, kerosene, diesel oil
 - refinery gases, kerosene, gasoline, diesel oil
 - refinery gases, gasoline, mazut, diesel oil
 - gasoline, kerosene, stylon, petroleum ether
- 128) A characteristic feature of compounds containing an ionic bond is not:
- easy solubility in water

- b) difficult solubility in polar solvents
 - c) high melting point
 - d) high boiling point
- 129) According to the Bronsted-Lowry acid-base theory, an acid:
- a) is a substance containing hydrogen in its molecules
 - b) is a compound that dissociates in an aqueous solution into hydronium cations and acetate anions
 - c) is a proton acceptor (recipient)
 - d) becomes base as a result of proton dissociation
- 130) The electromotive force is:
- a) a difference between electrode potential in a cell operating in a closed electrical circuit
 - b) a difference between electrode potential in a cell measured for an open circuit
 - c) a relative value of a potential of a metal to its ion
 - d) the ability of the metal to oxidize in a cell operating in a closed circuit
- 131) Water was added to the weak electrolyte solution. It was found that:
- a) solution density increased
 - b) degree of dissociation increased
 - c) no changes occurred
 - d) degree of dissociation decreased
- 132) Force $F = 110\text{N}$, directed upwards, acts on a body of mass $m = 10\text{ kg}$. What is the acceleration a of the body ($g = 10\text{ m/s}^2$)?
- a) $a = 1,1\text{ m/s}^2$
 - b) $a = 1\text{ m/s}^2$
 - c) $a = 0,11\text{ m/s}^2$
 - d) $a = 0,1\text{ m/s}^2$
- 133) A grenade thrown vertically upwards bursts at the highest point of its flight into three equal parts, the first of which moves vertically upwards. If the momentum of the second shard has the same value and is directed vertically downwards, the momentum of the third:
- a) is directed horizontally
 - b) is also directed downwards
 - c) is directed upwards
 - d) must be equal to zero
- 134) Earth's two satellites follow circular orbits. The first one follows an orbit with a radius R , and the second one follows an orbit with a radius $2R$. If the period of the first cycle is T , the period of the second cycle is equal to:
- a) $4T$
 - b) $2T$
 - c) $2,82T$
 - d) $0,5T$
- 135) Two full balls (solid spheres) are made of the same material. The first is eight times heavier than the second. The moment of inertia with respect to the axis going through the centre of the first ball is:
- a) 8 times greater than the moment of inertia of the second ball
 - b) 2 times greater than the moment of inertia of the second ball
 - c) 4 times greater than the moment of inertia of the second ball
 - d) 16 times greater than the moment of inertia of the second ball
- 136) A body moves in harmonic motion. When the deflection is half the amplitude, the kinetic energy of the body is:
- a) two times less than its potential energy

- b) equal to its potential energy
 - c) two times greater than its potential energy
 - d) three times greater than its potential energy
- 137) A particle of mass m , initially resting, is accelerated to speeds ever closer to the speed of light. As it approaches the speed of light, the momentum of this particle:
- a) approaches mc ($m=\text{const}$)
 - b) approaches $0,5mc^2$
 - c) approaches infinity
 - d) approaches mc^2
- 138) According to Gauss's law for magnetism, magnetic field lines:
- a) begin at the North Pole and end at the South Pole
 - b) begin at the South Pole and end at the North Pole
 - c) take the form of closed loops
 - d) begin at both poles and end at infinity
- 139) The magnetic field exists between the capacitor plates (obviously not the Earth's magnetic field):
- a) never
 - b) if the capacitor is charged
 - c) always
 - d) if the capacitor is being charged
- 140) In a heater with a resistance of 23 Ohm (Ω), a power of no more than 2300 W can be emitted. The maximum value of an electric current which can flow through this heater is:
- a) 5 A
 - b) 2 A
 - c) 20 A
 - d) 10 A
- 141) Two heaters of equal power were connected in series and connected to the grid. The water will boil:
- a) in approximately four times longer than with a single heater
 - b) at the same time as for one heater
 - c) in approximately two times longer than with a single heater
 - d) in approximately half the time of a single heater
- 142) The kinetic energy of a charged particle moving in a magnetic field:
- a) increases or decreases depending on the direction of velocity in relation to the direction of the magnetic field
 - b) does not change
 - c) increases
 - d) decreases
- 143) A microwave oven produces a standing wave with a frequency of 3GHz. The electromagnetic wavelength is:
- a) 1 cm
 - b) 30 cm
 - c) 3 cm
 - d) 10 cm
- 144) The wavelength of light propagating in vacuum is λ . After passing to a medium of refractive index n , the wavelength will be:
- a) $(n-1)\lambda$
 - b) λ
 - c) λ/n

d) $n \lambda$

145) A photon of energy $h\nu$ (h - Planck's constant, ν - frequency, c - speed of light) can be assigned momentum, wavelength and mass equal to:

- a) $h\nu/c, c/\nu, h\nu/c^2$
- b) $h\nu/c^2, c/\nu, h\nu/c$
- c) $c/\nu, h\nu/c, h\nu/c^2$
- d) $c/\nu, h\nu/c^2, h\nu/c$

146) The highest speed of electrons knocked out in the external photoelectric effect can be obtained by illuminating the metal surface with which light?

- a) red
- b) yellow
- c) green
- d) blue

147) How many times more energy is needed to ionize a ground-state hydrogen atom than to transfer it to the first excited state:

- a) 4 times
- b) 4/3 times
- c) 2 times
- d) 1/4 times

148) ^{238}U through nuclear transformation into ^{234}U , emits:

- a) an α particle, two electrons and two antineutrinos
- b) an α particle and two positrons
- c) an α particle
- d) an α particle and two electrons

149) $\lim_{x \rightarrow 0} \frac{\sin 2x}{\sin 5x} =$

- a) 3
- b) $\frac{2}{5}$
- c) 0
- d) $\frac{3}{2}$

150) $\int \left(2 \sin \frac{x}{2} + \frac{1}{x^2} \right) dx =$

- a) $-4 \cos \frac{x}{2} + x + C$
- b) $-4 \cos \frac{x}{2} + \frac{1}{x} + C$
- c) $-4 \cos \frac{x}{2} - \frac{1}{x} + C$
- d) $2 \cos \frac{x}{2} - \frac{1}{x} + C$

151) $\int \text{ctg} x dx =$

- a) $\ln |\cos x| + C, \cos x \neq 0$
- b) $-\ln |\cos x| + C, \cos x \neq 0$
- c) $-\ln |\sin x| + C, \sin x \neq 0$
- d) $\ln |\sin x| + C, \sin x \neq 0$

152) $\int x \cos x dx =$

- a) $x \cos x - \sin x + C$
- b) $x \sin x + \cos x + C$
- c) $x \cos x + \sin x + C$
- d) $x \sin x - \cos x + C$

153) If the function $f(x)$ is integrable and even in the range $\langle -a, a \rangle$ then $\int_{-a}^a f(x) dx$ equals:

- a) $-\int_0^a f(x) dx$
- b) $2 \int_0^a f(x) dx$
- c) 0
- d) $\int_0^a f(x) dx$

154) The derivative of a function $F(x) = \int_0^{x^2} e^{-t^2} dt$ equals:

- a) $F'(x) = e^{-x^2} \cdot 2x$
- b) $F'(x) = e^{-x^4} \cdot 2x$
- c) $F'(x) = e^{-x^4} \cdot 4x^3$
- d) $F'(x) = e^{-x^2} \cdot 4x^3$

155) The surface area between the lines $y = x^2 - 1, y = 0$ equals:

- a) 2
- b) $\frac{4}{3}$
- c) $\frac{2}{3}$
- d) $\frac{1}{3}$

156) Vertical asymptotes of the graph of a rational function $f(x) = \frac{x}{x^2-2}$ are lines:

- a) $x = 0, x = 1$
- b) $x = -2, x = 2$
- c) $x = -\sqrt{2}, x = \sqrt{2}$
- d) $x = -2, x = 1$

157) $(1 + i)^{12} =$

- a) $64i$
- b) 64
- c) -64
- d) $-64i$

158) $\sqrt{-i} =$

- a) $\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i, -\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}i$
- b) $\frac{1}{2} - \frac{1}{2}i, -\frac{1}{2} + \frac{1}{2}i$
- c) $\frac{1}{2} + \frac{1}{2}i, -\frac{1}{2} - \frac{1}{2}i$
- d) $-\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i, \frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}i$

159) The solution of equation $z^2 - 2z + 5 = 0$ are the following complex numbers:

- a) $1 - 2i, 1 + 2i$
- b) $3 + i, -3 - i$
- c) $-1 + 2i, -1 - 2i$
- d) $\frac{3}{2} + \frac{\sqrt{3}}{2}i, \frac{3}{2} - \frac{\sqrt{3}}{2}i$

160) The product of multiplication of matrix $A = \begin{bmatrix} 1 & 0 & 2 \\ 3 & 5 & 1 \end{bmatrix}$ by matrix $B = \begin{bmatrix} 1 & 3 \\ 7 & 5 \\ 0 & 2 \end{bmatrix}$ is matrix:

- a) $\begin{bmatrix} 1 & 10 \\ 21 & 10 \\ 3 & 9 \end{bmatrix}$
- b) $\begin{bmatrix} 35 & 25 \\ 0 & 2 \end{bmatrix}$
- c) $\begin{bmatrix} 1 & 7 \\ 38 & 36 \end{bmatrix}$

d) $\begin{bmatrix} 1 & 3 \\ 0 & 0 \\ 0 & 4 \end{bmatrix}$

161) The inverse matrix of matrix A exists if:

- a) $\det A = 0$
- b) $\det A < 0$
- c) $\det A \neq 0$
- d) $\det A > 0$

162) If we enter the formula $=A1 + B1 / C1 + D1$ in cell E1 of an MS Excel spreadsheet, and then in cells A1, B1, C1 and D1 enter the following numeric values

	A	B	C	D
1	2	8	4	1

then cell E1 will show value:

- a) 3,6
- b) 3,5
- c) 5
- d) 2

163) If we enter the formula $=A1 - \$B1 + \$C\$1 - D\1 in cell E1 of an MS Excel spreadsheet, and the neighbouring cells will have the following numeric values

	A	B	C	D
1	2	3	5	1
2	3	2	6	4

then after copying the formula from cell E1 to cell E2, cell E2 will show value:

- a) 4
- b) 7
- c) 6
- d) 5

164) The operating system:

- a) is one of the computer's utilities
- b) controls the operation of the entire device (e.g. computer)
- c) controls the operation of computer devices
- d) prepares the computer for operation after startup, it is not needed afterwards

165) The electronic signature is currently:

- a) implemented using asymmetric encryption (with two keys)
- b) implemented using symmetric encryption (with one key)
- c) a scanned signature of the user attached in an electronic version to his documents
- d) securing documents against reading by unauthorized persons

166) How many bytes are 1 MB in binary?

- a) 2^{20}
- b) 10^6
- c) 1 000 000
- d) 1024

167) The first-order derivative of the function $f(x)$ at the point x_0 is equal to:

- a) the slope of the tangent line to the graph of the function $f(x)$ at the point x_0
- b) the tangent of the slope of the tangent line to the graph of the function $f(x)$ at the point x_0
- c) the tangent of the slope of the secant line from point $(x_0, f(x_0))$

- d) the slope of the secant line from point $(x_0, f(x_0))$
- 168) How many bits does the device address (IP) have in the current Internet protocol (IP v4)?
- 8
 - 128
 - 32
 - 24
- 169) In how many ways can different characters be encoded in one byte?
- 1024
 - 100
 - 8
 - 256
- 170) What is Facebook?
- none of the answers are correct
 - a social group on the Internet
 - a mail server
 - a blog collection
- 171) Are modem and a network adapter synonymous with the same device?
- yes, they differ only in the place of installation - network cards are mounted inside the computer and modems are connected from the outside
 - yes, modem is the name used in the past when these devices were very slow. Now they are much faster and are called network adapters
 - no
 - yes
- 172) What are Peer To Peer (P2P) computer networks?
- none of the answers are correct
 - private networks of a closed user group
 - computer networks where there is no server, only users' computers
 - computer networks where each computer is both a client and a server
- 173) The derivative of a function $f(x) = 2 \sin^2 x + x^3$ for $x \in (-\infty, +\infty)$ equals:
- $4 \cos x + 3x$
 - $4 \sin x \cos x + 3x^2$
 - $4 \cos x + 3x^2$
 - $4 \sin x + 3x^2$
- 174) The sum of the three initial components in the Maclaurin formula for the function $f(x) = xe^x$ has form:
- $1 + \frac{x^2}{2} + \frac{x^3}{2!}$
 - $1 + x + \frac{x^2}{2!}$
 - $x + x^2 + \frac{x^3}{2!}$
 - $x + \frac{x^2}{2} + \frac{x^3}{2!}$
- 175) The function $f(x) = \frac{x^3}{3} - x$ is descending in the range:
- $(-\infty, \infty)$
 - $(0, +\infty)$
 - $(1, +\infty)$
 - $(\frac{1}{\sqrt{3}}, +\infty)$

- 176) The function $f(x)$ is differentiable in the range $(-2, 2)$. If the function $F(x) = f^2(x) - x$ has a local maximum in point $x_0 \in (-2, 2)$ then:
- $f(x_0)f'(x_0) = \frac{1}{2}$
 - $f(x_0) = f'(x_0) = 1$
 - $f'(x_0) = 0$
 - $f'(x_0) = 2f(x_0) = \frac{1}{2}$
- 177) If $x^2 + y^2 = 9$ then $\frac{dx}{dy} =$
- $\frac{1}{2\sqrt{9-x^2}}$
 - $-\frac{1}{2\sqrt{9-x^2}}$
 - $-\frac{x}{y}$
 - $\frac{x}{y}$
- 178) $\nabla(x + 3y^2) =$
- $1 + 6y$
 - $x\vec{i} + 3y^2 \cdot \vec{i}$
 - $\vec{i} + 6\vec{i}$
 - $\vec{i} + 6y\vec{i}$
- 179) The Laplace operator for function $f(x, z) = x^2 + \ln(z)$ equals:
- $2 - z^{-2}$
 - $\frac{2}{z}$
 - $2x + \frac{1}{z}$
 - $2 + \frac{1}{z}\vec{i}$
- 180) The domain of the function $f(x) = \arccos \frac{1}{x}$ is the interval:
- $[0, +\infty)$
 - $[-\frac{\pi}{2}, \frac{\pi}{2}]$
 - $[0, \pi]$
 - $(-\infty, 1) \cup (1, +\infty)$
- 181) The confidence interval for the mean value of the variable X with a normal distribution $N(m, \sigma)$ in the general population, determined on the basis of a small sample is based on the:
- F-distribution (Snedecor's F distribution)
 - normal distribution
 - Poisson distribution
 - t-distribution (Student's t-distribution) with $n-1$ degrees of freedom
- 182) Which of the definitions of the infinite limit of the numerical infinite sequence is correct?
- $\lim_{n \rightarrow +\infty} a_n = \infty \Leftrightarrow \forall \varepsilon > 0 \exists n_0 \in \mathbb{N}_+ \forall n \in \mathbb{N}_+ [(n \geq n_0) \Rightarrow (a_n > \varepsilon)]$
 - $\lim_{n \rightarrow +\infty} a_n = \infty \Leftrightarrow \forall \varepsilon > 0 \exists n_0 \in \mathbb{N}_+ \forall n \in \mathbb{N}_+ [(n \geq n_0) \Rightarrow (a_n < \varepsilon)]$
 - $\lim_{n \rightarrow +\infty} a_n = \infty \Leftrightarrow \forall \varepsilon > 0 \exists n_0 \in \mathbb{N}_+ \forall n \in \mathbb{N}_+ [(n \geq n_0) \Rightarrow (a_n > \varepsilon)]$
 - $\lim_{n \rightarrow +\infty} a_n = \infty \Leftrightarrow \forall \varepsilon > 0 \exists n_0 \in \mathbb{N}_+ \forall n \in \mathbb{N}_+ [(n \geq n_0) \Rightarrow (a_n < \varepsilon)]$
- 183) $\lim_{n \rightarrow \infty} \frac{3n^2 + 7n + 5}{n + 2} =$
- ∞
 - 7
 - 3
 - 0

184) $\lim_{n \rightarrow \infty} \left(\frac{n+5}{n}\right)^n =$

- a) ∞
- b) 1
- c) 5
- d) e^5

185) $\lim_{n \rightarrow \infty} \frac{1+2+2^2+2^3+\dots+2^n}{2^n} =$

- a) $\frac{1}{3}$
- b) 0,2
- c) 2
- d) 0

186) The standard command language for relational database systems is:

- a) HTML
- b) SQL
- c) UNIX
- d) ASCII

187) The most common and most abundant non-hydrocarbon admixture in natural gas is:

- a) nitrogen
- b) carbon dioxide
- c) helium
- d) hydrogen sulfide

188) Kerogen derived from the remains of marine plankton deposited in an anaerobic environment is:

- a) type II kerogen
- b) type I kerogen
- c) type III kerogen
- d) type IV kerogen

189) A potential bedrock is a rock in which:

- a) the organic substance has reached the maturity level to generate hydrocarbons under natural conditions
- b) hydrocarbons have been generated in the past
- c) the organic substance has not reached the maturity level to generate hydrocarbons under natural conditions
- d) under current natural conditions, hydrocarbons are generated and released

190) During the thermal transformation of kerogen, at the stage of catagenesis, the following is formed:

- a) graphite residuum
- b) thermocatalytic gas
- c) biogenic gas
- d) crude oil and thermogenic natural gas

191) Bituminous shale contains:

- a) microbial gas
- b) thermocatalytic gas
- c) crude oil of low density and viscosity
- d) crude oil of high density and viscosity

192) The primary migration is the movement of hydrocarbons:

- a) from the bedrock to the reservoir rock
- b) within the mature bedrock

- c) within the reservoir rock
- d) within the potential bedrock

193) The petroleum traps due to the unconformities are

- a) depositional traps
- b) stratigraphic traps
- c) tectonic traps
- d) hybrid traps

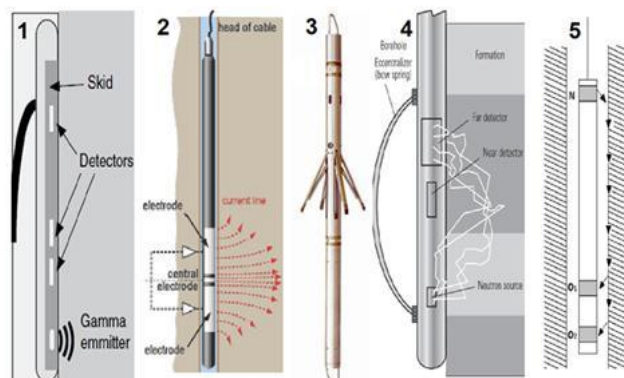
194) The method of calculating crude oil and natural gas resources by calculating the volume of reservoir rocks saturated with hydrocarbons is:

- a) the volumetric method
- b) the analogy method
- c) the mass balance method
- d) the decline curve method

195) Match the terms:

- a) sonic logging - hydrogen concentration in pores
gamma ray logging - modulus of elasticity
neutron logging - energy spectra
spontaneous potential logging - correlation of changes in resistance
induction logging - electric potential
- b) sonic logging - modulus of elasticity
gamma ray logging - energy spectra
neutron logging - hydrogen concentration in pores
spontaneous potential logging - electric potential
induction logging - correlation of changes in resistance
- c) sonic logging - hydrogen concentration in pores
gamma ray logging - correlation of changes in resistance
neutron logging - modulus of elasticity
spontaneous potential logging - electric potential
induction logging - energy spectra
- d) sonic logging - modulus of elasticity
gamma ray logging - energy spectra
neutron logging - hydrogen concentration in pores
spontaneous potential logging - correlation of changes in resistance
induction logging - electric potential

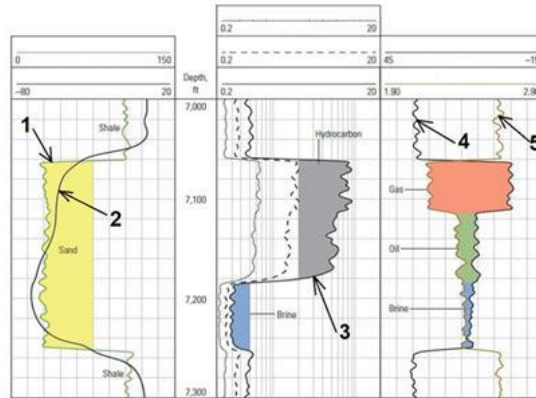
196) Match the probe names to the pictures below:



- a) 1 – gamma-gamma density sonde, 2 – three-electrode resistivity sonde, 3 – cavernometer, 4 – neutron sonde, 5 – two-receiver sonic sonde
- b) 1 – neutron sonde, 2 – three-electrode resistivity sonde, 3 – cavernometer, 4 – gamma-gamma density sonde, 5 – two-receiver sonic sonde

- c) 1 – neutron sonde, 2 – cavernometer, 3 – three-electrode resistivity sonde, 4 – two-receiver sonic sonde, 5 – gamma-gamma density sonde
- d) 1 – gamma-gamma density sonde, 2 – cavernometer, 3 – three-electrode resistivity sonde 4 – neutron sonde, 5 – two-receiver sonic sonde

197) What types of geophysical profiling is shown in the following geophysical diagrams? Match names with numbers 1 through 5:



- a) 1 – spontaneous potential log, 2 – gamma ray log, 3 – resistivity log, 4 – gamma-gamma density log, 5 – neutron porosity log
- b) 1 – gamma ray log, 2 – spontaneous potential log, 3 – resistivity log, 4 – gamma-gamma density log, 5 – neutron porosity log
- c) 1 – gamma ray log, 2 – spontaneous potential log, 3 – resistivity log, 4 – neutron porosity log, 5 – gamma-gamma density log
- d) 1 – gamma-gamma density log, 2 – resistivity log, 3 – spontaneous potential log, 4 – neutron porosity log, 5 – gamma ray log

198) Arrange well logging methods in order of increasing measuring range of the sonde:

- a) sonic logging, neutron-neutron logging, resistivity logging, resistivity microprofiling, induction logging
- b) resistivity microprofiling, sonic logging, neutron-neutron logging, resistivity logging, induction logging
- c) induction logging, resistivity microprofiling, neutron-neutron logging, sonic logging, resistivity logging
- d) induction logging, resistivity logging, neutron-neutron logging, sonic logging, resistivity microprofiling

199) What types of porosity coefficient can be determined from well logging?

- a) open, effective, and total porosity
- b) effective, open, and closed porosity
- c) open, effective, and dynamic porosity
- d) effective, dynamic, and total porosity

200) Which statement about borehole radiometry is not true?

- a) in drilling radiometry, each sonde must be equipped with a gamma ray detector
- b) in drilling radiometry, the depth range of sondes is relatively small: from approx. 15 cm for the gamma-gamma sonde to approx. 60 cm for the neutron sonde
- c) in drilling radiometry, all sondes are pressed against the borehole wall, and the clay sediment affects the measurement results
- d) radiometric logs measure the changes in natural or artificial radioactivity induced along the borehole

201) Which statement about the borehole electrometry is not true?

- a) resistance logging is the basis for determining the porosity coefficient, the type and saturation of the rock's pore spaces using the Archie equation
 - b) borehole electrometry methods are based on changes in the electrical properties of the rocks as a result of the drilling mud filtration to porous and permeable rock layers during drilling
 - c) the following methods are used in borehole electrometry: controlled resistance logging, induction logging, spontaneous potential logging, and sonic logging
 - d) borehole electrometry includes geophysical measurements using electric or electromagnetic fields
- 202) In seismic prospecting, the main parameter determined based on measurements is:
- a) resistivity (specific resistance)
 - b) velocity factor (wave propagation speed)
 - c) apparent resistivity
 - d) dielectric constant
- 203) The relationship between the longitudinal wave (V_p) and transverse wave (V_s) velocity in compact and crystalline rocks is as follows:
- a) $V_p < V_s$
 - b) $V_p > V_s$
 - c) $V_p = V_s$
 - d) none of the answers is correct
- 204) The Earth consists of the following physical layers:
- a) crust, lithosphere, core
 - b) crust, mesosphere, core
 - c) crust, mantle, asthenosphere
 - d) lithosphere, mantle, core
- 205) Continental megastructures consisting of a plinth (foundation) and a sedimentary cover are:
- a) sedimentary basins
 - b) platforms
 - c) shields
 - d) massifs
- 206) Exogenous geological processes include:
- a) weathering, erosion, surface mass movements
 - b) weathering, erosion, diastrophism
 - c) weathering, erosion, magmatism
 - d) weathering, erosion, metamorphism
- 207) Organogenic, chemical and biochemical limes are formed in the zone:
- a) pelagic
 - b) hemipelagic
 - c) littoral
 - d) sublittoral
- 208) The following processes are the most important in the sandstone diagenesis:
- a) compaction and dissolution
 - b) compaction and hardening of colloids
 - c) compaction and cementation
 - d) compaction and replacement
- 209) A wellbore is:
- a) a cylindrical mining excavation created using drilling methods
 - b) a cuboidal mining excavation created using drilling methods
 - c) a cylindrical mining excavation created using mining methods

- d) a cuboidal mining excavation created using mining methods
- 210) Due to the spatial position of the borehole axis, boreholes can be divided into:
- a) rectilinear and oblique
 - b) perpendicular and parallel
 - c) directional and oblique
 - d) curvilinear and oblique
- 211) According to the diameter, the boreholes can be divided into:
- a) low-diameter, medium-diameter, high-diameter
 - b) low-diameter, normal-diameter, high-diameter
 - c) small-diameter, medium-diameter, large-diameter
 - d) small-diameter, normal-diameter, large-diameter
- 212) Drilling tools are classified into:
- a) drilling bits, core bits, special purpose tools
 - b) augers, core bits, special purpose tools
 - c) grinders, core bits, special purpose tools
 - d) mills, cutters, grinders
- 213) Drill pipes are a part of:
- a) production pipes
 - b) casing
 - c) drill string
 - d) drilling rig construction
- 214) Conductor pipe is a string of:
- a) drill pipes
 - b) reservoir sampler
 - c) casing
 - d) production pipes
- 215) Casing is used for:
- a) performing geophysical measurements
 - b) building the foundation of the drilling rig
 - c) supporting the wellbore
 - d) building surface pipelines
- 216) Drill collars are a part of:
- a) production pipes
 - b) drill string
 - c) casing
 - d) blowout preventer equipment
- 217) Couplings are elements used for connecting:
- a) drill pipes
 - b) casing
 - c) production pipes
 - d) drill collars
- 218) Bearings are part of the construction of:
- a) PDC bits
 - b) blade bits
 - c) diamond bits
 - d) roller bits
- 219) Stabilizers are a part of:

- a) production pipes
 - b) drill collars
 - c) drill pipes
 - d) casing
- 220) Centralizers are the equipment elements of:
- a) blowout preventer
 - b) casing
 - c) drill collars
 - d) drill pipes
- 221) Wellbore scratchers are the equipment elements of:
- a) production pipes
 - b) drill pipes
 - c) drill collars
 - d) casing
- 222) Diamond-impregnated drill bit damages rocks mainly by:
- a) cutting
 - b) leaching
 - c) wear
 - d) crushing
- 223) PDC diamond bit damages rocks mainly by:
- a) leaching
 - b) crushing
 - c) wear
 - d) cutting
- 224) Roller bit damages rocks mainly by:
- a) wear
 - b) crushing
 - c) cutting
 - d) leaching
- 225) Kelly in a drill string element for drilling using:
- a) rotary table
 - b) power head
 - c) downhole motor
 - d) spindle drive
- 226) Vibrating sieves are part of:
- a) drilling rig hoisting system
 - b) mud cleaning system
 - c) drill string rotating system
 - d) blowout prevention system
- 227) Hydrocyclones are a component of:
- a) mud cleaning system
 - b) blowout prevention system
 - c) drill string assembly
 - d) production pipe column
- 228) Casing head is used for:
- a) fastening the casing on the pipe rack
 - b) fastening the casing during transport
 - c) joining the casing into a column

- d) installing casing columns in the borehole
- 229) Drilling tower, mast, and derrick are components of:
- drilling rig drive system
 - drilling rig hoist system
 - blowout prevention system
 - mud cleaning system
- 230) The quotient of the volume of gas to the volume of oil produced with it from the same oil-bearing layer is called:
- gas oil ratio
 - solution gas oil ratio
 - oil recovery factor
 - oil ratio
- 231) Indicate complete and correctly ranked stages of mining activity:
- 1 – shaft sinking, 2 – shaft support and reinforcement, 3 – dog headings mining, 4 – dog headings support, 5 – longwall headings mining, 6 – longwall headings support
 - 1 – rock sampling, 2 – reservoir resources calculation, 3 – fuel market value estimation, 4 – sale of the material
 - 1 – reservoir exploration and prospecting, 2 – reservoir documentation and assessment, 3 – design works, 4 – development, 5 – exploitation preparation, 6 – exploitation, 7 – exploited material processing, 8 – site liquidation and land reclamation
 - 1 – training, 2 – internship, 3 – independent work, 4 – supervising work, 5 – managerial work
- 232) Indicate the correct definition of the mining system:
- method of planned deposit extraction:
 - by making excavation pits of a given shape and dimensions,
 - with the defined direction of the mining face progress,
 - with the defined elimination method of the post-exploration space
 - underground mine work organization system
 - spatial arrangement of excavations in an open-pit or underground mine
 - method of planned deposit extraction:
 - by creating access and preparatory excavations
- 233) Indicate the complete list of natural hazards in mining:
- heavy rainfall, flooding, strong storms, lightning
 - failure to comply with occupational health and safety regulations by employees
 - rock burst, methane, gas and rock outbursts, coal dust explosion, climate, water, landslide, eruption, hydrogen sulphide, radioactive substances
 - hazards from machines, explosives, high voltage electricity, groundwater energy
- 234) Extractive waste is produced by:
- exploration, prospecting, exploitation, processing, and storage of minerals from deposits
 - exploitation and storage of minerals from deposits
 - exploration, prospecting, and processing of minerals
 - exploration and exploitation of minerals from deposits
- 235) The two most important factors determining the environmental impact of drilling operations are:
- sensitivity of the environment to contamination at the drilling site and well depth
 - borehole drilling method and designed methods of reservoir size assessment
 - geological and hydrogeological conditions at the drilling site
 - type of drilling mud and cementation technology of casing column
- 236) Classical mechanics does not describe:
- motion of inertia

- b) vibrational motion
- c) motion of relativistic particles
- d) motion of non-inertial systems

237) A weightless beam of length L is supported at its ends. After applying a force F at the distance $\frac{L}{4}$ from the left support, the reaction force of the left support will be:

- a) F
- b) $\frac{3F}{4}$
- c) $\frac{5F}{4}$
- d) $\frac{1F}{2}$

238) According to Hooke's law:

- a) elastic displacement is independent of the applied load
- b) elastic displacement is always proportional to the applied force
- c) plastic displacement is inversely proportional to the applied load
- d) plastic displacement is proportional to the applied force

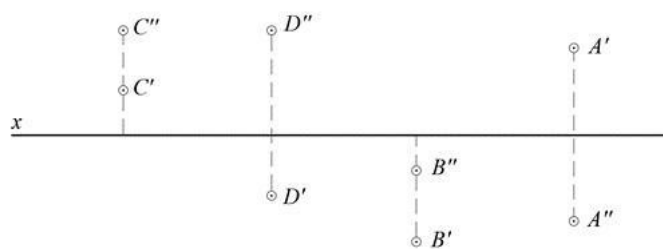
239) Young's modulus is:

- a) a constant determining the plasticity of a material, expressed as the relationship between the total material deformation and the acting load
- b) a constant determining the elasticity of a material, expressed as the relationship between the total material deformation and the acting load
- c) a constant determining the elasticity of a material, depending on the yield point
- d) a constant determining the elasticity of a material, expressed as the relationship between the relative linear deformation of the material and the normal stress acting in the same direction

240) What types of reactions occur in a pinned support?

- a) horizontal reaction
- b) horizontal and vertical reaction
- c) horizontal reaction and rotation (moment)
- d) vertical reaction

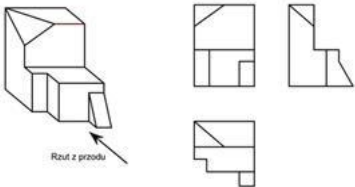
241) Monge's projection of four points is given. The point in the fourth quadrant is:



- a) point D
- b) point B
- c) point A
- d) point C

242) What is the purpose of a continuous thick line on a machine engineering drawing?

- a) marking the visible edges in the projection/view of the object
- b) no such line is used
- c) marking the invisible edges in the projection/view of the object
- d) marking the axis of symmetry

- 243) Which of the below is a non-permanent joint?
- rivet joint
 - welded joint
 - threaded joint
 - glued joint
- 244) How do rolling bearings sit on a shaft?
- using rivet joint
 - using press-fit connection with appropriate dimensional tolerances of the shaft pin
 - using welded joint
 - using keyway joint
- 245) The M10 mark on the dimensions of the joined elements (parts directly involved in the connection) indicates:
- welded joint
 - threaded joint
 - rivet joint
 - keyway joint
- 246) What kind of stresses are described by the symbol σ ? Select all correct:
- shear stress
 - bending stress
 - torsional stress
 - tensile and compressive stress
- 2 and 4
 - 1 and 2
 - 1, 2, 3 and 4
 - only 2
- 247) Permissible stress is:
- stress that can remain in the material without exceeding the strength and stiffness conditions and depends on the yield point of the material
 - stress dependent on the strength of the material as determined by the fatigue strength
 - stress that may occur in an element under load and may be slightly exceeded
 - stress calculated from the static diagram of an element subjected to a given load
- 248) For the object shown in axonometry, orthogonal projections were made according to the European method. Identify which orthographic projection is where the error is.
- 
- the error is in the front view
 - the error is in the side view
 - all projections are correct
 - the error is in the plan view
- 249) Which physical quantity can be measured by a sensor based on a thermocouple:
- temperature
 - tension
 - pressure
 - electrical resistance

250) The device used to change the electrical frequency is:

- a) rectifier
- b) LED
- c) transformer
- d) inverter