Option 1

1 Four equal electric charges $Q_1 = Q_2 = Q_3 = Q_4 = 40nc$ are located in the vertexes of a square with a side $a = 10cm$. Determine the force F which acts on the every charge from the rest three charges.

2. Electrical charge $Q = 30nc$ is put between a plates of a flat capacitor. The field of the capacitor acts on the charge with a force $F = 40mN$. Determine a force the F_1 of plates mutual attraction if an area of which of them is $S = 100cm^2$.

3 Proton which has an initial velocity $v = 100\,km/s$ flies into homogeneous electrical field ($E = 300V/cm$) along its strength lines. What distance *l* the proton must pass along the fields lines as so to its velocity increases twice?

4. Three current sources with EMF connected by the like poles. An internal resistance of the first current source is $r_1 = 0{,}4Ohm$, of the second current source is $r_2 = 0{,}6Ohm$. Determine an internal resistance r_3 of the third current source if across of the first source current with the strength $I = 1{,}13A$ passes.

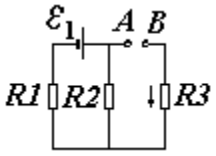
Option 2

1. Two small balls of the same mass $m = 0{,}1g$ are suspended in one point on the filaments with length $l = 30cm$. When the balls get the same charge q, the filaments became disjointed, forming the angle $\alpha = 60^\circ$ between themselves. Determine the charge q of every ball.

2. Electron is placed in uniform electrical field with strength $E = 200\,kV/m$. Determine a distance which electron passes during the time interval $t = ns$, if its initial the velocity is equal to zero? What is the electron velocity at the end of the this interval time?

3. The space between plates of a flat capacitor is filled by glass (ε =7). A distance between the plates is $d = 5mm$, potential difference $U = 500V$. Determine the energy of polarized glass plate if the area of its larger side is S=50cm^2 .

4. Three resistors with resistance $R_1 = 5Ohm, R_2 = 1Ohm,$ and $R_3 = 3Ohm$ and a current source with EMF $\varepsilon_1 = 1{,}4V$ are connected as it is shown in the figure. Determine an EMF of a current source which it is need to link in the circuit between the points A and B so that the current with the strength $I = 1A$ will pass through the third resistor in the direct, signed by the arrow. The internal resistance of the current sources may be neglected..



Option 3

1. The electrical field is produced by two parallel plates which have charge distribution upon the plate with surface density $\sigma_1 = 1nc/m^2$ and $\sigma_2 = 3nc/m^2$. Determine field strength E: 1) between the plates; 2) outside the plates.
2. Electrical field is produced by the positive charge distributed on unbounded plane with constant surface charge density $\sigma = 10\,nc/cm^2$. Determine the velocity get by an electron when it approaches to the plane from the distance $s_1 = 2cm$ to the distance $s_2 = 1cm$, if its initial velocity is equal to zero.
3. Two metal balls with radius $R_1 = 2cm$ and $R_2 = 6cm$ are connected by a conductor. To the balls the charge $Q = 1nc$ is given. Capacity of the conductor may be neglected. Determinate the charge surface density σ on each ball.
4. Current density in an aluminum conductor is $1A/mm^2$. Determine the electron directed motion average velocity $\langle v \rangle$ by proposing the free electrons concentration coincides with the concentration of atoms.

Option 4

1. Negative charged small ball with charge q rotates uniformly around fixed point charge $Q = 1nc$ under the action of attraction forces. Determine q/m for given ball if radius of its orbit is $R = 2cm$, and its angular velocity is $\omega = 3rad/s$
2. Point chargers $Q_1 = 1mkc$ and $Q_1 = 0{,}1mkc$ are located at the distance $r_1 = 10cm$ one from another. Determine the work A performing by the electrical field if the second charge will move away from the first of them at the distance:
1) $r_2 = 10m$; 2) $r_3 \to \infty$
3. Distance between the plates of a plane air capacitor is $2cm$, potential difference between them is $U = 6kV$. The charge of one from the plate is $Q = 10nc$. Determine the energy W of capacitor electrical field and interaction force F acting between the plates.
4. For an accumulator battery with $\varepsilon = 12V$ current strength of a short circuit is $I = 5A$. Determine the largest power $P_{\max}$, which may be obtained in an external part of a circuit containing given battery.

Option 5

1. Electrical field is produced by two point charges $Q_1 = 4nc$ and $Q_2 = 10nc$ which are placed at the distance $d == 10cm$ one from another Determine the field strength E in the space point situated at the distance $r_1 = 12cm$ from the first charge and at the distance $r_2 = 6cm$ from the second one.
2. Electrical field is produced by the positive charge uniformly distributed along an unbounded filament with linear density $\tau = 1{,}5\,nc/cm$. Determinate the work A

performed by the field when an electron displaces from the point being at the distance $r_1 = 1{,}5cm$ from the filament into the point being at the distance $r_1 = 1{,}0cm$ from the filament.

3. Two capacitors with capacities $C_1 = 3mkF$ and $C_2 = 6mkF$ are connected one with another and are connected to the battery with $120V$. Determine the charges Q_1 and Q_2 of each capacitor and potential difference U_1 and U_2 between their plates if the capacitors are connected:1) in parallel; 2) in series.

4. Current strength in a conductor increases uniformly from meaning I_0 till some maximal meaning during the time interval $t = 10s$. Over this time in the conductor the quantity of heat $Q = 1kJoule$ is generated. Determine a current arising speed dI/dt in the conductor, if its resistance is $R = 3Ohm.$

Option 6

1. Distance between two point charges with values $Q_1 = 5mkc$ and $Q_2 = 10mkc$ is $r = 10cm$. Determine the force F acting on point charge $Q = 0{,}1mkc$ which is located at the distance $r_1 = 6cm$ from the first charge and from the distance $r_2 = 8cm$ from the second one..

2. Forces of attraction between the plates of plane capacitor is $F = 50mN$. The area of plate is $S = 200sm^2$. Determine the electrical field energy density w of considered capacitor..

3. Upon the conducting spherical surface with radius $r_0 = 10cm$ uniformly the charge $q = 2nc$ is distributed. Determine a potential difference U between two points of space, one of which is situated at the distance $r_1 = 2cm$ from the outside of them, and at the second point situated at the same distance from the surface inside the volume bounded by the mentioned surface.

4. In copper conductor with volume $V = 6cm^3$ a value of heat $Q = 216\,joules$ is generated when the direct current passes along the conductor during the time interval $t = 1m$.. Determine the electrical field strength E inside of conductor, considering it as homogeneous one; the specific resistance of copper is $\rho = 1{,}7 \cdot 10^{-8} Ohm \cdot m$.

Option 7

1. In vertexes of regular hexagon with side length $a = 10cm$ point charges $Q,]2Q,3Q,4Q,5Q,6Q$ $(Q = 0{,}1mkc)$ are situated. Determine a force F acting at the point charge $Q = 0{,}1mkc$, located in the point, which is equidistant from the hexagon vertexes and which lies in the hexagon plane.

2. There is a point charge $Q = 10nc$ in the centre of sphere with radius $R = 20cm$. Determine a flux Φ_E of the electrostatic field strength vector through a surface of given sphere..

3. The plane air capacitor consists from two circle plates with radius $r = 10cm$. Distance between the plates is $d_1 = 10cm$. Capacitor was charged till the potential difference $U = 1{,}2kV$ and then was switched off current source. Determine the work the A is performed in order to enlarge distance between the plates to $d_2 = 3{,}5cm$..

4. EMF of the accumulator battery is $\varepsilon = 24V$, its internal resistance is $r = 1Ohm.$To the battery terminals a heater is connected, which consumes the power $P = 50W$ Calculate the current strength I in the circle and the efficiency η of the heater.

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Option 8

1. Distance between two equal charged balls is $r = 60cm$. The force attraction between the balls $F_1 = 70mkN$. After collision of balls and after their resetting the attraction force increases to $F_1 = 160mkN$. Determine the initial charges Q_1 and Q_2 of the balls. Consider the diameters of the balls are greatly smaller than the distance between them.

2. The charged particle is accelerated by the potential difference $U = 600V$, and as result it acquires the velocity $v = 5Mm/s$. Initial velocity of the particle is equal to zero. Determine the specific particle charge (the ratio of the particle charge to its mass).

3. Capacitors with capacities $C_1 = 1mkF$, $C_2 = 2mkF$, and $C_3 = 3mkF$ are under the voltage $V = 1{,}1kV$. Determine the energy $W_1, W_2,$ and W_3 each of them, if capacitors are connected:1) in series; 2) in parallel.

4. Determine the current density j in the ferrous conductor with the length $l = 10cm$, if this conductor is under the voltage $U = 6V$..Consider the electrical field inside of conductor to be homogeneous; specific resistance of ferrous is $\rho = 98nOhm \cdot m$.

Option 9

1. In vertexes of the regular triangle with the length of the side $a = 10cm$ are placed the charges $Q_1 = 10mkc, Q_2 = 20mkc, Q_1 = 10mkc,$ and $Q_3 = 30mkc,$. Determine the force F which acts on the each charge from the side of rest of them..

2. Between a charged capacitor switched from a current source exists an electrical field with strength E_0. How will the field strength E change if in a space between the capacity plate will be injected a dielectric layer: a) $E_0 > E;$ b) $E_0 > E;$

c) c) $E_0 \le E;$ d) $E_0 \le E.;$ e) $E_0 = E.$

3. Capacitor with a capacity $C_1 = 0{,}6mkF$ was charged till the voltage $U_1 = 300V$ and was connected with another capacitor, with a capacity $C_2 = 0{,}4mkF$, and which is charged till the voltage $U_2 = 150V$.. Determine the charge ΔQ, which passes through the conductor connecting the capacitors, by capacity of which one may neglect.

4. Current strength in a conductor with the resistance $R = 10Ohm$ uniformly decreases from $I = 3A$ till $I = 0$ during the time interval $\Delta t == 30s$. Determine the heat quantity Q generating in this conductor during given time interval.

Option 10

1. There is a system from two point charges $Q_1 = 100nc$ and $Q_2 = 10nc$, which are placed on the distance $r = 10cm$ one from another. Determine the potential energy W of the noted system.

2. Determine the potential difference U, which the particle must pass yn an electrical field to acquire the velocity $30\,Mm/s$, if the particle is :1) an electron;2) a proton. An initial velocity of both particles are considered to be zero. Electron mass is $m = 9{,}11 \cdot 10^{-31} kg$, proton mass is $m = 1{,}67 \cdot 10^{-27} kg$.

3. In accordance to the classical atom model in atom electron rotates around a nucleus along the closed orbits. Considering the orbit as circle determine the electron linear velocity on the orbit with radius $r = 0{,}053nm$ in the hydrogen atom. Electron mass is $m = 9{,}11 \cdot 10^{-31} kg$, its charge is $q = 1{,}6 \cdot 10^{-19} c$,

4. The current strength in the conductor with resistance $R = 100Ohm$ uniformly increases from meaning $I = 0$ till $I = 10A$ during the time interval $\Delta t = 10s$. Determine a heat quantity generating in this conductor during noted time interval.