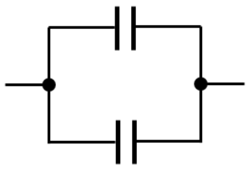
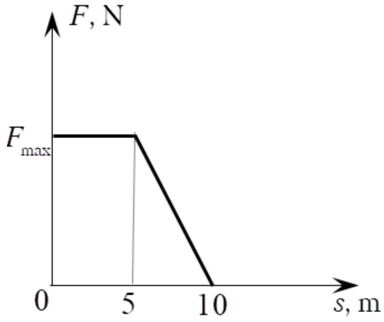
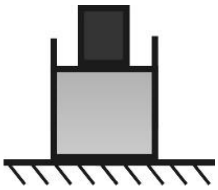
No.	Item	Score	
	I. FOR ITEMS 1-3 PROVIDE SHORT ANSWERS ACCORDING TO THE GIVEN REQUIREMENTS		
1	**Continue the following sentences as to make true statements:** **a)** In a uniformly accelerated rectilinear motion the acceleration of the body is .... **b)** When heating a mole of ideal gas isobarically the gas volume ……………….. **c)** A neutral body that cedes electrons, is ………………….. charged. **d)** When connecting two capacitors in series, the electrical capacity of the group is always ....than the capacity of each capacitor separately. **e)** The mass of the photon at rest is………………..	L 0 1 2 3 4 5	L 0 1 2 3 4 5
2	**Indicate (by using arrows) the correspondence between the following physical quantities and the physical units they represent:** Gravitational acceleration — mA Impulse — J/mol Molar heat capacity — V Electrical potential — J/(mol·K) Effective current intensity — N·s m/s^2	L 0 1 2 3 4 5	L 0 1 2 3 4 5
3	**State whether the following statements are true or false and circle the right answer:** **a)** The magnitude of the material point acceleration vector in uniform rectilinear motion is less than zero. **T F** **b)** The kinetic energy of the body does not depend on its speed. **T F** **c)** In the isothermal compression of the ideal gas, its internal energy variation is zero. **T F** **d)** The induced electromotive force changes according to the variation of the magnetic flux through a coil. **T F** **e)** An electron is emitted at β decay. **T F**	L 0 1 2 3 4 5	L 0 1 2 3 4 5
	II. IN EXERCISES 4-9 ANSWER THE QUESTIONS OR SOLVE THE TASKS, AND PROVIDE ARGUMENTS IN THE SPACES BELOW:		
4	The figure below shows four cylinders that contain the same amount of ideal monoatomic gas, at the same pressure but having different volumes. Identify the relationships between the internal energies of the gas in each case by marking on figures the gas internal energy in the cylinder using numbers from 1 to 4, 1 corresponds to the highest energy and 4 - to the lowest. 	L 0 1 2 3 4	L 0 1 2 3 4
5	**This task is composed of two statements, linked by the conjunction "*because*". Indicate if the statements are true (by writing T), or false (by writing F), as well as whether there is any "cause-effect" relationship between them (by writing "yes" or "no").** The momentum of a material point is equal to the half-product between the mass and the square of speed *because* the variation of the momentum of a material point is equal to the impulse of the net force. **ANSWER: I statement ____; II statement ____; "cause-effect" relationship____**	L 0 1 2 3	L 0 1 2 3

6	Monochromatic radiation with a wavelength of 331.5 nm falls on the metallic cathode of a photoelectric cell. To stop the photocurrent, a stopping voltage of 2.0 V must be applied. Determine the work function of the metal. SOLUTION	L 0 1 2 3 4 5	L 0 1 2 3 4 5
7	Two identical plate capacitors with the distance between the plates equal to 1.77 mm, filled with paraffin (ε_r = 2.2), are connected in parallel. Determine the plate area of a capacitor if the equivalent capacity of the group is 0.22 nF.  SOLUTION	L 0 1 2 3 4	L 0 1 2 3 4
8	The net force acting on a body with a mass of 1.5 kg changes according to the distance travelled along this force (see the figure below). What is the maximum force acted on the body, if it is known that the maximum speed reached by the body during its movement was equal to 12 m/s? Initially the body was at rest.  SOLUTION	L 0 1 2 3 4 5	L 0 1 2 3 4 5

9	An alternating current with an intensity of 4 A flows through the primary coil of an ideal transformer, which has 330 turns. How many turns does the secondary coil of the transformer have, if the intensity of the current flowing through it is equal to 55 A? Mention whether this is a step-up or step-down transformer. SOLUTION	L 0 1 2 3 4	L 0 1 2 3 4
III. FOR ITEMS 10-12 PROVIDE FULL SOLUTION TO THE GIVEN PROBLEMS			
10	There is a vertical cylinder in the vacuum, sealed with a light piston. The cylinder contains 0.050 mol of He gas, which expands isobarically (see the figure below). Determine the mass of the body placed over the piston, if the gas temperature increases by 10 K and the piston moves up by 16.62 cm. The friction between the cylinder and the piston can be neglected, and the free fall acceleration will be considered as 10 m/s^2.  SOLUTION	L 0 1 2 3 4 5 6 7	L 0 1 2 3 4 5 6 7

11	A proton comes into a homogeneous magnetic field with the induction equal to 53.38 mT, with the velocity oriented perpendicularly to the field lines. The radius of the proton trajectory is equal to 2 mm. Determine: a) The proton speed; b) The proton rotation frequency. The mass of the proton will be considered equal to $1.7 \cdot 10^{-27}$ kg. SOLUTION	a) L 0 1 2 3 4 5 b) L 0 1 2	a) L 0 1 2 3 4 5 b) L 0 1 2
12	You have an ideal voltmeter as well as an ideal ammeter, an ideal capacitor with unknown capacity, an alternating current generator with a known frequency and connecting wires. a) Draw the circuit diagram and describe how to determine the capacity of the capacitor; b) Derive the calculation formula. SOLUTION	a) L 0 1 2 b) L 0 1 2 3 4	a) L 0 1 2 b) L 0 1 2 3 4

ANNEX
Physical constants

Elementary charge $e = 1,60 \cdot 10^{-19}$ C	Avogadro's constant $N_A = 6,02 \cdot 10^{23}$ mol^{-1}
Electron rest mass $m_e = 9,11 \cdot 10^{-31}$ kg	Boltzmann's constant $k = 1,38 \cdot 10^{-23}$ J/K
Light speed in vacuum $c = 3,00 \cdot 10^{8}$ m/s	Ideal gas constant $R = 8,31$ J/(mol·K)
Gravitational constant $K = 6,67 \cdot 10^{-11}$ N·m^2/kg^2	Planck's constant $h = 6,63 \cdot 10^{-34}$ J·s
Electric constant $\varepsilon_0 = 8,85 \cdot 10^{-12}$ F/m	Coulomb's force constant $k_e = 9,00 \cdot 10^{9}$ N·m^2/C^2

MECHANICS

$$x = x_0 + v_{0x}t;\ x = x_0 + v_{0x}t + \frac{a_x t^2}{2};\ v_x = v_{0x} + a_x t;\ v_x^2 - v_{0x}^2 = 2a_x s_x;$$

$$\nu = \frac{1}{T};\ \omega = \frac{2\pi}{T};\ v = \omega r;\ \omega = 2\pi\nu;\ a_c = \frac{v^2}{r}.$$

$$\vec{F} = m\vec{a};\ \vec{F}_{12} = -\vec{F}_{21};\ F = K\frac{m_1 m_2}{r^2};\ \vec{F}_e = -k\Delta\vec{l};\ F_f = \mu N;\ F_A = \rho_0 V g;\ p = \rho g h;\ M = Fd.$$

$$\vec{p} = m\vec{v};\ \Delta\vec{p} = \vec{F}\Delta t;\ L_{\text{mec.}} = Fs\cos\alpha;\ P = \frac{L}{t};\ E_k = \frac{mv^2}{2};\ L_{12} = E_{k2} - E_{k1};\ E_p = mgh;\ E_p = \frac{kx^2}{2};$$

$$L_{12} = -\left(E_{p2} - E_{p1}\right);\ x = A\sin\left(\omega t + \varphi_0\right);\ T = 2\pi\sqrt{\frac{l}{g}};\ T = 2\pi\sqrt{\frac{m}{k}};\ \lambda = vT;\ y = A\sin\left(\omega t - kx + \varphi_0\right).$$

MOLECULAR PHYSICS AND THERMODYNAMICS

$$p = \frac{1}{3}m_0 n\overline{v^2} = \frac{2}{3}n\bar{\varepsilon}_{tr.};\ \bar{\varepsilon}_{tr.} = \frac{3}{2}kT;\ p = nkT;\ v_T = \sqrt{\frac{3RT}{M}};\ pV = \nu RT;\ \nu = \frac{m}{M};\ R = kN_A;\ M = m_0 N_A;$$

$$pV = \text{const.},\ T = \text{const.};\ \frac{p}{T} = \text{const.},\ V = \text{const.};\ \frac{V}{T} = \text{const.},\ p = \text{const.};\ \frac{pV}{T} = \text{const.},\ m = \text{const.}$$

$$U = \frac{3}{2}\frac{m}{M}RT;\ L = p\Delta V;\ Q = cm\Delta T;\ Q = \Delta U + L;\ \eta = \frac{Q_1 - Q_2}{Q_1};\ \eta_{\text{max.}} = \frac{T_1 - T_2}{T_1}$$

ELECTRODYNAMICS

$$F = k_e\frac{|q_1||q_2|}{\varepsilon_r r^2};\ k_e = \frac{1}{4\pi\varepsilon_0};\ \vec{E} = \frac{\vec{F}}{q};\ E = \frac{U}{d};\ \varphi = \frac{W}{q};\ \varphi = \frac{kq}{r};\ \Delta\varphi = U = \frac{L}{q};$$

$$C = \frac{q}{U};\ C = \frac{\varepsilon_0\varepsilon_r S}{d};\ C_P = \sum_{i=1}^{n} C_i;\ \frac{1}{C_S} = \sum_{i=1}^{n}\frac{1}{C_i}$$

$$I = \frac{\Delta q}{\Delta t};\ I = \frac{U}{R};\ I = \frac{\varepsilon}{R + r};\ I_{sc} = \frac{\varepsilon}{r};\ R = \rho\frac{l}{S};\ R_s = \sum_{i=1}^{n} R_i;\ \frac{1}{R_p} = \sum_{i=1}^{n}\frac{1}{R_i};\ L = IUt;\ Q = I^2 Rt;\ P = IU;\ \eta = \frac{P_u}{P_t};$$

$$R_S = \frac{R_A}{n-1};\ R_a = \left(n-1\right)R_V;\ F_m = IBl\sin\alpha;\ F_L = qvB\sin\alpha;\ \Phi = BS\cos\alpha;\ \varepsilon_i = -\frac{\Delta\Phi}{\Delta t};$$

$$W_e = \frac{CU^2}{2};\ q = q_m\cos\left(\omega t + \varphi_0\right);\ I = \frac{I_m}{\sqrt{2}};\ U = \frac{U_m}{\sqrt{2}};\ \frac{I_2}{I_1} \approx K = \frac{N_1}{N_2} = \frac{U_1}{U_2};\ X_C = \frac{1}{\omega C};\ X_L = \omega L;\ T = 2\pi\sqrt{LC};$$

$$\Delta = \pm 2m\cdot\frac{\lambda}{2};\ \Delta = \pm\left(2m+1\right)\cdot\frac{\lambda}{2};\ d\sin\varphi = \pm m\lambda;\ d = \frac{l}{N} = \frac{1}{n}$$

MODERN PHYSICS

$$\varepsilon_{ph} = \frac{hc}{\lambda};\ m_{ph} = \frac{h}{c\lambda};\ p_{ph} = \frac{h}{\lambda};\ h\nu = L_e + \frac{mv_{\max}^2}{2};\ \nu = \frac{c}{\lambda};\ h\nu = E_n - E_m;\ {}_Z^A\text{X} \to {}_{Z-2}^{A-4}\text{Y} + {}_2^4\text{He};\ {}_Z^A\text{X} \to {}_{Z+1}^{A}\text{Y} + {}_{-1}^{0}e;$$

$$1\ \text{eV} = 1,60\cdot 10^{-19}\ \text{J};\ 1\ \text{u} = 1,66\cdot 10^{-27}\ \text{kg}.$$