1) Amount, measurement, signal

- **mol** is a unit of the quantity : **amount of substance**
- **kmol** is a unit of the quantity : **amount of substance**
- **mmol / ml** is a unit of the quantity : **amount of substance**
- **mmol** is not a unit of the quantity : **amount of substance**
- **mol** is not a unit of the quantity : **mass**
- one **mol** of substance can be expressed by means of the **mass** units
- one **mol** of substance can be unambiguously (positively) expressed using the **volume** units
- the **mass** of a sample (matter) can be expressed by means of (converted to) the number of molecules
- the **molar mass** determines the relation betwen the **volume** and the **amount of substance**
- the molar mass determines the relation betwen the **mass** and the **amount of substance**
- the unit **mol / ml** represents the **molar concentration**
- the unit **mmol / ml** represents the **molar concentration**
- the unit **mmol / ml** does not represent the **molar concentration**
- the unit **mol / kg** represents the **molar concentration**
- one **mol** is approx. 6×10^{23} mg
- one **mol** always represents 6×10^{23} atoms
- one **kmol** is approx. 6×10^{26} particles
- one **mol** is approx. 6.023×10^{23} particles
- the data obtained at **mol / l** can be also expressed as **kg / l**
- the data obtained at **mol / l** can be also expressed as **mmol / l**
- the data obtained at **kg / l** cannot be also expressed as **mol / l**
- the value of **mol / l** is identical to the value of **mmol / ml**
- the value of **mol / l** is identical to the value of **kmol / ml**
- **mg / ml** is the unit for the **density**
- **mg / ml** is the unit for the **concentration**
- **kg / l** is not the unit for the **density**
- **kg / l** is not the unit for the **concentration**
- the same units are used for the **density** and the **concentration**
- the same units are not applicable for the **density** and the **concentration**

- errors of measurement can be **instrumental** and **methodological**
- errors are exclusively **random** and **instrumental**
- measurements cannot be influenced by **personal** error
- an inappropriate calibration of the device results in an **instrumental** error
- the dimension of **relative error** is the same as the dimension (units) of the **result**
- the dimension of **relative error** is not the same as the dimension (units) of the **results**
- **absolute error** of the measurement is expressed in **per cent**
- **absolute error** of the measurement is not expressed in **per cent**
- **relative error** equals to the ratio of the **absolute error** and the **result**
- **relative error** is expressed in **per cent**
- **statistical error** is expressed exclusively as the **absolute** error

- **statistical error** (of the measurement) can be expressed as both the **absolute** and the **relative** errors
- SEM (SE) determines the interval in which the arithmetic mean (average) is never located
- SEM (SE) determines the interval in which the **arithmetic mean** (average) is highly probably located
- there is **over 60%** probability that the arithmetic mean (average) is located in the interval between the **mean minus SEM** (SE) and the **mean plus SEM**
- there is **below 60%** probability that the arithmetic mean (average) is located in the interval betwen the **mean minus SEM** (SE) and the **mean plus SEM**
- there is **over 60%** probability that the individual measurement appears in the interval between the **arithmetic mean** (average) **minus SD** and the **mean plus SD**
- there **is below 70%** probability that the individual measurement appears in the interval between the **arithmetic mean** (average) **minus SD** and the **mean plus SD**
- **instrumental error** of the measurement is always expressed in **per cent**
- **random error** of the measurement can be expressed in **per cent**
- **SEM** (SE) is always expressed in **per cent**
- **SD** can be expressed in **per cent**
- **arithmetic mean** (average) is the most appropriate value that characterizes given quantity (at least within the normal Gauss distribution)
- **arithmetic mean** (average) equals to the total (the sum) of all individual measurements (data) divided by the number of these measurements
- **arithmetic mean** (average) equals to the total (the sum) of all individual measurements (data) multiplied by the number of these measurements
- **arithmetic mean** (average) is the most accurate value of each quantity
- **arithmetic mean** (average) is the most probable value for Gauss normal distribution
- **arithmetic mean** (average) never equals to the most frequently measured value
- **arithmetic mean** (average) may equal to the most frequently measured value
- **arithmetic mean** (average) is practicaly identical with **median** in the data of the normal Gauss distribution
- **arithmetic mean** (average) cannot equal to **median**
- **arithmetic mean** (average) cannot equal to **modus (mod)**
- **modus (mod)** may equal to **median**
- **modus (mod)** never equals to **median**
- **modus (mod)** is the „middle“ value (at least half of the values is more or equal to **modus** and, at the same time, at least half of the values is less or equal to modus)
- **median** is the most frequent value
- in the data set : 2, 2, 3, 2, 3 – the **modus (mod)** is 2
- in the data set : 2, 2, 3, 2, 2 – the **modus (mod)** is 3
- **modus (mod)** is the most frequent value in the data set
- in the data set : 2, 2, 3, 3, 2 – the **median** is 2
- **median** is the „middle“ value (at least half of the values is more or equal to median and, at the same time, at least half of the values is less or equal to median)

- the calibration means to adjust the zero on the device

- biosignals are all signals produced by organs and tissues within the body
- nerve impulses do not represent the biosignal
- nerve impulses represent the biosignal
- electromyographic signal does not represent the biosignal
- electromyographic signal represents the biosignal
- the mass of myocardium represents the biosignal
- **signal** is a form of matter carrying the information
- **signal** is a form of matter without the information
- electric current never represents any signal
- electric current can represent the signal
- **pressure** never represents any signal
- **pressure** can represent the signal
- non-electric signal is transformed into the electrical one by transducers in order to process them using electrical equipment
- a transducer may employ the changes of electrical resistance
- a transducer never employs the changes of capacity
- a transducer never employs the changes of electrical resistance
- a transducer may employ the changes of capacity
- the negative feedback is the information acquired by the system that „amplify“ the deflection (increases the input signal even more when the output increases)
- the negative feedback is the information acquired by the system that „attenuates“ (reduces) the deflection (decreases the input signal when the output increases)
- the positive feedback is the information acquired by the system that „amplify“ the deflection (increases the input signal even more when the output increases)
- the positive feedback is the information acquired by the system that „attenuates“ (reduces) the deflection (decreases the input signal when the output increases)
- the longer the period, the higher the frequency of periodic behavior
- the longer the period, the lower the frequency of periodic behavior
- the higher the amplitude,the lower the frequency of periodic behavior
- the higher the amplitude, the higher the frequency of periodic behavior
- the higher the frequency, the shorter the period of periodic behavior
- the lower the frequency, the longer the period of periodic behavior
- the shorter the period, the higher the amplitude of periodic behavior
- the longer the period, the lower the amplitude of periodic behavior
- an amplifier is a device that increases frequency of the electric voltage, electric current, or electric power
- if the period of signal on oscilloscope is 5 cm representing 50 ms, then the amplitude of this signal is 10 mV
- biosignals are being generated also by the interaction of the organism with an external stimulus (e.g. with electromagnetic field, ionizing radiation, etc.)
- a **comparative method** of measurement (e.g. the density using a pycnometer) is based on the measurement of given quantity on **unknown sample** and also on the **sample, which characteristics (measured quantity) are known**
- when we adjust **zero equillibrium position** of the balance (e.g. by setting it by pushing the „zero“ button) it is guaranteed that by balancing the object (e.g. by reading the mass from the display) we get correct result

- using linear interpolation method, if **3 kg** correspond to **6 ml** and **4 kg** corresponds to **8 ml**, then **3.5 kg** correspond to **7 ml**
- it is easier to measure directly the **amount of substance** (in mole) than the **mass**
- the accuracy of **volume** measurement is usually higher than the accuracy of **weighing**
- an example of linear relationship : 3-fold input results in 3-fold output
- an example of linear relationship : 3-fold input results in constant output
- an example of linear relationship : 3-fold input results in 6-fold output

<u>2) Cell, membrane</u>

- **cell** is a basic structural and functional component of living organisms
- cells can live without an interaction with the surroundings
- cells cannot live without an interaction with the surroundings
- a size of the cell is approx. **0.01 µm (0.005-0.12 µm)**
- a size of the cell is approx. **0.01 nm (0.005-0.12 nm)**
- a size of the cell is approx. **0.01 mm (0.005-0.12 mm)**
- basic features of living cells are metabolism, excitability, reproduction
- basic features of living cells are not metabolism, excitability, reproduction
- the length of a cell can be many times higher than the size of its cell body
- the length of a cell can never be many times higher than the size of its cell body
- air is not exchanged betwen the cell and the extracellular space
- oxygen is not exchanged betwen the cell and the extracellular space
- oxygen is exchanged betwen the cell and the extracellular space
- heat is not exchanged betwen the cell and the extracellular space
- heat is exchanged betwen the cell and the extracellular space
- the intracellular space (cytoplasm) contains particularly (>100 **mmol/liter**) H^+ and K^+
- the intracellular space (cytoplasm) contains particularly (>100 **mmol/liter**) Na^+ and Ca^+
- the extracellular space (outside of the cell) contains particularly (> 100 **mmol/liter**) Ca^{2+} and K^+
- the extracellular space (outside of the cell) contains particularly (> 100 **mmol/liter**) Na^+ and water
- the extracellular concentration of Na^+ is several times higher than its intracellular concentration
- the extracellular concentration of Na^+ is several times lower than its intracellular concentration
- intra- and extra-cellular concentrations of Cl^- are identical
- the extracellular concentration of K^+ is several times higher than its intracellular concentration
- the extracellular concentration of K^+ is several times lower than its intracellular concentration

- cholesterol is present in cell membranes
- cholesterol is not present in cell membranes
- water is an eseential component of cell membranes
- water is not an essential component of cell membranes
- proteins are not present in cell membranes

- proteins are present in cell membranes
- the cell membrane is built by one layer of phospholipidic cells
- a surface of cell membranes is approx.7.5 **nm**
- a thickness of cell membranes is approx. 7.5 **nm**
- a thickness of cell membranes is approx. 1/1000 of the size of the cell
- a thickness of cell membranes is approx. 1/10 of the size of the cell
- membranes of living cells are electrically depolarized
- membranes of living cells are electrically polarized
- cell membranes contain mostly phospholipids, proteins, molecules of sugar, cholesterol
- cell membranes do not contain phospholipids
- cell membranes do not contain saccharides
- there are the intracellular membranes (covering the surface of organels) and plasmatic membranes (covering the cells)
- membrane channels are built mostly by proteine molecules
- membrane channels are not built by proteine molecules
- membrane receptors might be made of glycoprotein molecules
- membrane receptors are never made of glycoprotein molecules
- main functions of a cellular membrane are : polarization, reproduction, and semipermeability
- semipermeability is an important feature of cell membranes
- polarization is an important feature of cell membranes
- cell mambranes do not contain genes
- cell mambranes contain genes

- the saline (physiological solution) is approx. 300 **mOsm** (300 mmol of particles / litre)
- the saline (physiological solution) is approx. 300 **Osm** (300 mol of particles / litre)
- the haemolysis of RBCs (erythrocytes) is visible in each hypotonic environment
- the haemolysis of RBCs (erythrocytes) is visible in highly hypotonic solution
- RBCs (erythrocytes) shrink (reduce their volume) in strong hypotonic environment
- RBCs (erythrocytes) shrink (reduce their volume) in hypertonic environment
- the molar concentration of hypertonic solution is higher than the concentration of **0.9%** NaCl (isotonic physiological solution - saline)
- the molar concentration of hypertonic solution is lower than the concentration of **0.9%** NaCl (isotonic physiological solution - saline)
- the saline (physiological solution) is **9 g of NaCl / 100 ml** of the solution
- the saline (physiological solution) is **9 g of NaCl / 1000 ml** of the solution
- haemolysed RBCs (erythrocytes) are observed as a sediment (after the sedimentation or centrifugation of samples)
- RBCs (erythrocytes) are observed as a sediment (after the sedimentation or centrifugation of samples)
- an oncotic pressure of proteins represents the difference between the total osmotic pressure and the osmotic pressure of „low-molecules“ (particularly inorganic) components in the blood plasma
- an oncotic pressure is manifested on the membrane permeable for water and small molecules

- an oncotic pressure is manifested on the membrane permeable for water and colloids
- an oncotic pressure is manifested on the membrane permeable for colloids
- edema occurs when oncotic pressure of plasma is too high
- edema occurs when oncotic pressure of plasma is too low
- edema occurs when blood pressure is too low
- edema occurs when blood pressure is high
- blood cells swell (expand their volume) in hypotonic solution
- blood cells swell (expand their volume) in isotonic solution
- blood cells swell (expand their volume) in hypertonic solution
- the ability of RBCs (erythrocytes) to withstand (to a certain degree) hypotonic environment is called osmotic resistance of RBCs (erythrocytes)
- elasticity of cell membrane may contribute to osmotic resistance of RBCs (erythrocytes)

3) Membrane transport

- diffusion through membrane channels is a continuous uninterrupted process
- diffusion through membrane channels can be interrupted (reduced) by closing the channels
- diffusion through membrane channels does not depend on the type of diffusing molecules
- diffusion through membrane channels does not depend on the type of these channels
- diffusion through membrane channels depends on the type of diffusing molecules
- diffusion through membrane channels depends on the type of these channels
- membrane transport is performed e.g. by diffusion
- membrane transport is performed e.g. by facilitated diffusion
- carriers within the membrane facilitate the membrane transport for given substance (molecules)
- carriers within the membrane reduce the membrane transport for given substance (molecules)
- diffusion through membrane channels allows the penetration of ions, e.g. Na^+, K^+, Ca^{2+}, Cl^- across the membrane
- diffusion through membrane channels allows the penetration of macromolecules (e.g. proteins) across the membrane
- facilitated diffusion allows the transport of e.g. amino acid and protein molecules across the membrane
- diffusion through membrane channels is an active transport mechanism through cell membranes
- diffusion through the membrane channels is a passive transport mechanism through cell membranes
- diffusion occurs because thermal (heat) movement of molecules
- diffusion is a spontaneous transport of the substance from the area of its lower concentration to the area with its higher concentration
- diffusion is a spontaneous transport of the substance from the area of its higher concentration to the area with its lower concentration
- diffusion of the substance dissolved in the water depends on the membrane permeability to water molecules
- diffusion does not depend on the temperature

- diffusion depends on the temperature

- an amount of diffused substance is proportional to the duration of diffusion
- an amount of diffused substance is not proportional to the duration of diffusion
- an amount of diffused substance is proportional to the square of the surface area through which the substance diffuses
- an amount of diffused substance is proportional to the surface area through which the substance diffuses
- an amount of diffused substance is inversely proportional to the concentration gradient
- an amount of diffused substance is proportional to the concentration gradient
- an amount of diffused substance is proportional to the distance which the substance must pass
- osmosis is reverse process to the difusion (the penetration and movement of the substance reversely than during the difusion)
- osmosis requires some carriers for transport of substances being dissolved
- osmosis is the diffusion being acting through the membrane
- osmosis is an active transport of water molecules only
- channels within the membrane control permeability of the membrane *via* opening and closing them according to the membrane potential or the receptor activity
- osmosis is an active transport through cell membranes
- osmosis occurs because thermal (heat) movement of molecules
- the **diffusion constant** (coefficient) depends on both the composition and structure of the membrane and on the sort of diffused substance (e.g. gas)
- the **diffusion constant** (coefficient) depends on the sort of diffused substance, but not on the composition and structure of the membrane
- membrane transports never work against concentration gradients
- membrane channels are classified as „voltage“ or „ligand“ gated
- osmotic pressure depends on the mass of solution
- osmotic pressure depends on the number of liquid molecules
- osmotic pressure depends on the volume of solution
- osmotic pressure depends on the number of dissolved molecules

- the glucose symport employs the concentration gradient of sodium ions in order to transport glucose molecules into the cell against the glucose concentration gradient
- the glucose symport employs the concentration gradient of potassium ions in order to transport glucose molecules into the cell against the glucose concentration gradient
- co-transports are active mechanisms of transport of molecules through the membrane utilizing the energy directly from ATP molecules
- hydrolysis of ATP usually accompanies active transports
- exocytosis is an active transport mechanism
- exocytosis is a passive transport mechanism
- at synapses, release of mediator molecules is performed by **exocytosis**
- cell membrane contains either channels for $\mathbf{Na^+}$ or for $\mathbf{K^+}$
- cell membrane contains channels for both $\mathbf{Na^+}$ and $\mathbf{K^+}$

- Na^+-K^+ ATP-ase is the enzyme placed within intracellular membranes
- Na^+-K^+ ATP-ase is the enzyme placed within (at) cellular membranes
- Na^+-K^+ ATP-ase performs active transport of **Na^+** out of the cell and **K^+** into the cell
- Na^+-K^+ ATP-ase performs active transport of **K^+** out of the cell and **Na^+** into the cell
- the Natrium-Potassium pump requires ADP molecules to operate (to work)
- the Natrium-Potassium pump requires action potential for its activation
- the Natrium-Potassium pump requires ATP molecules to operate (to work)
- the Natrium-Potassium pump does not require action potential for its activation
- filtration is a passive transport through membranes following the electrochemical gradient
- filtration is a passive transport of ions through cell membranes following the gradient of concentration
- filtration is an active transport through membranes following the electrochemical gradient
- filtration is an active transport of ions through cell membranes following the gradient of concentration
- passive and active transports (through the membrane) require a delivery of free energy from the molecules of ATP

4) Resting membrane potential, action potential

- any change of membrane potential represents an **action potential**
- any change of membrane potential does not lead to **action potential**
- membrane potential rises (shifts to positive values) during the hyperpolarization phase of action potential
- membrane potential decreases under the level of resting membrane potential during the hyperpolarization phase of action potential
- membrane potential shifts to **0 mV** during the hyperpolarization phase of action potential
- membrane potential exceeds the threshold during the hyperpolarization phase of action potential
- membrane potential rises (shifts to positive values) during the depolarization phase of action potential
- membrane potential decreases (shifts to negative values) during the depolarization phase of action potential
- action potential of neuron is approx. -70 V
- action potential of neuron is approx. -70 μV
- action potential of neuron is approx. -70 mV
- action potencial is kind of general electric event of „irritable“ tissues
- action potencial is kind of general electric event of each living cell
- action potentials do not occur on non-myelinated nerve fibers
- action potentials occur on non-myelinated nerve fibers
- the general law (principle) **“all or nothing“** does not apply to conduction along nerve fibers
- the general law (principle) **“all or nothing“** applies to conduction along nerve fibers
- the Na^+-K^+ ATP-ase reniews (and maintains) resting membrane potential

- the Na^+-K^+ ATP-ase gives rise to action potential

- resting membrane potential is potencial difference measured between the inside and the outside of the cell
- intracellular spaces of cells are charged negativelly compared to extracellular ones
- intracellular spaces of cells are charged positively compared to extracellular ones
- resting membrane potencial is caused by 10 – 30 fold higher concentration of extracellular ions inside the cell
- resting membrane potencial is caused by 10 – 30 fold higher concentration of intracellular ions within the extracellular space
- resting membrane potential results from higher concentration of divalent cations within the extracellular space
- resting membrane potential results from higher concentration of divalent cations within the intracellular space
- action potential usually results from an abrupt and massive influx of **Na^+** ions into the cell (natrium influx)
- action potential results from efflux of **K^+** ions from the cell
- action potentials end with repolarization being caused by active transport of potassium into the cell
- the stronger the stimulus, the higher the number of action potentials
- the stronger the stimulus, the higher the amplitude of action potencials
- the stronger the stimulus, the lower the amplitude of action potencials
- the magnitude of action potentials depends on the stimulus strength
- the magnitude of action potentials does not depend on the stimulus strength
- the magnitude of membrane potential (e.g. generator potential or resting potential) depends on membrane conductances (permeability of the membrane) and the concentration of ions
- the magnitude of membrane potential (e.g. generator potential or resting potential) depends on membrane conductances (permeability of the membrane), but not on the concentration of ions
- the magnitude of membrane potential (e.g. generator potential or resting potential) depends on the concentration of ions, but not on membrane conductances (permeability of the membrane)
- during action potential the intracellular space gathers natrium ions (the total number of natrium ions within the cell increases)
- during action potentials the intracellular space gathers potassium ions (the total number of potasium ions within the cell increases)

- action potential spreads along nerve fibers (muscle cells) with the same shape and magnitude
- action potential spreads along nerve fibers (muscle cells) with the same shape, but not the same magnitude
- action potential spreads along nerve fibers (muscle cells) with the same magnitude, but not the same shape

- action potencial propagates in myelinated fibers by „jumping“ (a saltatory transmission)
- action potencial propagates in non-myelinated fibers by „jumping“ (a saltatory transmission)
- conduction velocity of action potentials in nerve fibers is inversely proportional to their diameter (thickness)
- conduction velocity of action potentials in non-myelinated nerve fibers is inversely proportional to their diameter (thickness)
- conduction velocity of action potentials in non-myelinated nerve fibers are usually lower than in myelinated fibers
- saltatory propagation of action potentials along nerves is performed by neurotransmiters
- the longer the internods (stages between the Ranvier nodes), the faster the conduction velocity of action potentials along myelinated nerve fibers
- conduction velocity of action potentials depends on stimulus intensity
- conduction velocity of action potentials does not depend on stimulus intensity
- conduction velocity of action potentials in myelinated fibers is lower than in non-myelinated fibers
- the thinner the nerve fiber, the lower the speed of propagation of action potentials
- the thicker the nerve fiber, the faster the propagation of action potentials
- conduction velocity of action potentials is identical during both orthodromic and antidromic propagations
- conduction velocity of action potentials is not identical during orthodromic and antidromic propagations
- during the refractory period of action potential the excitability of the nerve membrane is reduced (potentially this membrane is not excitable at all)
- during the refractory period of action potential the excitability of the nerve membrane is increased
- during the relative refractory period of action potential the mebrane is not excitable (irritable) at all
- during the relative refractory period of action potential there is increased mebrane excitability (irritability)
- action potentials propagate in non-myelinated fibers by membrane depolarization, action potential induces action potential at adjacent part of the membrane (“continual“ spreading, local currents mechanism)
- action potentials propagate in non-myelinated fibers by membrane polarization and the induction of action potential at adjacent membrane (“continual“ spreading)
- action potentials propagate in myelinated fibers by membrane depolarization, action potential induces action potential at adjacent part of the membrane (“continual“ spreading, local currents mechanism)

5) Synapse, electrical activity of muscle

- action potencials are transmitted at synapse by “jumping“ the Ranvier nodes (saltatory transmission)
- postsynaptic potencials are transmitted at synapse by “jumping“ the Ranvier nodes (saltatory transmission)
- chemical synapses allow both directions of neural transmission

- chemical synapses allow only one direction of neural transmission
- polarization of the subsynaptic membrane at excitatory synapse increases during the transmission of the signal
- polarization of the subsynaptic membrane at excitatory synapse decreases during the transmission of the signal
- polarization of the subsynaptic membrane at inhibitory synapse increases during the transmission of the signal
- activation of inhibitory synapse does not result in an occurence of action potentials on the postsynaptic neuron
- activation of inhibitory synapse can result in an occurence of action potentials on the postsynaptic neuron
- activation of excitatory synapse never results in an occurence of action potentials on the postsynaptic neuron
- postsynaptic potentials represent local gradual (stepwise) electrical response (of membrane)
- postsynaptic potentials can represent local depolarization of postsynaptic membrane
- postsynaptic potentials can represent local hyperpolarization of postsynaptic membrane
- postsynaptic potentials are counted up exclusively by temporal summation
- postsynaptic potentials are counted up exclusively by spatial summation
- progressive depolarization of cellular membranes due to activation of several excitatory synapses represents spatial summation
- progressive depolarization of cellular membranes due to activation of several excitatory synapses represents temporal summation
- progressive hyperpolarization of cellular membranes due to activation of several excitatory synapses represents spatial summation
- progressive hyperpolarization of cellular membranes due to activation of several inhibitory synapses represents spatial summation
- progressive depolarization of cellular membranes due to activation of the same excitatory synapse represents temporal summation
- progressive hyperpolarization of cellular membranes due to activation of the same inhibitory synapse represents temporal summation
- progressive depolarization of cellular membranes due to activation of the same excitatory synapse represents spatial summation
- progressive hyperpolarization of cellular membranes due to activation of the same inhibitory synapse represents spatial summation
- postsynaptic potentials are excitatory when membrane permeability for **Na^+** decreases
- postsynaptic potentials are inhibitory when membrane permeability for **Na^+** decreases
- postsynaptic potentials are inhibitory when membrane permeability for **Cl^-** decreases
- postsynaptic potentials are excitatory when membrane permeability for **Cl^-** decreases
- postsynaptic potentials do not contribute to either temporal or spatial summation

- there are axo-axonal, axo-dendritic, and axo-somatic synapses
- there are no axo-axonal synapses
- there are no axo-somatic synapses
- there are axo-somatic synapses

- there are axo-axonal synapses
- hyperpolarization increases the efficiency of synaptic transmission
- synaptic transmission is based mostly upon action of chemical mediators
- synaptic transmission is not based upon action of chemical mediators
- synaptic transmission is based upon action of **Na** and **K** ions
- mediators are usually released from the presynaptic membrane
- mediators are usually not released from the postsynaptic membrane
- mediators are usually not released from the subsynaptic membrane
- mediators are usually released from the postsynaptic membrane
- mediators are usually released from the subsynaptic membrane
- mediators bind on the voltage gated channels of the postsynaptic membrane
- mediators bind mainly on receptors of the subsynaptic membrane
- binding of neurotransmitters on receptors of subsynaptic membrane can result in opening of ligand-gated ion channels
- binding of neurotransmitters on receptors of subsynaptic membrane can result in activation of G-protein (the 2nd messenger)
- synaptic transmission results in opening of voltage-gated ion channels on the postsynaptic neuron
- neurotransmiters affect particularly membrane potencial of the postsynaptic neuron
- neurotransmitters are eliminated from the synaptic cleft by diffusion, by re-uptake back to the presynaptic neuron, or they are metabolized (chemically deactivated)
- glutamate and glycine are typical excitatory neurotransmitters
- GABA is a kind of typical inhibitory neurotransmitter
- acetylcholine and glycine are typical excitatory neurotransmitters
- glutamate is a kind of typical inhibitory neurotransmitter
- GABA and glycine are typical inhibitory neurotransmitters
- Ca^{2+} is neurotransmitter of synaptic transmission from motor nerve fibers to the muscle cells (at the neuromuscular junction)
- Ca^{2+} is typical neurotransmitter of synaptic transmission in brain

- local electric event (e.g. the end plate potential) conforms to the "**all or nothing**" law
- local electric event (e.g. the depolarization during EPSP) does not conform to the "**all or nothing**" law, its magnitude depends on „stimulus intensity"
- one **motor unit of skeletal muscle** contracts due to activation of one motoneuron
- one **motor unit of cardiac muscle** contracts due to activation of one related motoneuron
- **amplitude** of action potential at skeletal muscle cells depends on the intensity of stimulus
- high concentration of $\mathbf{Ca^{2+}}$ in the sarcoplasm is required for transmission of action potentials from the nerve to the muscle
- high concentration of $\mathbf{Ca^{2+}}$ in the sarcoplasm is not required for transmission of action potentials from the nerve to the muscle
- myocardium **can not be activated** without special conductive nerve fibres at all
- myocardium can be activated directly, e.g. by an electric impulse

- resting membrane potential of myocardial cells depends particularly on concentration gradient of **Ca^{2+}**
- the weaker the stimulus, the lower the depolarization or hyperpolarization of irritable membranes (local graded responses)
- the stronger (more vigorous) the stimulus, the higher the depolarization or hyperpolarization of irritable membranes (local gradual responses)
- the stronger (more vigorous) the stimulus, the lower the depolarization or hyperpolarization of irritable membranes (local graded responses)
- **duration of action potential** in skeletal muscle cell and the cell of myocardium is similar and markedly shorter than action potential duration in smooth muscle cells
- **duration of action potential** in skeletal muscle cell is usually markedly shorter than action potential duration in smooth muscle cell
- **duration of action potential** in skeletal muscle cell is usually markedly shorter than action potential duration in cardiac muscle cell
- **duration of action potential** in skeletal muscle cell is usually markedly longer than action potential duration in smooth muscle cell
- **duration of action potential** in skeletal muscle cell is usually markedly longer than action potential duration in cardiac muscle cell
- **Prepotential** is a kind of gradual **hyperpolarization** of cell membranes of conductive heart system due to alterations in parmeability of channels within these membranes
- **Prepotential** is a kind of gradual **depolarization** of cell membranes of conductive heart system due to alterations in parmeability of channels within these membranes
- **Prepotential** is gradual **depolarization** of cell membranes of conductive heart system (particulalrly the Sinoatrial node) resulting in an occurence of action potential
- conductive system of heart consists of Sinoatrial node (SA), Atrio-ventricular node (AV), Tawar bundle, left and right Hiss straps, and Purkyne fibres
- conductive system of heart consists of Sinoatrial node (SA), Atrio-ventricular node (AV), Hiss bundle, left and right Tawar straps, and Purkyne fibres
- depolarization propagates from the **Atrioventricular node** (AV) to atrias and ventricles in healthy adult heart
- depolarization propagates from the **Sinoatrial node** (SA) to atrias and via conductive system also to ventricles in healthy adult heart

6) Muscle

- an individual action potential of muscle cell evokes one shortlasting contraction – “single muscle twitch“
- several action potentials of muscle cell during a short period of time are required to evoke one shortlasting contraction – “single muscle twitch“
- temporal summation of muscle contraction always results in its isotonic contraction
- temporal summation of muscle contraction always results in its isometric contraction
- incomplete (unfused) tetanus always results in isometric contraction of the muscle
- incomplete (unfused) tetanus always results in isotonic contraction of the muscle
- recruitment of additional motor units results in strengthening of muscle contraction
- recruitment of additional motor units results in contraction of additional muscle cells
- lower frequency of skeleton muscle stimulation results in “wave“ incomplete (unfused) tetanus, higher frequency of stimulation results in“smooth“ complete (fused) tetanus

- lower frequency of skeleton muscle stimulation results in “smooth“ complete (fused) tetanus, higher frequency of stimulation results in “wave“ incomplete (unfused) tetanus
- superposition and summation of skeleton muscle twitches (possibly resulting in tetanus) are produced by two or more stimuli, which closely follow each other
- superposition and summation of skeleton muscle twitches (possibly resulting in tetanus) are produced by spatial summation of stimuli from several motoneurons
- muscle cells respond to stimulation by action potentials
- muscle cells respond to stimulation by contraction
- action potentials of muscle cells activate biochemical processes leading to the muscle contraction
- action potentials of muscle cells do not lead to muscle contraction
- motor units of skeletal muscles are determined by the number of myofibrils within the muscle fiber
- motor units of skeletal muscles are determined by the number of sarcomeres within the muscle fiber
- motor units of skeletal muscles are determined by the number of muscle fibers that are innervated by the particular motoneuron
- refractory periods of skeletal and cardiac muscles are short (sompared to that for smooth muscle)
- refractory periods of smooth and cardiac muscles are short (compared to that for skeletal muscle)
- refractory periods of skeletal muscle are short (compared to those for cardiac and smooth muscles)

- action potentials (depolarization) of muscle cell release Ca^{2+} into the intracellular space
- action potentials (depolarization) of muscle cell release Ca^{2+} from the sarcoplasmic reticulum into the cell
- action potentials (depolarization) of muscle cell release Ca^{2+} from the sarcoplasmic reticulum into the extracellular space (out of cells)
- action potentials (depolarization) of muscle cell releases ATP from the sarcoplasmic reticulum into the cell
- action potentials (depolarization) of muscle cell releases ATP from the sarcoplasmic reticulum into the extracellular space (out of cells)
- Ca^{2+} being required for muscle contraction, is stored within the sarcoplasmic reticulum and tubular system
- Ca^{2+} has to be pumped out of the intracellular space into the sarcoplasmic reticulum and tubular system in order to contract the muscle
- Ca^{2+} is actively transported (from intracellular space) into the sarcoplasmatic reticulum and tubular system by Ca^{2+} pump
- the sarcoplasmic reticulum and tubular system release Ca^{2+} only after hyperpolarization of these structures
- the sarcoplasmic reticulum and tubular system release Ca^{2+} only after depolarization of these structures
- ATP molecules are required for Actin and Troponin molecules to „wedge“ into each other (contraction)
- generally Ca^{2+} are required for contraction of muscle cell

- Ca^{2+} is an activator of muscle contraction by means of its interaction with Troponin (resulting in exposed binding spots of contraction elements)
- Ca^{2+} is an activator of muscle contraction by means of its interaction with Actin (resulting in altered conformation of Actinomyosin)
- Na^{+} is not an activator of muscle contraction
- K^{+} is an activator of muscle contraction by means of its interaction with Troponin (resulting in exposed binding spots of contraction elements)
- termination of muscle contraction is provided by depletion of ATP
- termination of muscle contraction is provided by „draining“ (pumping out) Ca^{2+} from the intracellular space
- ATP-dependent „pump“ Ca^{2+} ATP-ase „pumps“ Ca^{2+} into the sarcoplasmic reticulum resulting in ***rigor mortis***
- so called "plateau" of cardiac action potentials is caused mainly by Ca^{2+} **influx**
- so called "plateau" of cardiac action potentials is caused mainly by Ca^{2+} **efflux**
- contraction of heart requires rapid increase of Ca^{2+} concentration in the sarcoplasm
- contraction of heart **does not require** rapid increase of $\mathbf{Ca^{2+}}$ concentration in the **sarcoplasm**

- **myofibrils** are randomly arranged in muscle fibre
- **myofibrils** contain in series aligned (arranged) **sarcomeres**
- myofibrils contain contractile proteins **Actin** and **Troponin**
- myofibrils contain contractile proteins **Actin** and **Myosin**
- during skeletal muscle contraction the „heads“ of **Troponin** molecules shift **Actin** filaments
- interaction of **Myosin** and **Troponin** results in muscle contraction
- interaction of **Myosin** and **Actin** results in muscle contraction
- myocardium (the heart muscle) is not cross stripped
- myocardium (the heart muscle) is cross stripped
- smooth muscle is not cross stripped, its contraction is slower and longer lasting comparing with skeletal muscle
- cardiac muscle is not cross stripped, its contraction is slower and longer lasting comparing with skeletal muscle
- **skeletal** and **smooth** muscles are primarily controlled by the nerve system, but neural control does not participate in the function of **cardiac** muscle
- neural control participates in regulation of cardiac and smooth muscles
- neural control participates in regulation of cardiac and skeletal muscles
- neural control does not participate in regulation of cardiac and smooth muscles
- cardiac muscle is not controled voluntarily, but skeletal and smooth muscles are under the voluntary control
- cardiac and skeletal muscles are completely out of voluntary control
- smooth and skeletal muscles are completely out of voluntary control
- cardiac and smooth muscles are out of voluntary control
- cells of cardiac muscle are jointed with **Intercalar discs**, which enhance synchronization (and speed) of heart contraction
- cells of cardiac muscle are not jointed with **Intercalar discs**, which would slow down heart contraction

- cardiac and skeletal muscles are simillar each other because they content Intercalar discs
- cardiac and smooth muscles usually work as a Syncytium (coordinated network of cells)
- cells of smooth muscles are jointed with the „gap junction“ type of interconnections, which allow spreading of action potentials and spreading of contraction from one cell to another
- cells of skeletal muscles are jointed with the „gap junction“ type of interconnections, which allow spreading of action potentials and spreading of contraction from one cell to another

7) Respiration

- amount of gas dissolved in liquid is directly proportional to the partial pressure of this gas, and its coefficient of solubility (the Henry law)
- amount of gas dissolved in liquid is inversely proportional to the partial pressure of this gas, and its coefficient of solubility (the Henry law)
- the higher the partial pressure of the gas over the liquid, the higher the amount of this gas dissolved in the liquid
- the amount of O_2 dissolved in **1 l** of blood can never exceed **3 ml**
- the amount of O_2 dissolved in **1 l** of blood can exceed **3 ml**
- the amount of CO_2 dissolved (physically) in blood is several fold higher than the amount of oxygen in spite of lower partial pressure of CO_2
- the amount of O_2 dissolved (physically) in blood is several fold higher than the amount of CO_2 due to higher partial pressure of CO_2
- coefficient of CO_2 solubility in blood is several times higher than the coefficient for O_2
- coefficient of CO_2 solubility in blood is several times lower than the coefficient for O_2
- majority of oxygen in blood is transported „chemically“ bound to haemoglobin
- majority of oxygen in blood is transported „physically“ dissolved in plasma
- majority of CO_2 does not create chemical compounds in blood
- diffusion can completely compensate oxygen supply to tissues during significantly reduced perfusion of lung tissue
- oxygen is transported by blood „physically“ dissolved in blood (plasma) and also „chemically“ bound to haemoglobin
- oxygen is transported by blood exclusively as „physically“ dissolved
- oxygen is transported by blood exclusively as „chemically“ bound to haemoglobin
- pulmonary surfactant lowers surface tension between the air and the liquid in alveoli
- pulmonary surfactant raises the surface tension between the air and the liquid in alveoli

- total pressure of gas mixture (gases do not chemically interact) equals to the sum of partial pressures of the mixture components (the Dalton law)
- total volume of gas mixture is expressed by the Dalton law
- total temperature of gas mixture is expressed by the Dalton law
- percentage and volume fraction of O_2, CO_2, N_2 in the alveolar air is not reduced by the presence of water vapours (comparing with atmosphere)
- percentage and volume fraction of O_2, CO_2, N_2 in the alveolar air is affected by the presence of water vapours (comparing with atmosphere)

- partial pressure of oxygen in alveoli approximately equals to the partial pressure of oxygen at venous end of pulmonary capillaries
- pressure gradient of **oxygen** diffusion in lungs is approximately 8 kPa
- pressure gradient of **oxygen** diffusion in lungs is approximately 8 torr
- pressure gradient of **CO_2** diffusion in lungs is approximately 0.8 kPa
- pressure gradient of **CO_2** diffusion in lungs is approximately 0.8 torr
- partial pressure of **CO_2** in alveoli is during normal breathing approximately 0.53 kPa (4 mmHg)
- partial pressure of **CO_2** in venous blood is during normal breathing approximately 0.53 kPa (4 mmHg)
- partial pressure of oxygen in arterial blood is lower than that in the atmosphere or in the air within the airways
- partial pressure of oxygen in venous blood is lower than that in the atmosphere or in the air within the airways
- partial pressure of oxygen in respiratory system does not change
- partial pressure of oxygen in arterial blood equals to partial pressure of carbon dioxide in the atmosphere
- oxygen diffuses through alveolocapillary membrane from pulmonary alveoli into pulmonary capillaries because partial pressure of the air in alveoli is higher than its pressure in venous blood
- carbon dioxide diffuses through alveolocapillary membrane from pulmonary capillaries into pulmonary alveoli because partial pressure of carbon monooxide is higher in pulmonary capillaries
- partial pressures of N_2, O_2, and CO_2 can be calculated according to the Dalton law

- difusion of oxygen from pulmonary alveoli to pulmonary capillaries through alveolocapillary membrane does not depend on the thickness of this membrane
- difusion of oxygen from pulmonary alveoli to pulmonary capillaries through alveolocapillary membrane depends on the thickness of this membrane
- oxygen is transported between lungs and tissues by the respiratory system
- difusion of CO_2 in lungs is facilitated by reverse difusion of oxygen in lungs (the Dalton law)
- difusion of CO_2 in lungs does not depend on the difusion of oxygen in lungs
- difusion of oxygen in lungs does not depend on the difusion of CO_2 in lungs
- internal respiration (at cellular level) involves difusion, perfusion, and distribution
- internal respiration (at cellular level) requires proper functions of external respiration, heart, and blood vessels
- quiet respiration in adults supplies the body with approximately 2500 ml of O_2 and releases from the body approximately 2000 ml of CO_2 every minute
- quiet respiration in adults supplies the body with approximately 250 ml of O_2 and releases from the body approximately 200 ml of CO_2 every minute
- external respiration involves ventilation, distribution, diffusion, and perfusion
- external respiration involves 3 processes: ventilation, distribution, and diffusion
- external respiration is performed exclusively by lungs
- external respiration is not performed exclusively by lungs

- diffusion of O_2 and CO_2 follows their pressure gradients at alveolocapillary membrane, at walls of blood capillaries, and at cell membranes of tissues
- difusion coefficient of CO_2 is approximately 20 times lower than difusion coefficient of O_2
- difusion coefficient of O_2 is approximately 20 times lower than difusion coefficient of CO_2

8) Ventilation

- the air flows into lungs during inspiration due to positive intrathoracic pressure produced by respiratory muscles
- the air flows into lungs during inspiration due to negative intrathoracic pressure (compared to the atmospheric pressure) produced by respiratory muscles
- intrapulmonary pressure has to be lower than the atmospheric pressure in order to accomplish inspiration
- intrapulmonary pressure has to be higher than the atmospheric pressure in order to accomplish inspiration
- expiratory airflow in the airways is not produced by the pressure difference
- expiratory airflow in the airways is produced by the pressure difference
- during quiet breathing both pleural and intrapulmonary pressures are always negative (compared to atmospheric pressure)
- during quiet breathing both pleural and intrapulmonary pressures are always positive (compared to atmospheric pressure)
- during quiet breathing pleural pressure is always negative and intrapulmonary pressure is always positive (compared to atmospheric pressure)
- during quiet breathing pleural pressure is always positive and intrapulmonary pressure is always negative (compared to atmospheric pressure)
- pleural pressure during quiet breathing is always negative (compared to atmospheric pressure)
- pleural pressure during quiet breathing is always positive (compared to atmospheric pressure)
- pleural pressure reaches **-1 kPa** at the end of quiet expiration
- pleural pressure does not reach **-1 kPa** at the end of quiet expiration
- during forceful inspiration and expiration, pleural and intrapulmonary pressures are alternately negative and positive (compared to atmospheric pressure)
- intrapulmonary pressure decreases during the course of expiration
- intrapulmonary pressure increases during inspiratory-expiratory transition
- pleural pressure is higher than the atmospheric pressure at the beginning of inspiration
- during inspiration, negative intrapulmonary pressure leads to the positive value of pleural pressure

- quiet expiration is performed by elatic recoil of lungs and chest and by a passive shift of the diaphragm upwards
- quiet (eupneic) inspiration and expiration are performed by contraction of the diaphragm and abdominal muscles

- during inspiration the diaphragm is actively moving downwards
- airflow within the airways is measured in **l / min** (possibly in ml / s)
- airflow within the airways is not measured in **l** (possibly in ml)
- tidal volume is not measured in **l / min** (possibly in ml / s)
- tidal volume is measured in **l** (possibly in ml)
- inspiratory air volume depends on inspiratory airflow and the duration of inspiration
- inspiratory air volume depends on inspiratory airflow
- inspiratory air volume depends on the duration of inspiration
- ventilation is performed by rhythmic activation and relaxation of smooth muscles
- ventilation is performed by rhythmic activation and relaxation of striated muscles
- during inspiration, volume of the chest decreases and volume of the lungs increases
- during expiration, volume of the chest decreases and volume of the lungs increases
- the most important inspiratory muscle is musculus intercostales externi
- the most important inspiratory muscle is the diaphragm
- distribution is represented particularly by mixing of inhaled air with the air which remained in the airways and the lungs after expiration
- quiet expiration is produced by contraction of abdominal muscles
- during forceful expiration, abdominal muscles usually contract

- transition from inspiration to expiration is initiated (generated) by neurons in the brain
- spontaneous breathing is possible without action of neurons in the brain
- airflow in the airways is affected also by lung compliance and airway resistance
- airflow in the airways is not affected by lung compliance at all
- airflow in the airways is not affected by airway resistance
- the Paralelogram illustrates function of the diaphragm and abdominal muscles
- the Paralelogram illustrates respiratory function of intercostal muscles
- the Hering model of breathing illustrates also effects of high negative and positive pressures on filling of large veins in the chest
- bronchoconstriction (e.g. in asthma bronchiale) makes breathing more difficult because of lower compliance of lungs
- bronchoconstriction (e.g. in asthma bronchiale) makes breathing easier because of lower compliance of lungs
- bronchoconstriction (e.g. in asthma bronchiale) makes breathing more difficult because of lower airways resistance
- bronchoconstriction (e.g. in asthma bronchiale) makes breathing more difficult because of higher airways resistance
- lung compliance is expressed in **kPa / N**
- lung compliance is expressed in **l / kPa**
- anatomical dead space is approximately **250 ml** in healthy adults
- anatomical dead space is approximately **150 ml** in healthy adults
- anatomical dead space is not approximately **350 ml** in healthy adults
- anatomical dead space is the volume of inhaled air that does not reach alveols during inspiration
- air volume within bronchi after the inspiration represents a part of anatomical dead space

<u>9) Volumes and capacities, spirometry</u>

- tidal volume (V_T) in adults is approx. **0.5 l**
- tidal volume (V_T) in adults is approx. **0.5 ml**
- tidal volume (V_T) is the volume of air inhaled during quiet inspiration
- tidal volume (V_T) is not the volume of air inhaled during quiet inspiration
- tidal volume (V_T) is the volume of air exhaled during quiet expiration
- inspiratory reserve volume (IRV) in adults is approx. **2500 ml**
- inspiratory reserve volume (IRV) is the volume of air that is inspired with maximum effort
- inspiratory reserve volume (IRV) is the volume of air that is inspired with maximum effort after quiet expiration
- inspiratory reserve volume (IRV) is the volume of air that is inspired with maximum effort after quiet inspiration
- inspiratory reserve volume (IRV) in adults is approximately **500 ml**
- inspiratory reserve volume (IRV) **is greater** than expiratory reserve volume (ERV) in adults
- exspiratory reserve volume (ERV) in adults is approximately **500 ml**
- exspiratory reserve volume (ERV) in adults is approximately **1000 ml**
- exspiratory reserve volume (ERV) is the volume of air that is exhaled with maximum effort after quiet inspiration
- exspiratory reserve volume (ERV) is the volume of air that is exhaled with maximum effort after quiet expiration
- exspiratory reserve volume (ERV) in adults is greater than tidal volume (V_T)
- exspiratory capacity (EC) is the volume of air that is exhaled with maximum effort after quiet expiration
- exspiratory capacity (EC) is the volume of air that is exhaled with maximum effort after quiet inspiration
- inspiratory capacity (IC) = tidal volume (V_T) + inspiratory reserve volume (IRV)
- inspiratory capacity (IC) is the volume of air that is inhaled with maximum effort after the quiet expiration
- inspiratory capacity (IC) is the volume of air that is inhaled with maximum effort after quiet inspiration

- **vital capacity** of lungs (VC) = tidal volume (V_T) + inspiratory reserve volume (IRV) + expiratory capacity (EC)
- **vital capacity** of lungs is the volume of air that is exhaled after maximum inspiration
- **vital capacity** of lungs is the volume of air that is exhaled with maximum effort after maximum inspiration
- **vital capacity** in adults is typically **3 l**
- **vital capacity** in adults is typically **4 l**
- **vital capacity** of lungs includes also functional residual capacity (FRC)
- **vital capacity** in females is usually greater than that in males

- **vital capacity** of lungs = residual volume (RV) + expiratory reserve volume (ERV) + inspiratory reserve volume (IRV) + tidal volume (V_T)
- **functional residual capacity** (FRC) = expiratory reserve volume (ERV) + residual volume (RV)
- **functional residual capacity** (FRC) is the volume of air in lungs after quiet expiration
- **residual volume** (RV) is the volume of air within lungs after quiet expiration
- **residual volume** (RV) is the volume of air within lungs after the maximum expiration
- **residual volume** (RV) = collapse air (400 ml) + minimum air (800 ml)
- **collapse air** is the volume of air that cannot be removed from lungs
- **minimum air** (minimum volume) is volume remaining in lungs after bilateral pneumothorax
- in order to measure vital capacity patient is asked to take maximum inspiration after maximum expiration and then to breathe quietly into the spirometer
- the Hering model of breathing allows to illustrate the Müller maneuver by reduction of the model volume (maximum expiratory pressure)
- the Müller maneuver demonstrates maximum inspiratory effort (maximum inspiratory pressure)
- the Valsalv maneuver demonstrates maximum expiratory effort (maximum expiratory pressure)
- the Hering model of breathing allows to illustrate the Valsalv manoeuver by maximum pull on the membrane and increasing of the model volume (maximum inspiratory pressure)
- total lung capacity (TLC) is the sum of 4 main lung volumes

- **functional residual capacity** (FRC) cannot be measured by spirometer
- **functional residual capacity** (FRC) can be measured by spirometer
- **tidal volume** can be measured by spirometer
- **tidal volume** cannot be measured by spirometer
- **vital capacity** of lungs can be measured by spirometer
- **vital capacity** of lungs cannot be measured by spirometer
- **residual volume** can be measured by spirometer
- **residual volume** cannot be measured by spirometer
- spirometer (with recording system) is not able to measure the dynamic parameters of breathing (e.g. FEV_1)
- spirometer (with recording system) is able to measure some of the dynamic parameters of breathing (e.g. FEV_1)
- spirometer can measure (at least some of) static parameters of breathing
- **minute ventilation** = tidal volume x number of breaths per minute (respiratory rate) i.e. $MV = V_T . f$
- minute ventilation depends on the depth of breathing more than on the respiratory rate (number of breaths per minute)
- **minute ventilation** in adults is approx. **350 ml/min** during quiet breathing
- **minute ventilation** represents the volume of air exchanged in the alveolar space
- **minute ventilation** equals **alveolar ventilation**
- **minute ventilation** does not equal **alveolar ventilation**

- **minute ventilation** can be calculated as number of breaths per minute (respiratory rate) multiplied by alveolar ventilation
- **alveolar ventilation** = minute ventilation – dead space (dead volume)
- **alveolar ventilation** = minute ventilation – (dead space x respiratory rate) or minute ventilation – (dead volume x number of breaths per minute)

10) Bloodstream, blood
- density of blood is lower than density of plasma
- density of blood is higher than density of plasma
- density of blood is lower than density of red blood cells
- density of red blood cells is lower than density of blood
- density of healthy human blood is about **1060 g / l**
- some diseases lead to significantly altered blood density
- all diseases lead to significantly altered blood density
- if density of blood is higher than density of copper sulphate solution, the „drop' of this blood travels to the surface of the solution
- if density of blood is lower than density of copper sulphate solution, the „drop" of this blood travels to the surface of the solution
- if density of blood is lower than density of copper sulphate solution, the „drop" of this blood sinks in the solution
- if density of blood is higher than density of copper sulphate solution, the „drop" of this blood sinks in the solution
- diffusion of O_2 and CO_2 occurs commonly with the filtration of water and nutritions in blood capillaries
- diffusion of O_2 and CO_2 occurs in blood capillaries, but there is no filtration of water and nutritions
- filtration of water and nutritions occurs in blood capillaries, there is no O_2 and CO_2 diffusion there
- in blood capillaries there is exchange of either water or nutritions, not both
- waste products of metabolism are resorbed in veins, not in capillaries
- waste products of metabolism are resorbed in capillaries
- waste products of metabolism are resorbed in capillaries, not in veins
- „collecting" blood system is composed of veins and lymphatic vessels
- **oedema** (tissue swelling) is an accumulation of liquid particularly within the cells of upper part of the body
- **oncotic pressure** participates on filtration of water from the intravascular to the extravascular space
- high blood pressure within the venous system increases the chance of oedema formation
- decrease of **oncotic pressure** (particularly due to lower content of plasmatic albumins within the plasma) reduces the chance of oedema
- decrease of **oncotic pressure** (particularly due to lower content of plasmatic albumins within the plasma) increases the chance of oedema
- increase of capillary vessels permeability decreases the chance of oedema formation
- decrease of the lymph drain increases the chance of oedema formation
- decrease of the lymph drain decreases the chance of oedema formation

- **viscosity** of blood is lower than viscosity of water
- **viscosity** of blood is higher than viscosity of water
- **viscosity** of honey is higher than viscosity of blood
- **viscosity** of honey is lower than viscosity of blood
- **viscosity** of blood can be affected by pathological processes
- **viscosity** of blood cannot be affected by pathological processes
- blood flow does not depend on viscosity of blood
- blood flow depends also on viscosity of blood
- blood flow depends solely on viscosity of blood
- **viscosity** of liquids characterizes **internal friction** (among molecules) of liquids
- **viscosity** characterizes **external friction** of an object
- **viscosity** does not characterize gravity interactions among molecules
- **viscosity** of blood is determined by **permeability** of blood vessels
- **viscosity** of blood is not determined by **permeability** of blood vessels
- **viscosity** of „complex“ liquids (colloids, blood, etc.) is affected by the speed of the liquid flow
- **viscosity** of „complex“ liquids (colloids, blood, etc.) is not affected by the speed of the liquid flow
- viscosity of water is affected by the speed of its flow
- viscosity of plasma is affected by the speed of its flow
- decrease of **viscosity** of flowing liquid may result in occurence of turbulences
- decrease of **viscosity** of flowing liquid reduces the chance of turbulences
- increase of **viscosity** of flowing liquid reduces the chance of occurence of turbulences
- the higher the **viscosity**, the lower the blood flow
- the lower the **viscosity**, the lower the blood flow
- blood viscosity is about 4.5-fold higher than viscosity of distilled water
- blood **viscosity** does not depend on the temperature
- blood **viscosity** depends on the temperature
- **viscosity** does not depend on the concentration of dissolved substances
- **viscosity** depends on the concentration of dissolved substances

- narrowing of blood vessel may result in occurence of **turbulence** within the blood stream
- speed of blood in the vessel is inversely proportional to the cross-section area of the vessel in accordance with the **Equation of Continuity**
- speed of blood in the vessel is proportional to the cross-section area of the vessel in accordance with the **Equation of Continuity**
- speed of blood in the vessel is proportional to the density of blood according to the **Equation of Continuity**
- speed of blood in the vessel is inversely proportional to the density of blood according to the **Equation of Continuity**
- the higher the **Reynold's number**, the higher the probability for turbulent flow (e.g. of blood)

- the higher the **Reynold's number**, the lower the probability for turbulent flow (e.g. of blood)
- sound phenomenons, which occurs during blood flow are caused by the turbulent blood flow
- sound phenomenons, which occurs during blood flow are caused by the laminar blood flow
- mean speed of blood flow within the aorta is **0.03 m/s**
- blood flow is inversely proportional to the pressure gradient
- blood flow is proportional to the pressure gradient (at least for laminar flow)
- elasticity of arteries is lower than elasticity of veins
- elasticity of arteries is higher than elasticity of veins
- elasticity of arteries supports blood flow also during the heart diastole
- blood flow during the diastole is maintained by **inertia** (momentum) of blood
- blood flow within any circulatory system requires pressure gradient
- blood flow within any circulatory system requires **inertia** (momentum) of blood
- elasticity of blood vessels increases efficiency of the heart
- higher elasticity of blood vessels reduces efficiency of the heart
- the "high pressure vessel system" is represented by aorta and arteries
- the resistive blood circuit represents arterioles regulating vascular resistance by their vasoconstriction (vasodilatation)
- the resistive blood circuit represents blood capillaries regulating vascular resistance by their vasoconstriction (vasodilatation)
- diffusion of molecules in the diffusive blood circuit (capillaries) is regulated by contraction of smooth muscles in the capillary wall
- diffusion rate in capillaries is affected by vasoconstriction very little
- the speed of blood flow in capillaries is approximately **1 m/s**
- blood flow is proportional to pressure gradient, blood viscosity, and inversely proportional to the resistance of arterioles
- the speed of blood flow in capillaries is higher than the speed of blood flow in arteries
- the speed of blood flow in capillaries is lower than the speed of blood flow in arteries
- blood pressure during systole is maintained by elasticity of arteries

11) Blood pressure, heart

- heart functionally represents two simultaneously working pumps
- heart represent only one pump with 2 outputs (systemic and pulmonary) – 1 ventricle
- in healthy adults at rest **systolic (stroke) volume** (SV) is approx. 70 ml
- **systolic (stroke) volumes** of left and right ventricles are essentially the same
- **systolic (stroke) volume** (SV) of left ventricle is higher than SV of right ventricle
- **systolic (stroke) volume** (SV) of right ventricle is higher than SV of left ventricle
- **diastolic (end-diastolic) volume** of heart is smaller than its systolic volume (SV)
- **diastolic (end-diastolic) volume** of ventricle is higher than its systolic volume
- **end-systolic volume** of ventricles is practically zero
- **end-systolic volume** of ventricles is not zero (ventricles are not completely empty at the end of systole)

- minute heart volume (MV) = diastolic volume (DV) x heart rate (the number of pulses per minute or frequency of heart / min)
- minute heart volume (MV) = systolic (stroke) volume (SV) x heart rate (the number of pulses per minute or frequency of heart / min)
- minute heart volume (MV) = systolic (stroke) volume (SV) x respiratory rate (the number of breaths per minute)
- right heart is filled during diastole, left heart during the time between diastole and systole
- left heart is filled during diastole, right heart during the time between diastole and systole
- the wall of the right ventricle is about three times thicker than the wall of the left ventricle
- the wall of the right ventricle is about three times thinner than the wall of the left ventricle
- the wall of the left ventricle is about three times thicker than the wall of the right ventricle
- heart in healthy adult pumps approx. 5 litre of blood per minute at rest through the systemic circulation
- heart in healthy adult pumps approx. 5 litre of blood per minute at rest through the pulmonary circulation
- flow rate through pulmonary circulation is higher than flow rate through systemic circulation
- flow rate through pulmonary circulation is lower than flow rate through systemic circulation
- flow rates through pulmonary and systemic circulation are practically equal
- trained heart (e.g. in sportsmen) beats at rest faster and at lower systolic volume – it is more efficient than non-trained heart
- trained heart beats at rest slower and at higher systolic volume – it is more efficient than non-trained heart
- contraction of heart myocardium requires instant increase of potasium concentration within the sarcoplasm
- contraction of heart myocardium requires instant increase of sodium concentration within the sarcoplasm
- contraction of heart myocardium requires instant increase of calcium concentration within the sarcoplasm
- during systole, right ventricle works several fold harder than left ventricle
- during systole, left ventricle works several fold harder than right ventricle

- pressure gradient of large bloodstream (systemic circulation) is approx. **100 kPa**
- pressure gradient in the pulmonary circulation is approx. **30 kPa** (4 mm Hg)
- pressure gradient of large bloodstream (systemic circulation) is approx. **100 torr**
- pressure gradient of large bloodstream (systemic circulation) is approx. **15 kPa**
- pressure gradient of large bloodstream (systemic circulation) is approx. **15 torr**
- pressure gradient in the pulmonary circulation is approx. **4 kPa**
- pressure gradient in the pulmonary circulation is approx. **30 torr**

- typical value of systolic blood pressure within the right ventricle is about **4.6 kPa**
- typical value of systolic blood pressure within the right ventricle is about **4.6 torr**
- typical values of systolic blood pressure within heart atria are almost as high as those in ventricles
- typical values of diastolic pressure within heart ventricles are approx. **0 kPa**
- typical values of diastolic pressure within heart ventricles are approx. **0 torr**
- typical values of diastolic pressure within heart atria are negative
- typical values of diastolic pressure within the left atrium are slightly positive, in the right atrium they are slightly negative
- typical values of systolic blood pressure within the left ventricle (and in the aorta) are about **16 mm Hg** (16 torr)
- typical values of systolic blood pressure within the left ventricle (and in the aorta) are about **16 kPa**
- negative pressure is measured (comparing with atmospheric pressure) within both heart ventricles of healthy adults during the diastole
- negative pressure is measured (comparing with atmospheric pressure) within both heart atria of healthy adults during the diastole
- mean blood pressure can be calculated as the value of diastolic pressure plus one third of the pulse pressure (pressure amplitude)
- mean blood pressure is higher than the arithmetic average of systolic and diastolic pressures
- mean blood pressure is lower than the arithmetic average of systolic and diastolic pressures
- mean blood pressure is higher than systolic blood pressure
- mean blood pressure is lower than diastolic blood pressure
- mean blood pressure is lower than systolic blood pressure
- mean blood pressure is higher than diastolic blood pressure
- **1 kPa** is approx. **7.5 torr** (mm Hg), and this equals to approx. 10 cm H_2O
- **1 torr** (mm Hg) is approx. **7.5 kPa** (approx. 75 cm H_2O)

- positive blood pressure is measured (compared to the atmospheric one) in pulmonary artery and in aorta during diastole due to elasticity of arteries
- using tonometer with a cuff for blood pressure measurement (e.g. on a. brachialis) the pressure in the cuff must exceed both diastolic and systolic pressures
- using tonometer with a cuff for blood pressure measurement (e.g. on a. brachialis) the pressure in the cuff must exceed diastolic but not systolic pressure
- the model of blood vessels elasticity illustrates blood flow during diastole (when no pressure gradient is produced by heart)
- the model of blood vessels elasticity illustrates immediate stop of blood flow during diastole (when no pressure gradient is produced by heart) in elastic pipes (such as arteries)
- the model of blood vessels elasticity shows lower flow rate within elastic pipes compared to rigid (glass) pipes
- the model of blood vessels elasticity shows higher flow rate within elastic pipes compared to rigid (glass) pipes

- reduced elasticity of arteries results in increased irregularity of blood flow (increased high and low flow difference)
- the higher is blood pressure and the larger is the diameter of blood vessel, the higher is mechanical tension within the wall (and risk of damage) of this blood vessel (**Laplace law**)
- the lower is blood pressure and the smaller is the diameter of blood vessel, the lower is mechanical tension within the wall (and risk of damage) of this blood vessel (**Laplace law**)
- the higher is blood pressure and the smaller is the diameter of blood vessel, the higher is mechanical tension within the wall (and risk of damage) of this blood vessel (**Laplace law**)
- the larger is the diameter of blood vessel and the lower is blood pressure, the higher is mechanical tension within the wall (and risk of damage) of this blood vessel (**Laplace law**)
- transduser (detecting „head gauge“) is used in indirect method of blood pressure measurement
- transduser (detecting „head gauge“) is used in direct method of blood pressure measurement
- during **auscultatory method** the first hearable (detectable) sound (the first phenomenon of Korotkov) indicates the value of systolic pressure
- during **auscultatory method** the diastolic blood pressure is indicated by listening of the second acoustic phenomenon of Korotkov
- during **auscultatory method** the value of diastolic blood pressure is indicated by moment when all sounds from circulation disappear (the 5th phenomenon of Korotkov)
- during **auscultatory method** the diastolic blood pressure is indicated by moment when we hear a murmur (the 3rd phenomenon of Korotkov)
- during **auscultatory method** the systolic blood pressure is indicated by moment when we hear a murmur (the 3rd phenomenon of Korotkov)
- transduser (detecting „head gauge“) for blood pressure measurement can employ the changes of resistance, capacity, or induction (resistive-tensiometric, capacitive, inductive transducing)
- using palpate method we can determine mean arterial blood pressure
- using palpate method we can determine diastolic arterial blood pressure
- using palpate method we can determine systolic arterial blood pressure
- for direct measurement of blood pressure the catheter has to be introduced into the vessel
- the catheter is not introduced in the vessel for direct measurement of blood pressure

<u>12) ECG</u>

- action potential (membrane potential) of myocardial cell is identical with ECG curve
- electrocardiogram is a record of mechanical changes during the heart cycle
- electrocardiogram shows (gives) a record of electrical changes during the heart cycle
- all duration of myocardial action potential is typically over 200 ms
- all duration of myocardial action potential is typically below 200 ms
- during the phase of depolarization, myocard behaves as electrical dipole

- during the phase of repolarization myocardial muscle fibers do not behave as electrical dipoles
- electrical potentials from the body surface are recorded by pin (needle) electrodes
- using bipolar leads (e.g. CR, CL, CF) potential differences between two places on the body surface are measured
- bipolar leads detect potential differences between two inert (indifferent zero) electrodes
- monophasic potential is obtained by bipolar electrodes
- standard bipolar limb leads are labeled as I., II., III.
- monophasic potential is obtained from bi-polar electrodes
- bipolar limb lead I. detects the potential difference between the right hand and left foot
- bipolar limb lead III. detects potential differences between right and left foot
- bipolar limb lead II. detects potential differences between right hand and left foot
- augmented unipolar limb leads are designated as VR, VL, and VF
- the Wilson clamp represents a „star“ connection of three 5000 ohm resistors, by which the electrodes are connected to the right hand, left hand, and left foot
- the Wilson clamp represents a „star“ connection of three 5000 ohm resistors, by which the electrodes are connected to the right hand, right foot, and left foot
- unipolar chest leads (labeled as V_1, V_2, ...) detect potential differences by the set of electrodes placed on the chest
- bipolar leads represent potential differences between active and inert (indifferent zero) electrode
- bipolar leads are limb leads after Goldberg
- leads **aVR, aVL, aVF** are bipolar leads
- the Wilson clamp is a part of standard bipolar limb leads
- the Wilson clamp is a part of **limb leads I., II., III.**
- the Wilson clamp provides reference (zero) potential in unipolar leads

- **QRS** complex on ECG curve represents the depolarization of atria
- **QRS** complex on ECG curve represents the repolarization of atria
- **QRS** complex on ECG curve represents the depolarization of ventricles
- **QRS** complex on ECG curve **does not** represent the repolarization of ventricles
- **wave P** on ECG curve represents the repolarization of heart atria
- **wave P** on ECG curve represents the depolarization of heart atria
- depolarization of both heart ventricles is manifested on ECG curve as the **QRS** complex
- repolarization of ventricles on the ECG curve represents **PQ interval**
- **wave T** on ECG curve represents the repolarization of heart conductive system
- **isoelectric line** represents the level of constant (zero) potential difference in ECG records
- normal duration of **PQ segment** is above 0.22 s
- time duration of **PQ segment** is approx. one half of the duration of **PQ interval**
- normal duration of QRS complex is 0.08 ms
- normal duration of QRS complex is about 0.08 s
- normal duration of ST segment is above 0.22 s
- **interval QT** is one of the most variable characteristics of ECG curve, it shortens at

higher heart rate
- the duration of **P wave** on the ECG curve is typically longer than the duration of **wave T**
- QRS complex on the ECG curve consists of oscillations Q and S and the isoelectric segment R
- on the ECG curve the P and T deflections from isolelectric line are denoted as waves
- segments PQ and ST represent the potential level of isoelectric line
- intervals PQ and ST represent the potential level of isoelectric line
- during ECG recording the examined person is usually grounded
- during ECG recording conductive gels or pastes are used in order to reduce transitional resistances between electrodes and skin
- „pressure“ (connection) force of electrodes affects quality of ECG recording

- in order to determine the electrical axis of the heart, amplitudes of QRS deflections from standard limb leads are used
- **heart rate** can be determined from the time difference of **R-R intervals** (the period of ECG cycle)
- one can determine heart rate from the time difference S-T
- magnitudes of Q, R, S oscillations are measured from the isoelectric line
- electrical axis of the heart is determined from at least two bipolar leads of ECG
- during construction of the electrical axis of the heart the values of QRS complexes are put at vertexes (tips) of equilateral triangle
- the mean vector of QRS complex (the vector from one particular lead) is the sum of absolute values of the Q, R, and S oscillations
- electrical axis of the heart represents the vector usually oriented downward to the left
- electrical axis of the heart represents the vector from the centre of Einthoven triangle to the intersection of perpendiculars from individual QRS vectors at each triangle side (from individual leads)
- electrical axis of the heart represents the vector from the centre of Einthoven triangle to the intersection of parallels from individual QRS vectors at each triangle side (from individual leads)
- physiological (normal) direction of electrical axis of the heart in frontal plane is clockwise from horizontal to the left +30 to +120˚
- electrical axis of the heart always points (is oriented) in frontal plane clockwise from horizontal to the left -30 to +110˚
- electrical axis of the heart can be constructed from ENG (electroneurogram) recordings
- electrical axis of the heart is not identical with its anatomical axis
- electrical axis of the heart is identical with its anatomical axis
- mechanical action of the heart initiates its electrical activity
- mechanical action of the heart is initiated by electrical activity in the heart
- ECG analysis allows assessment of heart electrical activity and heart function
- ECG does not allow evaluation of heart rate and regularity of heart rhythm
- electrical activity (action potential) of healthy heart comes from Sinoatrial node
- electrical activity (action potential) of healthy heart comes from Atrioventricular node
- pathological deviation of heart electrical axis to the left can be caused by hypertrophy of the left ventricle

13) Perception

- sensory receptors have the lowest threshold selectively to one kind of stimulus
- sensory receptors are usually sensitive to several kinds of stimulus
- sensory receptors are usually **not sensitive** to several kinds of stimulus
- sensory receptor responds to stimulus first by **Generator potential** (local electrical event at the membrane)
- membranes of sensory receptor primarily produce action potentials
- primary response of the sensory cell (receptor) in not action potential
- **Generator potential** of receptor has a character of action potential
- action potential of receptor has a character of local response – local electric event (Generator potential)
- responses on nerve fibers have a character of action potentials ("all or nothing")
- information that the sensory receptor has been stimulated is transmitted into the CNS in form of action potentials
- action potentials „count up" by amplitude summation
- **Generator potentials** (local responses – local electric events) „count up" by frequency summation
- **Weber-Fechner** and **Stevens** laws express the fact, that the stronger is the intensity of stimulus, the higher (more intense) is the perception
- **Weber-Fechner** but not the **Stevens** law expresses the fact, that the stronger is the intensity of stimulus, the higher (more intense) is the perception
- **Stevens** but not the **Weber-Fechner** law expresses the fact, that the stronger is the intensity of stimulus, the higher (more intense) is the perception
- the stronger (more intense) the stimulus, the higher the amplitude of **Generator potential**, and consequently the higher the number of action potentials
- the lower (less intense) the stimulus, the lower the number of action potentials generated
- the lower (less intense) the stimulus, the higher the number of action potentials generated
- the higher (more intense) the stimulus, the lower the number of action potentials generated
- the **Law of projection** expresses that signals from individual (different) receptors are brought to the specific parts of brain cortex
- the **Law of projection** does not express that signals from individual (different) receptors are brought to the one (identical for all receptors) part of brain cortex
- there are chemoreceptors sensitive to different values of pH (acidity) in human body
- there are no receptors sensitive to different values of pH (acidity) in human body
- there are receptors sensitive (responsive) to X rays in human body
- there are no receptors sensitive (responsive) to X rays in human body
- there are receptors sensitive to **infrared radiation** in human body
- some thermoreceptors, mechanoreceptors, chemoreceptors, photoreceptors, or nociceptors belong to the group of **exteroreceptors**
- there are no mechanoreceptors and no nociceptors that belong to the group of **exteroreceptors**

- some thermoreceptors, mechanoreceptors, chemoreceptors, photoreceptors, nociceptors belong to the group of **interoreceptors**
- some thermoreceptors, mechanoreceptors, chemoreceptors, or nociceptors belong to the group of **exteroreceptors**
- **transduction** means the change of Generator potential (local response – local electric event) to the action potential
- **transformation** means the change of stimulus energy to the Generator potential (local response – local electric event)
- **transformation** means the change of Generator potential (local response – local electric event) to the action potentials
- **transduction** means the change of stimulus energy to the Generator potential (local response – local electric event)

- **adaptation** means that the magnitude of action potentials reduces in time
- **adaptation** is not a reduction of the magnitude of action potentials in time
- **baroreceptors** are characterized by slow adaptation
- **nociceptors** are characterized by fast (rapid) adaptation
- **baroreceptors** are characterized by fast (rapid) adaptation
- **nociceptors** are characterized by slow (possibly no) adaptation
- **nociceptors** are characterized by very rapid adaptation
- olfactory (smell) receptors are characterized by fast (rapid) adaptation
- olfactory (smell) receptors are characterized by slow adaptation
- fast (rapid) adaptation means that there is **very low** (possibly no) frequency of action potentials at the beginning of stimulation
- fast (rapid) adaptation means that there is **very low** (possibly no) frequency of action potentials **late** (e.g. seconds) after the beginning of stimulation
- **mechanoreceptors** participate on perception of vibrations
- **mechanoreceptors** participate on perception of pressure stimulation
- **chemoreceptors** participate on perception of sound
- **chemoreceptors** participate on perception of tension (pulling)
- **mechanoreceptors** participate on perception of partial pressure
- **mechanoreceptors** participate on perception of blood pressure
- mechanoreceptors participate on perception of sound
- **sound** is electromagnetic waving with the speed of about **330 m/s** in the air
- **sound** is mechanical waving with the speed of about **330 m/s** in the air
- **sound** is mechanical waving with the speed of about **330 m/min** in the air
- **sound** spreads in vacuum only as longitudinal waving
- **sound** spreads in vacuum only in form of radiation
- **sound** spreads in liquids and gases as longitudinal waving, in solids also as transverse waving
- pitch of the tone is determined by the sound intensity
- pitch of the tone is determined by its frequency
- pitch of the tone is determined by pain threshold
- **12 kHz** of mechanical oscillations can produce hearable sound (we can hear it)
- **12 Hz** of mechanical oscillations can produce hearable sound (we can hear it)

- the speed of sound in liquids is higher than the speed of sound in the air
- **loudness** relates to the sound intensity
- **loudness** is not related to the sound intensity level
- **loudness** is not related to the „colour“ of sound (musical colour)

- the lovest sensitivity of human ear is within the range 1 – 3 kHz
- the highest sensitivity of human ear is within the range 1 – 3 kHz
- the sensitivity of human ear is equal within all frequency range
- the sensitivity of human ear is not equal within all frequency range
- **hearing threshold** represents the level of the sound with the intensity of 1 dB
- **hearing threshold** represents the level of the sound with the intensity of 10 dB
- **hearing threshold** is the lowest frequency of sound that human ear can hear
- **hearing threshold** is the lowest intensity of sound that human ear can hear
- **hearing threshold** is not the lowest frequency of sound that human ear can hear
- **pain threshold** is the highest frequency of sound that human ear can hear
- **pain threshold** is the lowest frequency of sound that human ear can hear
- **upper limit** for hearing is identical with the pain threshold at the sound frequency of 1 kHz
- **upper limit** for hearing is the highest frequency of sound that human ear can hear
- **upper limit** for hearing is the lowest frequency of sound that human ear can hear
- **lower limit** for hearing is the lowest frequency of sound that human ear can hear
- **lower limit** for hearing is not the highest frequency of sound that human ear can hear
- the **organ of Corti** contains ciliary cells being placed in the middle ear
- the **organ of Corti** contains bones of the middle ear
- ion content of the **perilymph** (within the scala vestibuli and scala tympani) and the **endolymph** (within the scala media) differ
- receptors of sound are ciliary cells located on the basilary membrane of the **organ of Corti**
- the **organ of Corti** contains receptors (sensory cells) that are **insensitive** to movement of the basilary membrane
- the **organ of Corti** contains ciliary cells (sound sensory cells) being placed in the basilary membrane
- cochlear potentials represent the manifestation of **ciliary cells** activation within the organ of Corti
- cochlear potentials represent the manifestation of activation of **eardrum mechanoreceptors**
- ciliary cells (in the organ of Corti) respond to stimulation by both depolarization and hyperpolarization
- ciliary cells (in the organ of Corti) respond to stimulation exclusively by depolarization
- ciliary cells (in the organ of Corti) respond to stimulation exclusively by hyperpolarization
- higher sound intensity vibrates the basilary mambrane at higher frequency
- higher sound intensity does not vibrate the basilary mambrane at higher frequency
- different frequencies of sound are detected by irritation of different places on the basilary mebrane of the cochlea

- different sound frequencies are detected by the same receptors (at the same spot on the basilary mebrane of the cochlea) that are stimulated with different frequencies
- the **organ of Corti** is actual analyzer of sound
- the **organ of Corti** is not analyzer of sound
- bones within the middle ear transmit sound energy from the eardrum to the oval window, thus providing an **impedance** adjustement between gaseous and liquid environments
- bones within the middle ear transmit sound energy from the eardrum to the oval window, thus providing a **frequency** adjustement between gaseous and liquid environments

<u>14) Electricity, audiometry</u>

- amplifiers amplify (increase) frequency of electric current, electric voltage, or electric power
- amplifiers amplify (increase) e.g. electric voltage
- amplifiers amplify (increase) e.g. electric current
- amplifiers cannot amplify (increase) electric power
- amplifiers amplify (increase) e.g. frequency of electric current
- amplifiers do not amplify periods of alternating currents
- the width (range) of frequency band (transmission frequencies) of amplifier is derived from its frequency (transfer) characteristic
- the width (range) of frequency band (transmission frequencies) is not expressed in decibels
- the width (range) of frequency band (transmission frequencies) determines „undesirable“ (unsuitable) frequencies of amplifier
- if the period of signal on oscilloscope is 5 cm corresponding to 50 ms, consequently the amplitude of this signal is 10 mV
- every biosignal can be processed directly by differential amplifier
- transducer is used as a detector of electrical biosignals
- transducer can function as both converter and sensor (detector)
- transducer is usually used as electrode for transformation of biosignals
- transducer is not used for cumulation (collection) of biosignals
- **rheobase** is the intensity of electrical stimulus at double duration of the stimulus that induces threshold response
- **chronaxy** is the shortest time during which the stimulus with intensity of rheobase induces the response
- **chronaxy** expresses intensity of electrical stimulus
- the higher the tissue excitability, the longer the chronaxy
- the higher the tissue excitability, the shorter the chronaxy
- electrical resistance of skin is expressed in ohms
- intensity of alternating current (AC) is expressed in volts
- tissue impedance is measured in ohms
- electric currents pass the tissue mainly through structures with the lowest resistance
- electric currents pass the tissue mainly through structures with the highest resistance

- electrical resistance of membranes to low frequency electric current is negligible

- electrical resistance of membranes to direct current (DC) is significant (considerable)
- resistance of membranes to direct current (DC) is negligible
- **bone tissue** has the highest electric resistance among tissues of living body
- high frequency electric current passes membranes much easier than low frequency electric current
- **bone tissue** has the lowest electric resistance among tissues of living body
- tissue fluid and cytoplasm are much better electric conductors than membranes
- electric resistance of tissues is not temporally stable (stable in time) when electric current passes through
- electric resistance of skin is temporally stable (stable in time) when electric current passes through
- electric properties of skin are affected by a presence of **callous cells**
- electric properties of skin are affected by a presence of **sweat (sudoriferous) glands**
- blood and cerebrospinal fluid belong to the best electric conductors in the human body
- electric current passes only through homogenous tissues
- electric resistance of skin decreases during the time of application of electric current on this skin
- direct electric current (DC) has minimum electrolytic effects in the body
- direct electric current (DC) has mainly electrophoretic effects in the body
- excitatory (stimulation) effects of direct electric current manifest (express) only during rapid changes of this current e.g. during swithing it on or off
- thermal (heat) effects of direct electric current in the body are negligible
- electric current through tissues changes in time
- cells within the electric field behave as electric dipols
- electric resistance of dry skin is lower than the resistance of wet skin
- electrical resistance of dry skin is 10 times higher than the resistance of other soft tissues
- electric current stimulates both muscles and nerve tissues
- conduction of electric current in tissues depends only very little on molecular structure of tissues

- effects of alternating electric current (AC) on tissues do not depend on its frequency
- excitatory (stimulation) effects of alternating electric current increase with the increasing frequency up to approx. 100 Hz
- alternating electric current has mainly electrolytic effects in tissues
- high-frequency electric currents have mainly thermic and electrolytic effects in tissues
- excitatory (stimulation) effects of electric current slowly decrease at high frequencies
- the lower the frequency of alternating electric current, the higher the thermal (heat) effects of it
- tissue impedance depends on blood supply of this tissue
- tissue impedance has resistance and capacity components
- capacity component (capacitance) of tissue impedance is dominant (the highest) at low frequencies of electric current through the tissue
- tissue impedance has considerable character of capacity (capacitance)
- tissue impedance has dominant character of induction (inductance)

- tissue impedance does not depend on frequency
- tissue impedance increases with frequency
- the whole body impedance characterizes the body resistance to alternating electric current (AC)
- tissue impedance equals to the sum of capacitances of cell membranes
- during measurement of the whole body impedance the examined person has to be grounded
- multipotential (e.g. electromyogram – EMG) consists of many action potentials
- electroneurogram (ENG) of the only one nerve fiber is characterized by equal amplitudes of individual action potentials
- the duration of bursting activity as well as the frequency of action potentials can be determined from multipotential electromyogram (multiunit EMG)
- the duration of neuron bursting activity as well as the frequency of action potentials can be determined from multipotential electroneurogram (multiunit ENG)
- during audiometric examination of absolute hearing threshold the doctor must change (tune) the sound intensity and also the frequency of applied sound
- intensity of sound expressed in dB is the logarithm of absolute intensity (expressed in SI units W/m2)
- frequency is expressed in Hz^{-1} (reciprocal Hz)
- frequency is expressed in Hz
- upper limit of hearing can be determinated by gradual increase of sound intensity at the frequency of 1 kHz

15) Heat, temperature, thermoregulation

- heat is a form (type) of energy
- heat is not a form (type) of energy
- heat is a form (type) of temperature
- heat is (equals to) an internal energy of object
- heat is measured in J/K
- heat is not measured in J/K
- heat is measured in J
- heat is measured in kJ
- heat is measured in K/J
- heat **can be spontaneously transferred** from the body with lower thermal energy (content) to the body with higher thermal energy (content)
- heat **is never spontaneously transferred** from the body with lower thermal energy (content) to the body with higher thermal energy (content)
- heat **can be spontaneously transferred** from the body with higher thermal energy (content) to the body with lower thermal energy (content)
- heat can be transferred through vacuum
- heat is never transferred through vacuum
- heat is transferred through vacuum by conduction
- heat **is conducted** through vacuum
- the heat **is not conducted** through vacuum
- spontaneous heat „flow“ **is determined** by temperature gradient

- spontaneous heat „flow“ **is not determined** by temperature gradient
- heat **can be transported** from the cooler body (object) to the warmer body (object) with energy added to the system
- heat **is never transported** from the cooler body (object) to the warmer body (object) even with energy added to the system
- heat **can be transported** from the warmer body (object) to the cooler body (object)
- heat can be radiated (emited) in form of photons
- heat cannot be radiated (emited) in form of photons
- spontaneous heat transfer stops when the thermal energy (content) of two bodies equal
- temperature difference is proportional to (added or taken) heat and inversely proportional to thermal capacity
- temperature difference is proportional to (added or taken) heat and to thermal capacity

- temperature differences **1K = 1ºC**
- temperature differences **1K ≠ 1ºC**
- temperature differences **1F ≠ 1ºC**
- temperature can be detected also by nociceptors
- temperature **cannot** be detected by **nociceptors**
- temperature is detected by thermoreceptors and chemoreceptors
- temperature is detected by thermoreceptors and nociceptors
- temperature is detected exclusively by thermoreceptors
- human body temperature is within the entire human body constant
- human body temperature **is not constant** within the entire human body
- human body temperature is the same within the entire human body
- temperatures of different parts of human body differ
- human body temperature **is not the same** within the entire human body
- human body temperature depends exclusively on the amount of produced heat
- human body temperature depends also on the amount of produced heat
- human body temperature does not depend on heat produced by body
- human body temperature depends exclusively on the amount of expelled heat
- human body temperature depends also on the amount of expelled heat
- human body temperature does not exclusively depend on the amount of expelled heat
- internal temperature of human body is well balanced
- internal temperature of human body is variable more than 5 °C
- temperature of all parts of human body is stable
- temperature of some parts of human body varies
- internal temperature of human body is usualy measured in axila, under the tongue (sublingual), in rectum (rectal), and in external auditory canal
- axillary and sublingual temperatures equal
- axillary and sublingual temperatures do not equal
- rectal and axillary temperatures equal
- human body temperature is controlled by the central nervous system
- human body temperature is not controlled by the central nervous system

- heat is distributed within the human body mainly by means of conduction
- heat is distributed within the human body mainly by means of convection
- heat leaves the human body mainly by means of conduction
- heat usually leaves the human body mainly by means of radiation
- heat leaves the human body mainly by means of convection
- heat is primarily (and mainly) radiated out of body
- cooling of the human body (heat expenditure) can be under certain circumstances provided exclusively by means of evaporation
- cooling of the human body (heat expenditure) can be provided exclusively by means of conduction
- cooling of the human body (heat expenditure) can never be provided exclusively by means of evaporation
- thermoregulation controls heat expenditure by means of redistribution of blood
- redistribution of blood does not contribute to the thermoregulation (heat expenditure)
- thermoregulation controls human body temperature also by alteration of metabolic activity of the body
- thermoregulation center represents neurons of pituitary gland (hypophysis)
- thermoregulation center represents neurons of hypothalamus
- thermoregulation center is located within the posterior hypothalamus
- **cooling power** depends on the time during which the organism (body) is exposed to the atmosphere
- **cooling power** does not depend on the time during which the organism (body) is exposed to the atmosphere
- **cooling power** is defined as heat loss from 1 m^2 of the body surface that is exposed to the atmosphere
- **cooling power** is heat loss from 1 m^2 of the body surface with the temperature of 36,5 °C (that is exposed to the atmosphere) per 1 second
- the lower the ambient temperature (temperature of environment), the higher the heat loss (as well as the cooling power)
- the lower the ambient temperature (temperature of environment), the lower the heat loss (as well as the cooling power)
- heat loss of the human body is **directly proportional** to the ambient temperature, to the airflow, to the properties of environment (e.g. air humidity), and to the internal body temperature
- heat loss of the human body depends on the ambient temperature, the airflow, the properties of encironment (e.g. air humidity), and on the surface body temperature
- heat loss of the human body depends on the internal body temperature, but it does not depend on the ambient temperature, the airflow, and properties of environment (e.g. air humidity)
- thermoregulatory center integrates mainly stimuli from thermoreceptors and modifies body activities in order to reach the internal body temperature desired by the center
- fast measuring medical thermometer takes actual temperature of the body place where it is introduced
- fast measuring medical thermometer shows maximum temperature also after it is taken out of spot of measurement
- internal body temperature is stabilized by thermoregulation

16) Environmental influences

- in standing person **gravity** induces lower blood pressure in arteries of legs than in head arteries
- in standing person **gravity** induces higher blood pressure in arteries of head than in legs arteries
- **air embolism** can occur due to negative „suction" pressure (lower than atmospheric pressure) within big veins of the head in person keeping upright or sitting positions
- **air embolism** can occur due to positive pressure (higher than atmospheric pressure) within big veins of the head in person in lying down positions
- positive longitudinal overloading (head to legs) can cause „the white blindness" due to a drain of blood from retinal (choroid) vessels (and the brain)
- negative longitudinal overloading (legs to head) can cause „the red blindness" due to an excessive congest of blood (blood volume) in retinal (choroid) vessels (and the brain)
- negative effects of **overloading** cannot be reduced at all
- negative effects of **overloading** on blood circulation can be reduced by an appropriate positioning of body
- overloading (either positive or negative) has no effect on blood circulation
- overloading (either positive or negative) affects blood circulation
- **negative longitudinal overloading** (legs to head) can not induce any problems because the brain is well supplied by blood
- human body withstands **longitudinal overloading** better than transverse (chest to back) one
- human body withstands **transverse overloading** better than longitudinal (head to legs) one
- no gravity (**weightlesness state**) induces decalcification of bones, reduction of muscle matter, and dehydration
- overloading is expressed in a multiple of **g** factor, i.e. how many times is the weight higher than the weight in the earth gravity field (g is gravity acceleration)
- **overloading** more than **5g** is not dangerous already
- even very high intensity of radio-waving emission can not cause health troubles
- even very high intensity of infrared emission can not cause health troubles
- very high intensity of radio-waving emission can cause health troubles
- very high intensity of infrared emission can cause health troubles
- even very high intensity of the light can not cause any health damage
- very high intensity of the light can cause health damage

- concentrations of dissolved substances is measured by spectrophotometer at the minimum of absorption
- during the measurement of substance concentration by spectrophotometer the intensity of transmitting light increases with the increase of substance concentration
- ultraviolet light with wavelengths under **280 nm** (UV-C) induces mainly erythema
- ultraviolet light with wavelengths **280-315 nm** (UV-B) induces mainly destruction of biomolecules

- ultraviolet light with wavelengths under 280 nm (UV-C) has negative effect on the body
- ultraviolet light with wavelengths above **315 nm** (UV-A) induces mainly pigmentation
- oxygen and ozone in the atmosphere completely absorb **ultraviolet light**
- oxygen and ozone in the atmosphere significantly absorb ultraviolet light
- proteins can intensively absorb **ultraviolet light**
- nucleic acids can intensively absorb **ultraviolet light**
- proteins only weakly absorb **ultraviolet light**
- nucleic acids only weakly absorb **ultraviolet light**
- water insignificantly (negligibly) absorbs **ultraviolet light**
- **ultraviolet light** damages mostly retina of the eye
- **skin phototype** means that the skin responds specifically and typically to the exposure of ultraviolet light (e.g. by erythema)
- **skin phototype** means that the skin responds specifically and typically to the exposure of sunlight (e.g. by erythema)
- amount of absorbed light (absorbed energy) in the substance depends on the wavelength of falling (incoming) light
- amount of absorbed light (absorbed energy) in the substance depends on the frequency of falling (incoming) light
- amount of absorbed light (absorbed energy) in the substance depends on the type of the absorption material
- amount of absorbed light (absorbed energy) in the substance depends on the amount (intensity) of falling (incoming) light
- amount of absorbed light (absorbed energy) in the substance depends on the duration of exposure
- amount of light (intensity of light) passing the medium decreases exponentially with the thickness of the medium
- malignant melanoma is a cancer growing mostly due to overexposure to infrared light

- at high altitude the **proportion of oxygen** in the air markedly decreases
- at high altitude the **proportion of CO_2** in the air markedly decreases
- at high altitude partial **pressure of oxygen** in the air significantly decreases
- at high altitude partial **pressure of CO_2** in the air significantly decreases
- at high altitude the **proportion of oxygen** in the air markedly increases
- at high altitude the **proportion of CO_2** in the air markedly increases
- at high altitude partial **pressure of oxygen** in the air significantly increases
- at high altitude partial **pressure of CO_2** in the air significantly increases
- at high altitude (above 3,000 m) low partial **pressure of oxygen** in the air results in symptoms of **hypoxia**
- the main reason for **"mountain" disease** is hypoxia
- the main reason for **„caisson" disease** (decompresson disease) is hypoxia
- the symptoms of both acute and chronic hypoxia are the same
- the symptoms of chronic hypoxia are lung oedema, brain oedema, colaps, and unconsciousness
- during acclimatization to **chronic (prolonged) hypoxia** a release of erythropoetin from kidneys induces higher production of red blood cells

- during acclimatization to **acute (brief) hypoxia** a release of erythropoetin from kidneys induces higher production of red blood cells
- **„caisson“ disease** (decompresson disease) results from rapid release of gas bubbles (particularly nitrogen), which were dissolved in the body under high pressure
- **„caisson“ disease** (decompresson disease) results from too deep submersion of the diver
- **„caisson“ disease** (decompresson disease) results from too prolonged submersion of the diver
- **„caisson“ disease** (decompresson disease) results from too fast rising up (to surface) of the diver
- hyperbaric chambers can be used in treatment of "caisson" (decompression) disease
- patient can stay in hyperbaric chamber without any health consequence for whatever (e.g. very long) time
- hyperbaric chambers can be used in treatment of carbon monoxide poisoning
- hyperbaric chambers can be used in treatment of oxygen poisoning

17) Light, Imagine

- emissions of photons are caused by excitations of interacting atoms
- emissions of photons are caused by **de-excitations** of atoms
- atoms can be excited by absorption of any (whatever) photon
- atoms can be excited by absorption of photons with the energy = $\mathbf{E_2 - E_1}$; (E_1 : the energy of basic state, E_2 : the energy of excited state of the atom)
- atoms can be excited by absorption of photons with the energy = $\mathbf{E_2 - E_1}$; (E_1, E_2 : the energies of different excited states of the atom)
- atoms can be excited by absorption of photons with the frequency $\boldsymbol{\nu = (E_2 - E_1) / h}$; (E_1 : the energy of excited state, E_2 : the energy of basic state of the atom)
- infrared light has lower intensity than the visible light
- infrared light has higher intensity than the visible light
- visible light has lower intensity than the ultraviolet light
- visible light has higher intensity than the ultraviolet light
- infrared light has lower wavelength than the visible light
- infrared light has higher wavelength than the visible light
- infrared light has higher wavelength than the ultraviolet light
- photons of visible light carry lower energy than the photons of ultraviolet light
- photons of visible light carry lower energy than the photons of infrared light
- spectrum of monochromatic light is one spectral line
- spectrum of polychromatic light is one spectral line
- spectrum of polychromatic light can be continuous
- spectrum of polychromatic light can contain several spectral lines
- dependence of the number of absorbed photons on energy of these photons represents the absorption spectrum
- **population metastability** within the active laser medium is required for laser beam generation
- **pressure inversion** within the active laser medium is required for laser beam generation

- **population inversion** within the active laser medium is required for laser beam generation
- **metastability** of basic state of molecules or atoms of active laser medium is required for laser beam generation
- light dispersion causes the opening aberration of lens
- irregular curvature of the cornea causes spherical aberration (e.g. nearsightedness)
- irregular curvature of the cornea causes aspherical aberration
- outer light has to penetrate several optical media with different refractive indexes before reaching the eye retina
- light penetrates several eye structures to reach the retina; the lowest refraction is observed betwen the air and the cornea
- light penetrates several eye structures to reach the retina; the lens contributes mainly to the total eye power

- index of refraction depends on the wavelength of light
- index of refraction depends on the speed of light
- index of refraction depends on the medium through which the light travels
- index of refraction is expressed in $\mathbf{m/s^2}$
- index of refraction is expressed in **m/s**
- index of refraction is expressed in **m . s**
- index of refraction depends on the angle of incidence of light
- critical angle is maximum possible angle when the light beams penetrate from the air into the prism
- critical angle is minimum possible angle when the light beams penetrate from the air into the prism
- critical angle is minimum possible angle when the light beams penetrate from the prism into the air
- critical angle is maximum possible angle when the light beams penetrate from the prism into the air
- magnification of the lens can be expressed as a ratio betwen the image and object heights
- magnification of the lens can be expressed as a ratio betwen the image and object widths
- magnification of the lens can be expressed as a ratio betwen the distances to the object and to the image
- magnification of the lens is expressed in **dioptres**
- magnification of the lens is expressed in (**dioptres**)$^{-1}$
- magnification of the lens can be expressed in **per cent**
- magnification of the converging lens can be expressed as a ratio betwen the distances from the lens center to the image and from the lens center to the object
- the unit of optical power of eye is **lux**
- the unit of optical power of eye is **dioptre**
- the focal length of converging lens with the optical power of **5D** is **20 cm**
- the focal length of converging lens with the optical power of **5D** is **2 cm**
- the shorter the focal length of converging lens, the lower its refractiveness

- the shorter the focal length of converging lens, the higher its refractiveness
- the lower the radius of converging lens curvature, the lower the lens refractiveness
- the higher the radius of converging lens curvature, the higher the lens refractiveness
- fictive (non-real) image is produced on eye retina
- real image is produced on eye retina
- image on eye retina is inverted (inverse)
- image on eye retina is not straight (direct)
- image on eye retina is reduced (smaller than the object)
- image on eye retina is magnified (enlarged)

- resolution of light microscopes is proportional to the wavelength of used light and inversely proportional to the refractive index of environment between the slide (preparation) and the objective
- resolution of light microscopes is proportional to the wavelength of used light
- resolution of light microscopes depends on the refractive index of environment between the slide (preparation) and the objective
- magnification of microscope is a sum of magnifications relevant to individual optical parts of microscope, usually and mostly the sum of objective and eyepiece magnifications
- magnification of microscope is a ratio of magnifications relevant to individual optical parts of microscope, usually and mostly the ratio of objective and eyepiece magnifications
- magnification of microscope is a product of magnifications relevant to individual optical parts of microscope, usually and mostly the product of objective and eyepiece magnifications
- optimum magnification of microscope is usually attained by higher magnification of eyepiece and lower magnification of objective
- optimum magnification of microscope is usually attained by higher magnification of objective and lower magnification of eyepiece
- optimum magnification of microscope is usually attained by equal magnification of eyepiece and objective
- magnification of microscopes behind the optimum is called „**empty magnification**“, since this magnification does not allow to detect more details of an object
- magnification of microscopes below the optimum is called „**empty magnification**“, since this magnification does not allow to detect more details of an object
- each lens with optical power more than **4 D** (an absolute value) can be used as a magnifying glass
- each lens with optical power less than **4 D** can be used as a magnifying glass
- converging lenses with high optical powers work as magnifying glasses if the object is placed in the focal distance or even closer to the lens
- converging lenses with high optical powers do not work as magnifying glasses if the object is placed further than the focal distance ot the lens
- we observe real images of observed objects using both the magnifying glasses and microscopes
- we observe real images of observed objects using magnifying glasses, but fictive images in microscopes

- we observe real images of observed objects using microscopes, but fictive images in magnifying glasses
- a numerical aperture depends on an amount of light beams (the angle size), which gets in the objective from the observed spot (numerical aperture influences a resolution of the microscope)
- refractometric measurements of substance concentration employ the changes of the critical angle magnitude with changes of solution concentration
- spectrophotometric measurements of substance concentration employ the changes of the critical angle magnitude with changes of solution concentration
- we adjust and observe colour boundary at the position of critical angle during the measurement with refractometer
- converging lenses always produce real images of objects (regardless the position of objects to the lens)
- converging lenses can produce fictive images of objects
- fictive images could be captured on the opaque screen
- microscopes produce real images of observed objects because the function of eyepiece (ocular)
- microscopes produce real images of observed objects because the function of objective
- magnification of magnifying glass depends mostly on object position and very little on the lens optical power
- magnification of magnifying glass depends mainly on the lens optical power
- during the measurement of the size of objects using the microscope one must calibrate the ocular scale
- during the measurement of the distance to objects using the microscope, one must calibrate the ocular scale

<u>18) Eye, vision</u>

- accomodation mechanism represents an activation of cones and inhibition of rods on the retina
- rods and cones are not employed in eye accomodation
- accomodation mechanism represents an activation of rods and inhibition of cones on the retina
- in myopic (short sighted) eye, light beams focuse in front of retina; the defect is corrected by diverging lens
- in hypermetropic (far sighted) eye, light beams focuse in front of retina; the defect is corrected by converging lens
- in hypermetropic (far sighted) eye, light beams focuse behind the retina; the defect is corrected by diverging lens
- myopia (short sight) is corrected by diverging lenses
- myopia is spherical defect of eye, which means that it is different in horizontal and vertical directions
- hypermetropia (far sight) is spherical defect of eye, which means that it is different in horizontal and vertical directions
- presbyopia is kind of hypermetropia

- myopia is corrected by concave lenses
- myopia is corrected by convex lenses
- myopia is corrected by cylindrical lenses
- accomodation means the ability of eye to focus on (to perceive sharply) close objects
- accomodation means the ability of eye to change its optical power
- optical power of the cornea adjusts by a change of its curvature
- optical power of the cornea adjusts by a change of its distance from the retina
- optical power of human eyes is approx. **60** dioptres
- optical power of human eyes is approx. **90** dioptres
- optical power of human eyes is appro. **30** dioptres
- optical power can be expressed in $\mathbf{cm^{-1}}$
- optical power can be expressed in $\mathbf{m^{-1}}$
- **astigmatism** is spherical defect of eye, which means that it is different in horizontal and vertical directions
- **astigmatism** is colour defect
- **astigmatism** is corrected by concave lenses
- **astigmatism** is corrected by convex lenses
- **astigmatism** is corrected by cylindrical lenses
- **hypermetropia** is a monochromatic defect
- **myopia** is a monochromatic defect
- eye cornea is crucial for eye accomodation

- colour vision requires spectral decomposition of light in the eye
- colour vision does not require spectral decomposition of light in the eye
- rods and cones send their axons to the temporal lobe of brain (center of vision)
- eye retina contains mainly chemoreceptors
- retina comprises many layers of unipolar and ganglionar cells
- in the human retina the number of rods is higher than the number of cones
- in the human retina the number of cones is higher than the number of rods
- cones are more sensitive to light than the rods
- rods are less sensitive to light than the cones
- there are only cones in the macula lutea of retina providing "photopic" vision
- there are only rods in the macula lutea of retina providing "photopic" vision
- there are only rods in the blind spot of the retina
- there are only cones in the blind spot of the retina
- phototransmission is based upon absorption of photons by the photoreceptor pigment molecules
- absorption of light (photon) in the pigment results in alteration of the pigment molecule
- when the layer of ganglionic cells is injured (damaged) perception of light is mediated by fibers and action potentials directly from photoreceptors
- a primary response of photoreceptors to light stimulation is their hyperpolarization
- a primary response of photoreceptors to light stimulation is their depolarization
- after the excitation of photosensitive cells by light the ganglionic cells are depolarized
- after the excitation of photosensitive cells by light the ganglionic cells are hyperpolarized

- cones and rods contain different pigments
- different kind of cones contain different types of pigments
- an optic analyser consists of 3 parts: an eyeball, a retina, and a visual cortex
- we perceive a polychromatic light as a set (an assembly) of many colours
- cones provide perception of colours
- cones are not employed in the discrimination of colours
- rods provide perception of colours
- human eye discerns (distinguishes) approx. 150 colours (colour tones)
- human eye discerns (distinguishes) approx. 15 colours (colour tones)
- human eye discerns (distinguishes) approx. 1500 colours (colour tones)

- **deuteranomaly** is just reduced ability of person to clearly perceive the green colour
- **protanopy** is complete lost of ability to perceive the blue colour
- **tritanomaly** is aspheric defect in perception of the red colour
- **tritanopy** is lost ability to perceive the blue (and partially yellow) colour
- **cataract** occures due to the damage of the eye lens
- **miosis** (reduced size of pupil) occurs when the intensity of light is higher
- **meiosis** occurs when the intensity of light is lower
- human eye can distinguish two points and perceive them separately if their images reach two different cones at the fovea centralis
- human eye can distinguish two points and perceive them separately if their images reach two different cones
- human eye can distinguish two points and perceive them separately if their images reach two different rods
- visual acuity (Visus) is a fraction (ratio) where a numerator represents the distance of correct reading of signs and a denominator represents the distance of eye examination
- visual acuity (Visus) is a fraction (ratio) where a numerator represents the distance of eye examination and a denominator represents the distance of correct reading of signs
- visual acuity is expressed as a **Visus** (V)
- visual acuity represents an ability of vision to distinguish two close points (minimum separabile) expressed e.g. as a magnitude of the angle between the light beams from those two points
- visual acuity is examined using Scheiner charts
- a visual acuity is examined using Snellen charts
- accomodation width represents the range of distances at which the eye can provide sharp (focused) vision, or the range of change of optical powers of the eye (in dioptres)
- accomodation width is always entirely determined by the measurement of near point (punctum proximum - PP)
- accomodation width is always entirely determined by the measurement of far point (punctum remotum - PR)
- **near point** (PP – punctum proximum) is the nearest distance at which the eyes can detect light
- **far point** (PR - punctum remotum) is the most distant point at which the eyes can detect light
- if PP = **6 D** and PR = **-2 D**, the accomodation width is **8 D**; this eye is hypermetropic

- if PP = **6 D** and PR = **-2 D**, the accomodation width is **8 D**; this eye is myopic
- if PP = **10 D** and PR = **2 D**, the accomodation width is **8 D**; this eye is myopic
- Snellen types (symbols) are seen from appropriate distance at the angle of **1′**
- Snellen types (symbols) are seen from appropriate distance at the angle of **5′**
- Snellen types (symbols) are seen from appropriate distance at the angle of **1°**
- Snellen types (symbols) are seen from appropriate distance at the angle of **5″**

<u>19) Radiation and radioactivity</u>

- radioactivity is a kind of transformation within the atomic nucleus
- radioactivity means that the atom is not stable
- radioactivity is associated with particle emissions (releases)
- radioactivity is not associated with production of dangerous radiation
- radioactivity is characterized e.g. by an activity of the sample
- radioactivity can be characterized by a half-life
- radioactivity can never be induced by falling radiation
- radioactivity is a type of chemical reaction
- half-life is not related to the sample activity
- half-life represents the averaged „life" duration of unstable nuclei
- ionization is a decay of atomic nucleus
- ionization is an alteration of the number of electric charges within the atomic nucleus
- ionization is a change in number of atomic electrons
- spectrum of characteristic radiation (X rays) is continuous spectrum
- a brake radiation (bremsstrahlung) gives line spectrum
- spectrum of characteristic radiation (X rays) is line spectrum
- filtration of X-ray beams improves the quality of X-ray image
- scintilators employ transformation of the energy of X-rays (gamma rays) to the light
- scintilators employ transformation of the energy of X-rays (gamma rays) to radio waves
- scintilators employ transformation of the energy of X-rays (gamma rays) to microwaves
- marked molecules (containing radioactive isotopes) are used for evaluation of biological effects of radiation
- marked molecules (containing radioactive isotopes) are used for the calibration of dosimeters
- marked molecules (containing radioactive isotopes) are used for study of biological processes

- electrons in atomic covers (envelopes) are not primarily affected by beta particles
- electrons in atomic covers (envelopes) are not primarily affected by alpha particles
- electrons in atomic covers (envelopes) interact with gamma particles by **photoeffect**
- electrons in atomic covers (envelopes) interact with gamma particles by **Compton scatter**
- gamma particles with high energy interact with atomic nuclei and produce the pairs of electron and positron
- electrons in atomic covers (envelopes) do not directly interact with fast moving neutrons
- ionization is not caused by streams of particles with sub-threshold energy

- ionization is not caused by streams of photons with supra-threshold (supraliminal) energy
- ionization is induced by streams of gamma particles
- ionization is induced by streams of X ray photons
- ionization is induced by streams of alpha particles
- ionization is not induced by streams of beta particles (electrons and positrons)
- ionization is induced by streams of neutrons
- ionization is induced by microwave radiation
- ionization is induced by infrared radiation
- ionization is not induced by „braking“ radiation (bremsstrahlung)
- **Sv** (sievert) is the unit of **activity**
- **Sv** (sievert) is the unit of **dose**
- **Sv** (sievert) is not the unit of **dose**
- **Sv** (sievert) is the unit of **dose equivalent**
- Sv (sievert) is the unit of the exposure
- biological effects of radiation are expressed most correctly as the activity
- biological effects of radiation are expressed most correctly as the dose
- biological effects of radiation are expressed most correctly as the dose equivalent
- biological effects of radiation are expressed most correctly as the ionization
- **Gy** (Gray) is the unit of **dose**
- **$C.kg^{-1}$** is the unit of **dose**
- **C.kg** is the unit of **exposure** (irradiation)

- the type of cell damage caused by radiation does not depend on the type of radiation
- a cell damage caused by radiation does not depend on an energy of radiation particles
- ionization is the only process that cause damage of cells
- high permeability radiations induce larger damage in irradiated atoms and molecules than radiations with low permeability
- radiations with higher total energy always cause larger damage in the material than radiations with lower total energy
- the order of danger of radiation for living structures at identical dose of irradiation is (the most dangerous first): alpha, beta, neutrons
- the order of danger of radiation for living structures at identical dose of irradiation is (the most dangerous first): neutrons, beta, X-rays
- the order of danger of radiation for living structures at identical dose of irradiation is (the most dangerous first): alpha, neutrons, gamma
- the order of tissue sensitivity to ionizing radiation (larger damage at the same dose) is (the most sensitive first): bone marrow, thyroid gland, muscle
- the order of tissue sensitivity to ionizing radiation (larger damage at the same dose) is (the most sensitive first): thyroid gland, gonads, muscle
- alpha radiation has low permeability (short penetration) in materials
- braking rays (bremsstrahlung) have low permeability (short penetration) in materials
- X-ray has high permeability (deep penetration) in materials
- neutron radiations have low permeability (short penetration) in materials
- dose equivalent does not depend on a dose of irradiation

- dose equivalent depends on the type of radiation
- dose equivalent depends on the type of irradiated tissues
- water absorbs X-rays more than air
- air absorbs X-rays more than water
- water absorbs X-rays more than bones
- bones absorb X-rays more than water
- blood absorbs X-rays more than bones
- attenuations of X-rays penetrating materials do not depend on the layer thicknesses
- attenuations of X-rays penetrating materials depend on the layer thicknesses
- attenuations of X-rays penetrating materials do not depend on the energy of X-rays
- attenuations of X-rays penetrating materials depend on the energy of X-rays
- attenuations of X-rays penetrating materials do not depend on these materials
- attenuations of X-rays penetrating materials do not depend on the temperature
- attenuations of X-rays penetrating materials depend on the temperature

20) Diagnostic and therapeutical methods

- therapeutic and diagnostic methods are invasive and noninvasive
- radiotherapy is based on different absorption of ionizing radiation by different tissues
- the doses of radiation applied in radiotherapy are simillar to doses used in diagnostics but the configuration of irradiation is different
- skiascopy represents an organ imaging technique using the X-rays at an actual time
- skiagraphy is X-ray imaging technique performing the image of organs on the recording medium
- computer tomography (CT) represents an imaging of the organ at its layers by scanning
- computer tomography (CT) produces scan images based on a „transillumination“ of organs with X-rays
- radioisotopes when introduced into a body accumulate themselves within the examined organ, and release the radiation being detected (e.g. by gamma-camera)
- positron-emission tomography (PET) is based on the detection of positrons penetrating an examined tissue
- nuclear magnetic resonance tomography (NMR or NMRT) is based on an absorption of infrared radiation in the tissues by the strong magnetic field
- magnetic resonance (MR) employs ionizing as well as non-ionizing radiations in order to generate image
- electron microscopes use primarily a stream of fast electrons to create an image
- NMR tomographs do not contain magnet
- NMR tomographs do not contain radio transmitter
- NMR tomographs do not contain X-ray tube
- NMR does not detect nuclei ^{12}C
- NMR detects nuclei ^{12}C
- magnetic spectroscopy allows to determine the oedema size
- magnetic spectroscopy allows to determine the tumor size
- nuclear magnetic resonance allows to determine the tumor size
- nuclear magnetic resonance allows to locate the lesions (spots) of multiple sclerosis

- the advantage of magnetic resonance technique over CT is the absence of electromagnetic radiation
- the advantage of magnetic resonance technique over CT is possibility to use contrast substances
- the advantage of magnetic resonance technique over CT is the absence of ionizing electromagnetic radiation

- artificial ventilations may apply positive as well as negative pressure (comparing with atmospheric pressure)
- continuous positive airway pressure (CPAP) means that patients breathe spontaneously, however, the pressure of gas is higher than the atmospheric pressure
- during artificial ventilations at least certain of following parameters are set : an inspiratory duration, an expiratory duration, maximum allowed inspiratory and/or expiratory pressures and/or volumes
- a pacemaker, in fact, replaces damaged and unexcitable myocardial tissue
- effects of direct electric current (DC) are employed in diathermy
- galvanotherapy means the effects of high-frequency alternating electric currents (AC)
- percusion is based on the listening of sounds and murmurs by a stethoscope
- electroencephalografy (EEG) employs an intracellular recording of electrical activities of brain
- during a fiberscopy the examined organ is illuminated and its image is transferred using fiber optics
- fiberscopes allow observations of body cavities based on the total tissue reflection
- dialysis employs the diffusion of toxic metabolites from the blood into dialysing fluid
- dialysis employs the mechanisms of active transports
- dialysis employs the mechanisms of osmosis
- dialysis employs the mechanisms of exocytosis
- cautery is an equipment used for the coagulation of tissues by high temperatures
- cautery is an equipment used for the destruction of tissues by high pressures
- electrocoagulators are devices for the destruction of tissues by high temperatures
- electrocoagulators are devices for the tissues recovery by strong electric fields
- cryocautery causes a tissue destruction due to deep freezing
- cryocautery causes a tissue destruction due to high heating
- diathermy employs thermal effects of high-frequency electromagnetic fields
- defibrilation employs intense electric currents, which stimulate the heart tissue at the same time
- a defibrilator profoundly depolarizes the heart tissue, thus allowing a restoration of a regular depolarization and the normal heart action
- defibrilation employs low electric currents, which stimulate the heart tissue at the same time
- patients have to be grounded during defibrilation
- patients must not be grounded during defibrilation

- electric currents as well as magnetic fields can be used to stimulate the nerves and muscles during the rehabilitation due to they spasmolytic, anti-swelling, and analgetic effects
- an increase as well as a decrease of the tissue pH has analgetic effects
- laser si a useful tool at the surgery (a laser scalpel), photo-coagulation of retina and lens, and eye surgery
- an ultrasound treatment is commonly used to treat malignant tumors
- lithotripsy uses pulses of electromagnetic field at frequencies about 5 Hz in order to destroy kidney concrements (stones)
- using the ultrasound imaging techniques a record „A“ represents two dimensional (2D) picture of examined tissues
- ultrasound is the electromagnetic waving within tissues at frequencies above 20 kHz
- negative effects of ultrasound are mostly thermal effects and possible damage of tissues by cavitations
- ultrasound examinations employ unequal absorptions of energy in tissues and thus a reduction of transmitted field in order to create the image
- higher frequency ultrasound penetrates tissues less, however, it produces higher resolution image
- reflection of ultrasound on the transition (boundary) of two tissues depends only on the acoustic impedance of the first one
- reflection of ultrasound on the transition (boundary) of two tissues depends only on the acoustic impedance of the second one
- reflection of ultrasound on the transition (boundary) of two tissues depends on the acoustic impedances of both tissues
- reflection of ultrasound on the transition (boundary) of two tissues depends mainly on the frequency of ultrasound
- at the transition (boundary) of two media, the higher the acoustic impedances of both media, the higher the energy of reflected ultrasound
- at the transition (boundary) of two media, the lower the acoustic impedances of both media, the higher the energy of reflected ultrasound
- at the transition (boundary) of two media, the lower the difference of acoustic impedances of both media, the higher the energy of reflected ultrasound
- at the transition (boundary) of two media, the higher the difference of acoustic impedances of both media, the higher the energy of reflected ultrasound
- typical frequencies of ultrasound used for diagnostics are around 2 kHz
- typical frequencies of ultrasound used for diagnostics are around 20 kHz
- typical frequencies of ultrasound used for diagnostics are around 2 MHz
- relations of echo amplitudes and the distances within the tissues represent the ultrasound A - mode
- relations of echo amplitudes and the distances within the tissues represent the ultrasound B - mode
- relations of echo amplitudes and the distances within the tissues represent both the ultrasound A - mode and ultrasound B - mode