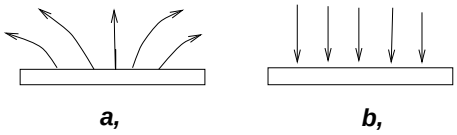
Name: Group:
Number of points:

Questions:

2 points for each question

1. There are two positive point charge in the space. Can the electric potential be zero in the vicinity of the charges?
2. What does the uniform electric field mean?
3. Give the definition of the equipotential surface!
4. On the figure electric lines of force on the surface of a piece of metal and on a surface of a piece of glass are depicted on. Identify the metal surface!



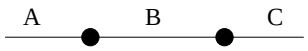
5. State the Ohm's low!

One–sentence–problems

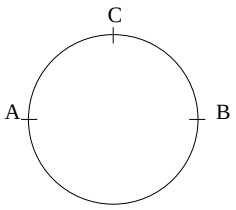
4 points for each questions

Give a *short* explanation of your answers!

1. There are two positive charges as it is shown by the figure. Choose one from regions A, B, C where the electric filed can be zero.



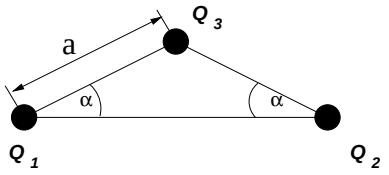
2. There is a uniform electric field between two oppositely charged parallel plates. How will the electric field change if the distance between the plates is decreased?
3. There is a metal ring shown by the figure. The resistance between contacts A and B is R_{AB} and the resistance between the contacts A and C is R_{AC}. Which is larger: R_{AB} or R_{AC}?



4. There is a charged metallic cube. Where is the electric potential larger: at the centre of one of its sides or at one of its vertices?
5. There are two oppositely charged large plate. Where is the electric field larger: at the middle or close to one of the plates?

Problems

1. There are three charges at the vertices of a triangle (see the figure).



$$\begin{aligned} Q_1 &= 10^{-4}C \\ Q_2 &= -2 \times 10^{-4}C \\ Q_3 &= 3 \times 10^{-4}C \\ \alpha &= 30^\circ \\ a &= 0.2m \end{aligned}$$

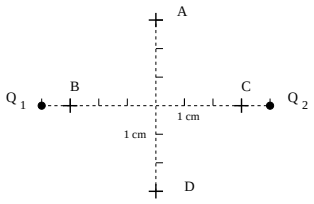
a. Give the force on the third charge! 10 points

b. How large is the electric potential at the middle of the triangle? 10 points

c. How large is the electric field at the place of the third charge? 5 points

2. The power dissipated on the system shown by the figure is 10 W.

$$\begin{aligned} R_1 &= 100\Omega \\ R_2 &= 200\Omega \\ R_3 &= 400\Omega \\ R_4 &= 300\Omega \\ C &= 100\mu F \end{aligned}$$



a. How large is the resistivity of the system? 6 points

b. Give voltage of the battery! 6 points

c. Give the potential drops on the resistors! 8 points

d. Give the charge stored in the capacitor! 5 points

0–30	31–43	44–54	55–67	68–80
1	2	3	4	5

Name: Group:
Number of points:

One–sentence–problems

3 points for each questions

Give a *short* explanation of your answers!

1. There are two charges on two vertices of a triangle. In which case can the electric field be zero at the third vertex of the triangle?

2. There is a neutral soap–bulb. How will the diameter of the bulb change if we put some charge on it?

3. There is a uniform electric field between two oppositely charged parallel plates. How will the electric field change if the distance between the plates is doubled?

4. There are two balls hanging on a piece of rope. One of them is conductor the other one is insulator. What happens if we touch them with a charged glass rod?

5. There are two oppositely charged large plate. Where is the electric field larger: at the middle or close to one of the plates?

Problems

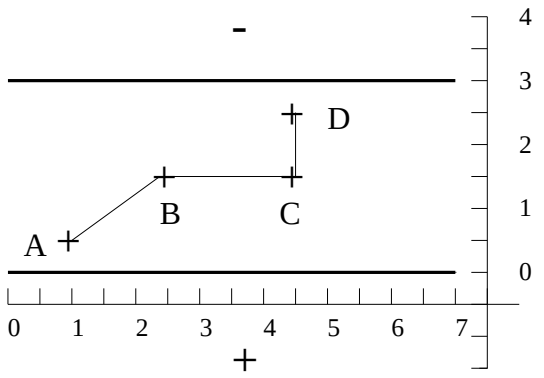
1. The vertical and horizontal komponents of the electric field formed by a point charge of $10^{-8}C$ at a given point are $3N/C$ and $4N/C$ respectively.

   a.) How large is the magnitude of the electric field at the same point? 5 points

   b.) How far is the point charge from the point? 5 points

   c.) Give the koordinates of the point if the charge is at the origin! 5 points

2. There is a uniform electric field of $100 N/C$ between two charged parallel plates. The lower one is positively charged. A small point charge of $-10^{-4} C$ is placed at the point A.



a.) How large force acts on the point charge at the points *A, B, C, D*? Sign the directions of the forces on the figure! 5 points

b.) How much work must be done on the charge in order to move it from point A to point B ? 5 points

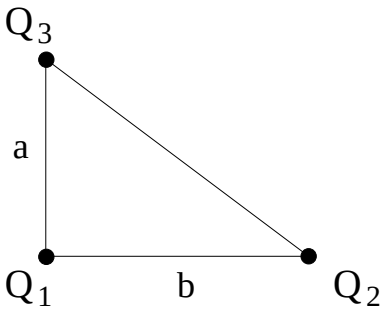
c.) How much work must be done on the charge in order to move it from point B to point C ? 5 points

The units on the figure are given in cm.

3. There are three charges given by the figure.

a.) Give the force acting on the third charge. 10 points

b.) Give the electric field at the place of the 1-st charge. 10 points



$$
\begin{aligned}
Q_1 &= 3 \times 10^{-4} C \\
Q_2 &= 1.3 \times 10^{-4} C \\
Q_3 &= 1.69 \times 10^{-4} C \\
a &= 0.05\ m \\
b &= 0.12\ m
\end{aligned}
$$

0–20	1	43–53	4
21–31	2	54–65	5
32–42	3		

Name: Group:
Number of points:

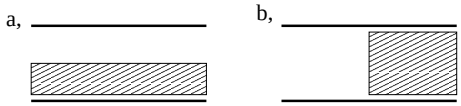
One–sentence–problems

3 points for each questions

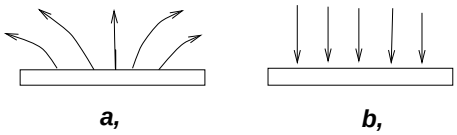
Give a *short* explanation of your answers!

1. There are two positive point charges close to each other. Can the electric potential be zero in the vicinity of the charges?

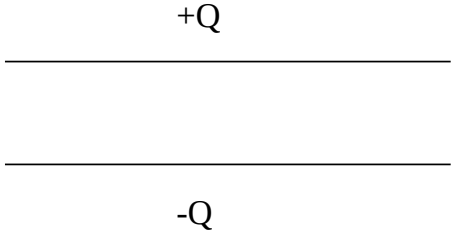
2. The space between two metal plates is partially filled according to the figure. Which system has larger capacity?



3. On the figure electric lines of force on the surface of a piece of metal and on a surface of a piece of glass are depicted. Identify the metal surface!



4. There are two charged parallel metal plates as it is given by the figure. Denote some of the equipotential surfaces on the figure!



0–15	1	34–42	4
16–24	2	43–50	5
25–33	3		

Problems

1. Two parallel metal plates with the area of 0.01 m^2 are separated 0.01m from each other. The space between the plates is filled by an insulator with $\epsilon_r = 10$.

   a.) Give the capacitance of the system! 3 points

   b.) We put $Q = 10^{-4}C$ charge on the plate. How large is the potential difference between the plates? 3 points

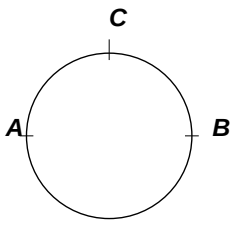
   c.) How does the potential difference change if the insulator is removed? 3 points

   d.) How much work do we have to do in order to remove the insulator? 5 points

2. There is a metal ring shown by fig. 1. made of a wire with the diameter of 0.5 mm. The radius of the ring is 0.5 m and its specific resistivity is 10^{-4} Ωm.

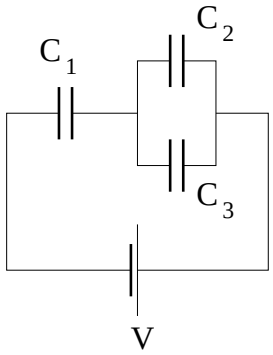
   a.) Give the resistivity of the system between the A and B points! 6 points

   b.) How large is the resistivity between the A and C points? 6 points



3. A system of capacitors given by the figure is connected to a battery.

$$C_1 = 20\mu F$$
$$C_2 = 10\mu F$$
$$C_3 = 20\mu F$$



   a.) How much charge is stored in the different capacitors if the voltage of the battery is 10 V? 4 points

   b.) Give the potential difference on each capacitors! 4 points

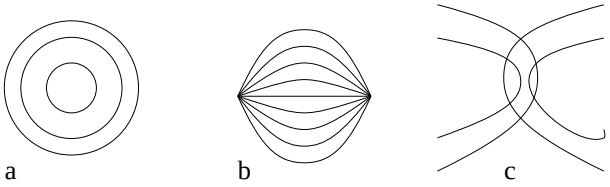
   c.) How much energy is stored in the system ? 4 points

Name: Group:
Number of points:

Questions:

2 points for each question

1. Give the unit of the electric field!
2. Which figure are electrostatic lines of force depicted on?



3. Is the electric field of a point charge proportional to the distance ?
4. There are two positive point charge in the space. Can the electric potential be zero in the vicinity of the charges?
5. What does the force between two point charges depend on?
6. What does the uniform electric field mean?
7. Give the definition of the equipotential surface!
8. Choose the vectors among the following physical quantities: electric field, force, electric potential, position, potential energy, kinetic energy.
9. How can we calculate the force between a set of point charges?
10. What is the unit of the electric potential?

Problems

1. The vertical and horizontal komponents of the electric field formed by a point charge of $10^{-8}C$ at a given point are $3N/C$ and $4N/C$ respectively.

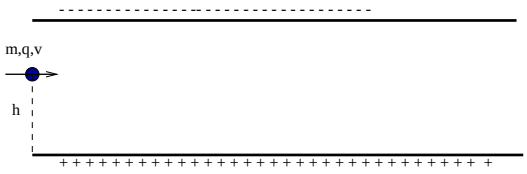
   a.) How large is the magnitude of the electric field at the same point?

   b.) How far is the point charge from the point?

   c.) Give the koordinates of the point if the charge is at the origin!

   d.) How large is the electric potential at the same point?

2. There is a uniform electric field of $100N/C$ between two charged parallel plates. The lower one is positively charged. A small point charge of $-10^{-4}C$ $0.1m$ above the positive plate is coming according to the figure with a velocity of $10m/s$. The mass of the small charge is $1g$.



   a.) How large force acts on the point charge?

   b.) How far does the point charge strike the positive plate?

   c.) How large is its velocity at that time?

3. There are two pint charges $1m$ apart from each other with a charge of $10^{-4}C$ and $-10^{-4}C$ respectively.

   a.) Give the points on the line joining the two charges where the electric potential is zero!

   b.) How large is the electric field at the same points?

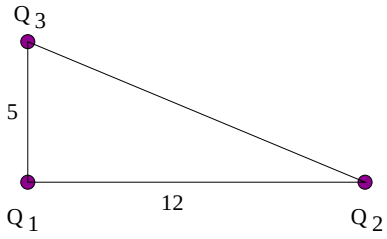
   c.) Where should we place a third charge of $2 \times 10^{-4}C$ in order to make the electric field zero at the same points.

   d.) How large is the electric potential in this case?

4. There are three charges given by the figure.

   a.) Give the force acting on the third charge.

   b.) How large is the potential energy of that charge?



Have a good luck!

Name: Group:
Number of points:

Questions:

2 points for each question

1. What does the capacity of a capacitor depend on?
2. What is the unit of the capacitance?
3. What does the energy stored in a capacitor depend on?
4. How large can a potential difference be on the surface of an ideal metal?
5. State the Ohm's low!
6. How does the resistivity of a metal wire depend on the area of the cross-section ?
7. Give the unit of the resistivity!
8. Give the unit of the specific resistivity!
9. How large is the capacity of a metal sphere with the radius of R!
10. Define the capacitance of a system!

Problems

1. Two parallel metals plate with the area of 0.01 m^2 are separated 0.01m from each other. The space between the plates is filled by an insulator with $\epsilon_r = 10$.

   a.) Give the capacitance of the system!

   b.) We put $Q = 10^{-4}C$ charge on the plate. How large is the potential difference between the plates?

   c.) How does the potential difference change if the insulator is removed?

   d.) How much work do we have to do in order to remove the insulator?

2. We have a voltage meter which can measure the voltage in the range of 0 – 3V. However, we have to measure the voltage in the power line in the range of 0 – 300V. The resistivity of the voltage meter is very large and we can neglect its effect. The resistivity of the new system must be 1MOhm.

   a.) Give the arrangement of the resistors we have to apply before the voltage meter!

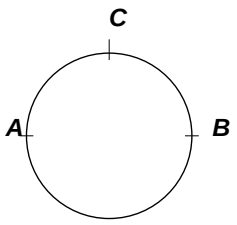
   b.) Give the resistivity of the resistors!

   c.) How much current will flow through the resistors when we measure the 220 V power line?

3. There is a metal ring shown by fig. 1. made of a wire with the diameter of 0.5 mm. The radius of the ring is 0.5 m and its specific resistivity is 10^{-4} Ohmm.

   a.) Give the resistivity of the system between the A and B points!

   b.) How large is the resistivity between the A and C points?



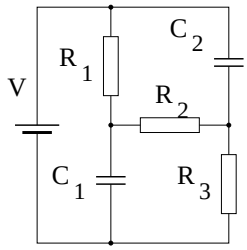
4. There is a net of resistors and capacitors given by the figure.

   a.) Give the voltage drops on each resistors!

   b.) Give the currents in each resistors!

   c.) How large is the resistivity of the hole system?

   d.) How much charge is stored in the capacitors?



$R_1 = 100\text{Ohm}$ $C_1 = 100\ \mu\text{F}$

$R_2 = 200\text{Ohm}$ $C_2 = 100\ \mu\text{F}$

$R_3 = 300\text{Ohm}$

$V = 9\text{V}$

Have a good luck!

Name: Group:
Number of points:

Questions:

2 points for each question

1. State the Faraday's law!
2. Give the definition of the self induction coefficient!
3. What does the flux depend on?
4. How does the self induction coefficient of a solenoid change if the number of turns is doubled?
5. Give the definition of the mutual induction coefficient!
6. Give the impedance of and inductor with self induction coefficient L!
7. Give the impedance of a capacitor!
8. How large is the phase different between the current and the voltage on a inductor?
9. How large is the phase different between the current and the voltage on a capacitor?
10. How large is the D.C. resistivity of a capacitor?

Problems

1. There is a solenoid consist of 100 turns. Its self induction coefficient is $L = 10^{-2}H$.

   Find the flux of the solenoid if the current is $I = 2A$ through it! 5 points

   The current is linearly decreasing to zero during $\Delta t = 0.5s$. How large is the induced voltage on the solenoid? 5 points

   Another 50 turns is put tightly on the solenoid. How large will the flux be in the second solenoid if the current is $I = 3A$?

   How large is the mutual induction coefficient of the system?

2. A wire frame is rotated in the presence of homogeneous magnetic field of $B = 2T$ with constant frequency of $= 10Hz$. The magnetic field is perpendicular to the axis of the frame. The surface area of the frame is $A = 2.5 \times 10^{-3}m^2$.

   Give the induced voltage as the function of the time!

   How large is the average of the induced voltage during $t = 1s$?

   How large is the largest dipole moment of the frame if its resistivity is $R = 1\Omega$?

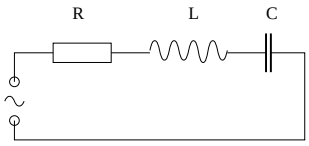
   At which position will the induced voltage be the largest?

3. In a RLC system given by the figure the amplitudes of the voltage on the capacitor, inductor and the resistor are the same as the voltage of the power supplyr: V = 100V. The resistivity of the resitor is R = 50 Ω.

   a, Find the frequency of the A.C. voltage!

   b, How large is the capacitance of the capacitor and the self induction coefficient of the inductor?

   c, How much power is dissipated on the system?



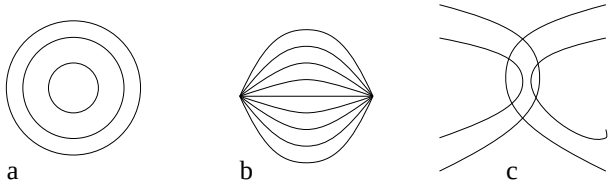
Have a good luck!

Name: Group:
Number of points:

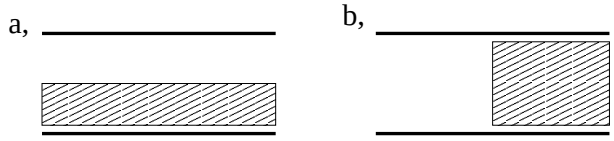
Questions:

2 points for each question

1. Give the unit of the electric field!
2. Which figure are electrostatic lines of force depicted on?



3. Is the electric field of a point charge proportional to the distance ?
4. What does the uniform electric field mean?
5. What is the unit of the electric potential?
6. What does the capacity of a capacitor depend on?
7. What is the unit of the capacitance?
8. What does the energy stored in a capacitor depend on?
9. The space between two metal plates is partially filled according to the figure. Which system has larger capacity?



10. How does the electric field between two charged parallel plates change if the space is filled by an insulator?

Problems

1. Two parallel metals plate with the area of 0.01 m^2 are separated 0.01m from each other. The space between the plates is filled by an insulator with $\epsilon_r = 10$.

   a.) Give the capacitance of the system!

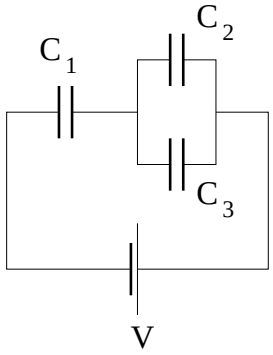
   b.) We put $Q = 10^{-4}C$ charge on the plate. How large is the potential difference between the plates?

   c.) How does the potential difference change if the insulator is removed?

   d.) How much work do we have to do in order to remove the insulator?

2. A system of capacitors given by the figure is connected to a battery.

$$C_1 = 20\mu F$$
$$C_2 = 10\mu F$$
$$C_3 = 20\mu F$$



   a.) How much charge is stored in the different capacitors if the voltage of the battery is 10 V? 5 points

   b.) Give the potential difference on each capacitors! 5 points

   c.) How much energy is stored in the system ? 5 points

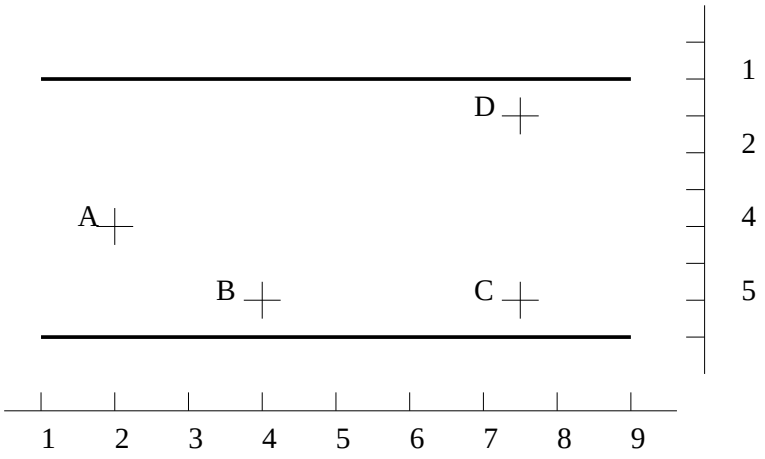
3. There are two metal plates. The voltage difference between the plates is 100 V. A small charge of 10^{-4} C is moved from one point to another. Give the work which has to be done on the charge if it is moved :

   a.) from point A to point B

   a.) from point B to point C

   a.) from point A to point C

   a.) from point A to point D

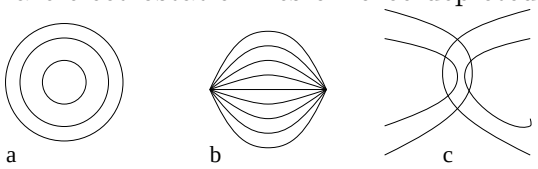


Name: Group:
Number of points:

Questions:

2 points for each question

1. What does the capacity of a capacitor depend on?
2. What is the unit of the capacitance?
3. Which figure are electrostatic lines of force depicted on?



4. What does the energy stored in a capacitor depend on?
5. How large can a potential difference be on the surface of an ideal metal?
6. Is the electric field of a point charge proportional to the distance ?
7. How large is the capacity of a metal sphere with the radius of R!
8. Define the capacitance of a system!
9. There are two positive point charge in the space. Can the electric potential be zero in the vicinity of the charges?
10. What does the force between two point charges depend on?

Problems

1. Two parallel metal circular plates with the radius of 0.1 m are separated 0.01m from each other. The space between the plates is filled by an insulator with $\epsilon_r = 5$.

   a.) Give the capacitance of the system! 5 points

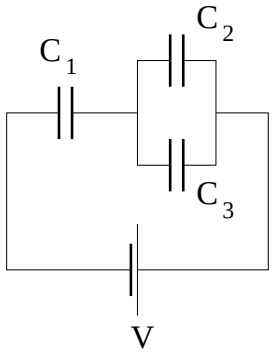
   b.) We put $Q = 10^{-4}C$ charge on the plate. How large is the potential difference between the plates? 5 points

   c.) How does the potential difference change if the insulator is removed? 5 points

   d.) How much work do we have to do in order to remove the insulator? 5 points

2. A system of capacitors given by the figure is connected to a battery.

$$C_1 = 20\mu F$$
$$C_2 = 10\mu F$$
$$C_3 = 20\mu F$$



   a.) How much charge is stored in the different capacitors if the voltage of the battery is 10 V? 5 points

   b.) Give the potential difference on each capacitors! 5 points

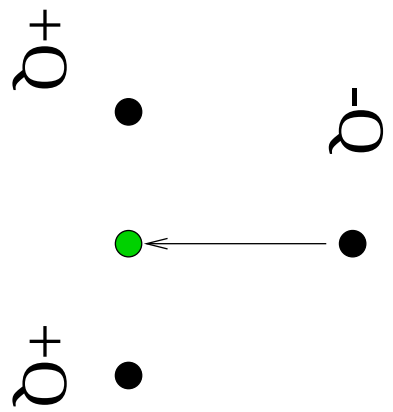
   c.) How much energy is stored in the system ? 5 points

3. There are three charges at the edges of an equal-sided triangle. The sides of the triangle is $a = 0.1m$, $Q = 10^{-3}C$ The negative charge is moved to the base of the triangle, as it is shown by the figure.

   a.) How much work has to be done during the process? 5 points

   b.) Give the electric potential at the place of the negative charge at the beginning and at the end! 5 points

   c.) How large is the potential energy of the system at the beginning? 5 points



Have a good luck!

Name: Group:
Number of points:

One–sentence–problems

3 points for each questions

Give a *short* explanation of your answers!

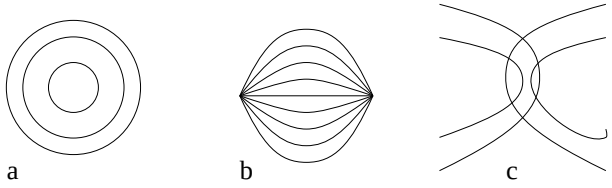
1. There are two charges on two vertices of a triangle. In which case can the electric field be zero at the third vertex of the triangle?

2. There is a neutral soap–bulb. How will the diameter of the bulb change if we put some charge on it?

3. What does the uniform electric field mean?

4. There are two oppositely charged large parallel plate. Where is the electric field larger: at the middle or close to one of the plates?

5. Which figure are electrostatic lines of force depicted on?

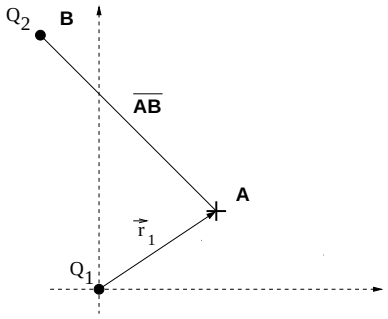


Problems

1. There is a charge of $Q_1 = 10^{-8}C$ at the origin.

   a.) Give the electric field at the point **A** given by the vector of $\vec{r}_1 : (0.6m, 0.8m)$! 5 points

   We put another charge of $Q_2 = 5 \times 10^{-8}C$ at a point **B**. The new electric field at the point **A** is $\vec{E}_{new} : (84N/C, 32N/C)$ (see the corresponding figure)

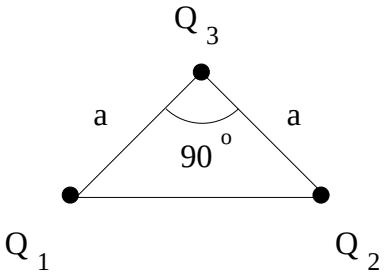
   b.) Find the distance $\overline{\mathbf{AB}}$ between points **A** and **B**! 5 points

   c.) Give the coordinates of the point **B**! 5 points

2. There are three charges at the vertices of a isosceles rectangular triangle as it is given by the figure.

   a.) Give the force acting on the third charge. 10 points

   b.) Give the electric field at the place of the 1-st charge. 10 points



$$\begin{aligned} Q_1 &= 2 \times 10^{-5} C \\ Q_2 &= -2 \times 10^{-5} C \\ Q_3 &= 3 \times 10^{-5} C \\ a &= 0.3\ m \end{aligned}$$

3. A particle with a mass of $m = 10^{-3} g$ is moving with constant velocity on a straight line in the presence of uniform downward directed electric field of $E = 3000 N/C$. Give the charge of the particle! 10 points

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0–20	1	41–50	4
21–30	2	51–60	5
31–40	3		

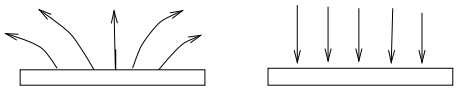
Name: Group:
Number of points:

One–sentence–problems

3 points for each questions

Give a *short* explanation of your answers!

1. Give the definition of the equipotential surface!
2. The capacity of two parallel metal plates is 2 nF (2×10^{-9} F). How large will the capacity of the system be if the distance between them is doubled?
3. On the figure electric lines of force on the surface of a piece of metal and on a surface of a piece of glass are depicted on. Identify the metal surface!



4. What does the capacity of a capacitor depend on?
5. How large can a potential difference be between two points on a surface of a metal ?

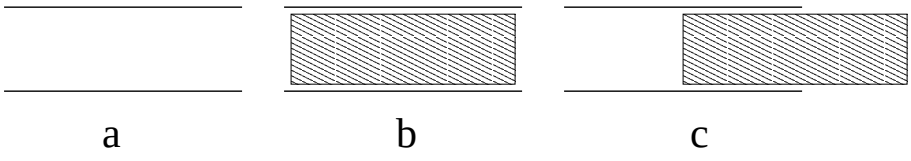
Problems

1. The amount of charge stored in the system shown by Fig. **a** is $Q = 2 \times 10^{-6}$ C and the voltage difference between the plates is $V_a = 2000$ V.

   a How large is the capacity of the system? 5 points

   b If the space between the plates is filled by an insulator the voltage will drop to $V_b = 1000$ V (Fig **b**). How large is the dielectric constant of the insulator? 5 points

   c How large will the voltage on the system if only the half of the space is filled by the insulator (Fig **c**)? (Hint: The half filled system can be considered as two parallel connected capacitor. One of them is filled and the other one is empty.) 5 points

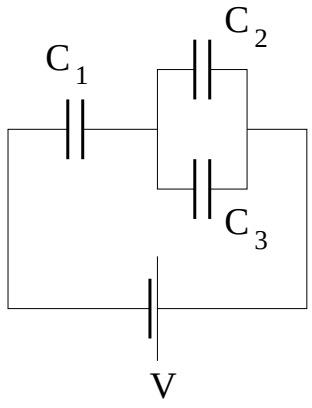


2. There is a network of capacitors as it is given by the figure below.

   a Find the voltages and the charges on the capacitors! 10 points

   b How much energy is stored in the system? 5 points

$$C_1 = 20\mu F$$
$$C_2 = 10\mu F$$
$$C_3 = 30\mu F$$
$$V = 12V$$



3. There are three charges at the vertices of an equilateral triangle as it is shown by Fig. **a**.

   a Give the electric potential at the point denoted by P on the figure! 7 points

   b How much work has to be done in order to move Q_2 from its original position to the midpoint between Q_1 and Q_3. See Fig. **b**. 8 points

$$Q_1 = 2 \times 10^{-5}\ C$$
$$Q_2 = 3 \times 10^{-5}\ C$$
$$Q_3 = -10^{-5}\ C$$
$$a = 0.3\ m$$

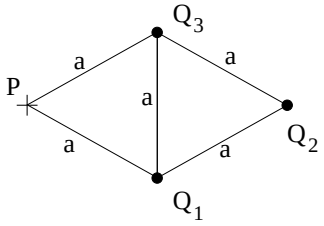


Figure **a**

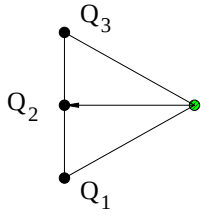


Figure **b**

0–20	1	41–50	4
21–30	2	51–60	5
31–40	3		

Name: Group:
Number of points:

One–sentence–problems

3 points for each questions

Give a *short* explanation of your answers!

1. There are two positive point charge in the space. Can the electric potential be zero in the vicinity of the charges?

2. Give the definition of the equipotential surface!

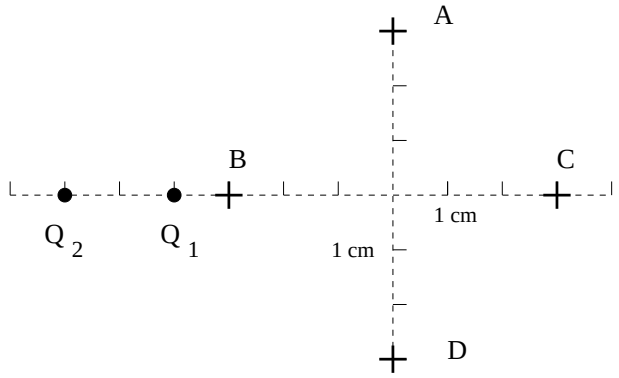
3. The capacity of two parallel metal plates is 2 nF (2×10^{-9} F). How large will the capacity of the system be if the distance between them is doubled?

4. There is a charged metallic cube. Where is the electric potential larger: at the center of one of its sides or at one of its vertices?

5. The energy stored in a capacitor is 10^{-4} J. How does the energy change if the space between the electrodes of the capacitor is filled by an insulator with dielectric constant of $\varepsilon_r = 4$?

Problems

1. There are two charges in the space according to the figure: $Q_1 = 10^{-5}$C, $Q_2 = -2 \times 10^{-5}$C.



Give the work we have to do in order to move a third charge of $q = 10^{-5}$C from

a) point **A** to point **B** 5 points

b) point **B** to point **C** 5 points

c) point **A** to point **D** 5 points

2. Two parallel metal plates with the area of $0.25\ m^2$ are separated 0.001 m from each other. The space between the plates is filled by an insulator with $\epsilon_r = 10$.

   a.) Give the capacitance of the system! 3 points

   b.) We put $Q = 10^{-5}C$ charge on the plate. How large is the potential difference between the plates? 4 points

   c.) How does the potential difference change if the insulator is removed? 4 points

   d.) How much work do we have to do in order to remove the insulator? 4 points

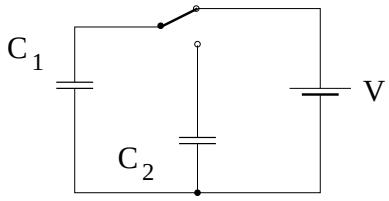
3. On the figure a network of capacitors is shown. At the first case C_1 is connected to the battery.

   a.) Give the amount of charge stored in the capacitor! 5 points

   b.) In the second case the two capacitors C_1 and C_2 are connected through the switch. Give the voltage on the capacitors! 5 points

   c.) Give the energy stored in the system in the two cases. 5 points!

$$C_1 = 10\ \mu F$$
$$C_2 = 20\ \mu F$$
$$V = 12\ V$$



0–20	1	41–50	4
21–30	2	51–60	5
31–40	3		

Name: Group:
Number of points:

One–sentence–problems

3 points for each questions

Give a *short* explanation of your answers!

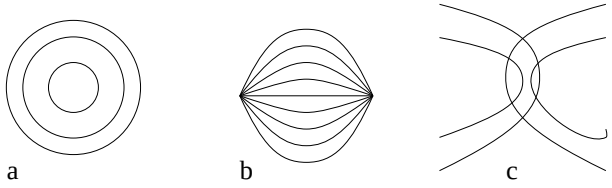
1. There are two charges on two vertexes of a triangle. In which case can the electric field be zero at the third vertex of the triangle?

2. There are two balls hanging on a piece of rope. One of them is conductor the other one is insulator. What happens if we touch them with a charged glass rod?

3. What does the uniform electric field mean?

4. Is the electric field of a point charge proportional of the distance?

5. Which figure are electrostatic lines of force depicted on?



Problems

1. There is a charge of $Q_1 = 10^{-8}C$ at the origin.

   a.) Give the electric field at the point **A** given by the vector of $\vec{r_1} : (0.6m, 0.8m)$! 5 points

   We put another charge of $Q_2 = 5 \times 10^{-8}C$ at a point **B**. The new electric field at the point **A** is
   $\vec{E}_{new} : (24N/C, 32N/C)$

   b.) Find the distance $\overline{\mathbf{AB}}$ between points **A** and **B**! 5 points

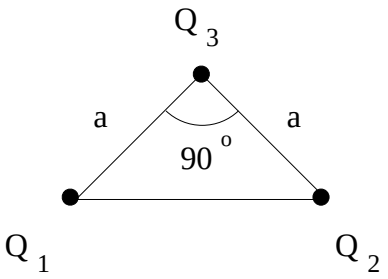
   c.) Give the coordinates of the point **B**! 5 points

2. There are three charges at the vertexes of a isosceles rectangular triangle as it is given by the figure.

a.) Give the force acting on the third charge! 5 points

b.) Give the length of the force vector! 5 points

c.) How large is the angle between the force and the bases of the triangle? 5 points



$$Q_1 = -1 \times 10^{-5} C$$
$$Q_2 = 2 \times 10^{-5} C$$
$$Q_3 = 3 \times 10^{-5} C$$
$$a = 0.3\ m$$

3. An electron is moving between two oppositely charged horizontal parallel plates. The position of the electron at a moment is given by the vector of $\vec{r} = (1m, 0.5m, 0m)$. The electric field at that point is $E = 10N/C$. The mass of the electron is: $m_e = 9.10 \times 10^{-31}$ kg and the charge of the electron is: $Q_e = 1.60 \times 10^{-19}$ C.

a.) Give the acceleration of the electron! 10 points

b.) In a short time the position of the electron will be $\vec{r} = (1m, 0.6m, 0.1m)$. How large is the electric field at that point? 5 points

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0–20	1	41–50	4
21–30	2	51–60	5
31–40	3		

Name: Group:
Number of points:

One–sentence–problems

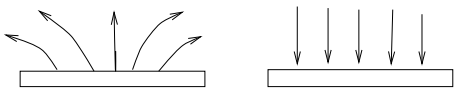
3 points for each questions

Give a *short* explanation of your answers!

1. The energy stored in a system which consist of two charged parallel metal plates is 10 J. How much work has to be done in order to double the distance between the plates?

2. The capacity of two parallel metal plates is 2 nF (2×10^{-9} F). How large will the capacity of the system be if the distance between them is doubled?

3. On the figure electric lines of force on the surface of a piece of metal and on a surface of a piece of glass are depicted on. Identify the metal surface!



a, ***b,***

4. There are two positive point charge in the space. Can the electric potential be zero in the vicinity of the charges?

5. How large can a potential difference be between two points on a surface of a metal ?

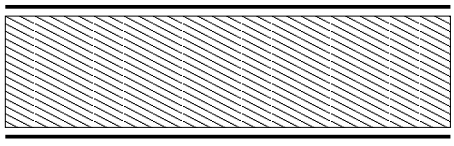
Problems

1. The amount of charge stored in the system shown by Fig. is $Q = 2 \times 10^{-4}$ C and the voltage difference between the plates is $V_a = 2000$ V.

   a How large is the capacity of the system? 3 points

   b If the insulator from the plates is removed the voltage will raise to 6000 V. How large is the dielectric constant of the insulator? 6 points

   c How much work has to be done in order to remove the insulator? 6 points

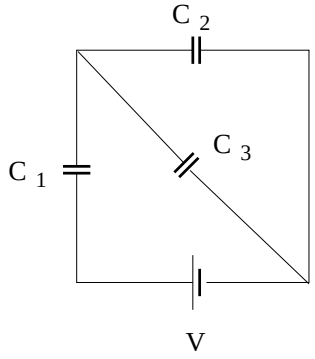


2. There is a network of capacitors as it is given by the figure below.

   a Find the voltages and the charges on the capacitors! 10 points

   b How much energy is stored in the system? 5 points

$$C_1 = 30\mu F$$
$$C_2 = 20\mu F$$
$$C_3 = 40\mu F$$
$$V = 12V$$

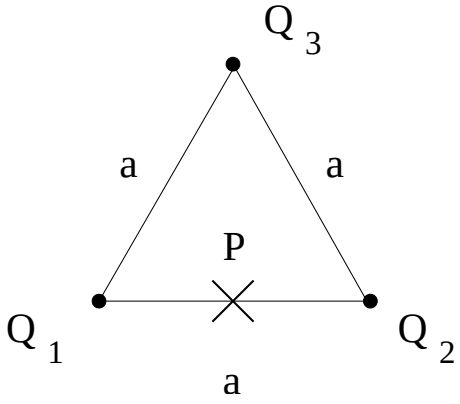


3. There are three charges at the vertices of an equilateral triangle as it is shown by Figure.

   a Give the electric potential at the point denoted by P on the figure! 7 points

   b How much work has to be done in order to move Q_3 from its original position to the point P. 8 points

$$Q_1 = 2 \times 10^{-5}\ C$$
$$Q_2 = 3 \times 10^{-5}\ C$$
$$Q_3 = -10^{-5}\ C$$
$$a = 0.3\ m$$



0–20	1	41–50	4
21–30	2	51–60	5
31–40	3		

Name: Group:
Number of points:

Problems

1. There are two charges Q_1 and Q_2 at the points $\vec{r}_1$ and $\vec{r}_2$, respectively.

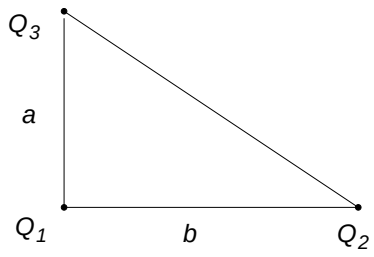
$$Q_1 = 10^{-4}\text{C} \qquad \vec{r}_1 = (1m, 1m)$$
$$Q_2 = 4 \times 10^{-4}\text{C} \qquad \vec{r}_1 = (4m, 5m)$$

   a.) How far from the first charge is the electric field zero? 8 points

   b.) Give the coordinates of that point! 7 points

2. A small charged particle is moving on a straight line with constant velocity in the presence of uniform electric field of $E = 100$ N/C. The charge of the particle is $Q = 10^{-4}$ C. Give the mass of the particle! 10 points

3. There are three charges at the vertices of a triangle as it is shown by the figure.

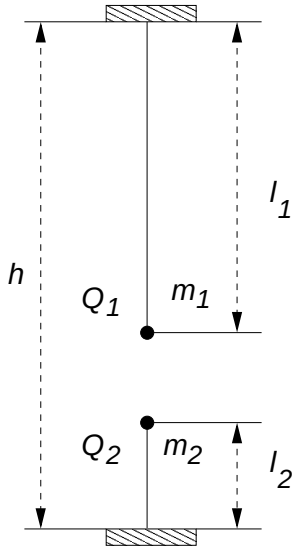


$$\begin{aligned} Q_1 &= 10^{-4}C \\ Q_2 &= -10^{-4}C \\ Q_3 &= 2 \times 10^{-4}C \\ a &= 0.3m \\ b &= 0.4m \end{aligned}$$

   a.) Give the force on Q_2! 10 points

   b.) Give the electric field at the place of the 2nd charge! 5 points

4. Two charges are hanging on two ropes according to the figure.



$$
\begin{aligned}
Q_1 &= 10^{-5}\ C \\
Q_2 &= -10^{-5}\ C \\
h &= 1\ m \\
l_1 &= 0.7\ m \\
l_2 &= 0.2\ m \\
m_1 &= 0.5\ kg \\
m_2 &= 0.5\ kg
\end{aligned}
$$

Give the tension in the ropes! 10 points

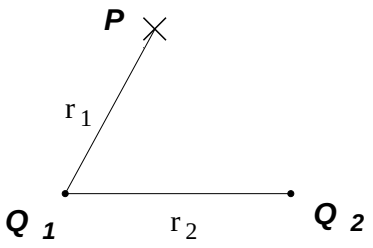
---

0 - 10	1
11 - 20	2
21 - 30	3
31 - 40	4
41 - 50	5

Name: Group:
Number of points:

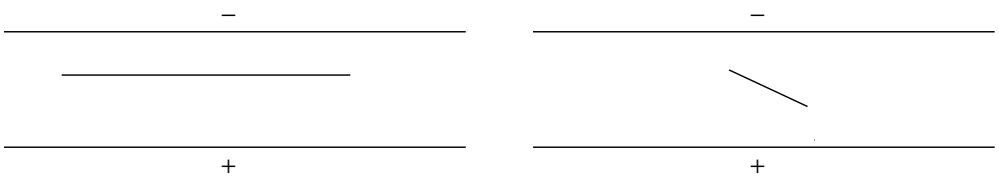
Problems

1. There are two charges, $Q_1 = 2 \times 10^{-6}\ C$ and $Q_2 = 10^{-6}\ C$, separated by a distance of $r_2 = 1\ m$. At a distance of $r_1 = 1\ m$ from Q_1, at the point P, the electric potential is $V = 2.7 \times 10^4\ V$.

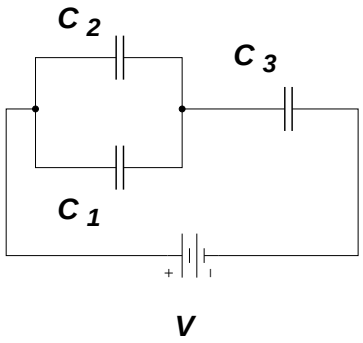


Give the coordinates the point P if Q_1 is at the origin! 12 points

2. There are two parallel, oppositely charged metal plates as it is shown by the figure. A small metal plate is put between the charged plates. Draw the schematic pictures of the electric lines of force in the two cases given by the figure. 8 points



3. A network of capacitors is depicted on the following figure.



$$C_1 = 10\ \mu F$$
$$C_2 = 20\ \mu F$$
$$C_3 = 15\ \mu F$$
$$V = 9\ V$$

a.) Give the voltages on each capacitors! 5 points

b.) Give the charges stored in each capacitors! 5 points

c.) How much energy is stored in the system? 5 points

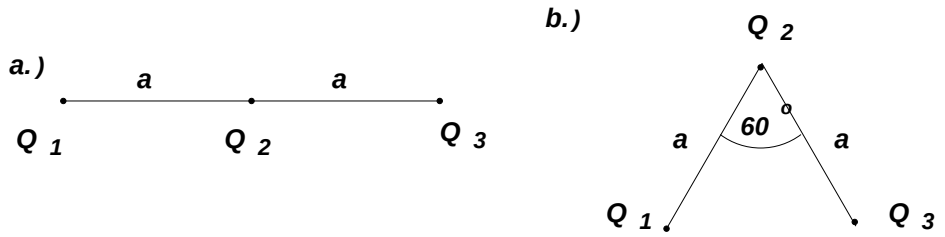
4. The amount of charge stored in the system shown by Fig. **a** is $Q = 2\times10^{-6}$ C and the voltage difference between the plates is $V_a = 2000$ V.

   a.) How large is the capacity of the system? 3 points

   b.) If the space between the plates is filled by an insulator the voltage will drop to $V_b = 1000$ V. How large is the dielectric constant of the insulator? 4 points

   c.) How much work has to be done in order to remove the insulator? 5 points

5. There are three charges on a line (Fig **a.**). The distance between the first and the second charges and second and the third charges are $a = 1\ m$. The system is distorted according to Fig. **b.**. How much energy must be done in order to bend the system? 13 points



$$Q_1 = 10^{-5}\ C \quad Q_2 = -2\times10^{-5}\ C \quad Q_3 = 10^{-5}\ C$$

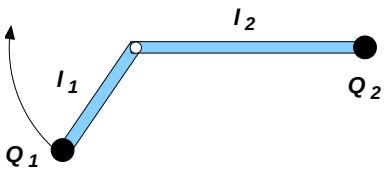
---

0 - 16	1
17 - 27	2
28 - 38	3
39 - 49	4
50 - 60	5

Name: Group:
Number of points:

Problems

1. There are two charges at the ends of two rods on a horizontal table. The first rod can rotate freely in the horizontal plane around the end of the rod as it is shown by figure.



$$Q_1 = 2 \times 10^{-5}\ C$$
$$l_1 = 0.1\ m$$
$$Q_2 = 10^{-5}\ C$$
$$l_2 = 0.3\ m$$

   a.) Give the position of the first charge! 4 points

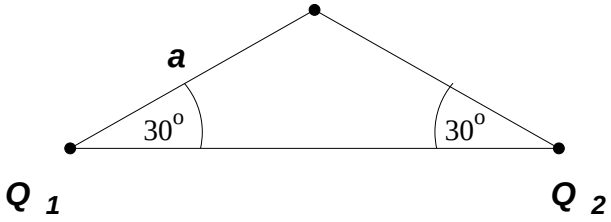
   b.) Give the forces on the charges! 4 points

   c.) Give the position and the forces if the sign of Q_1 is reversed! 7 points

2. A small charged particle is moving on a straight line with constant velocity in the presence of uniform electric field of $E = 200$ N/C. The charge of the particle is $Q = 4 \times 10^{-4}$ C. Give the mass of the particle! 10 points

3. Two identical charges are placed on a line. The amount of charges are $Q = 10^{-4}\ C$. How much charge must be put in the middle in order to keep them in equilibrium? 10 points

4. There are two charges on two vertices of a triangle as it is shown by the figure.



$$Q_1 = 2 \times 10^{-5}\ C$$
$$Q_2 = -2 \times 10^{-5}\ C$$
$$a = 0.3\ m$$

a.) Give the electric filed vector at the third vertex of the triangle! 7 points

b.) Where should we place a charge of $Q = 2 \times 10^{-4}\ C$ in order to have zero electric field at the third vertex of the triangle? 8 points

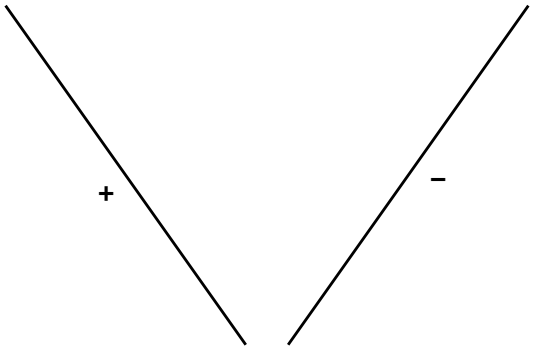
---

0 - 10	1
11 - 20	2
21 - 30	3
31 - 40	4
41 - 50	5

Name: Group:
Number of points:

Problems

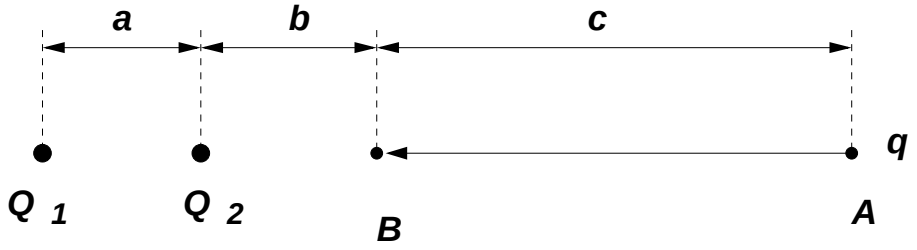
1. There are two oppositely charged metal plates as it is shown by the figure. Draw a schematic picture of the electric lines of force! 5 points



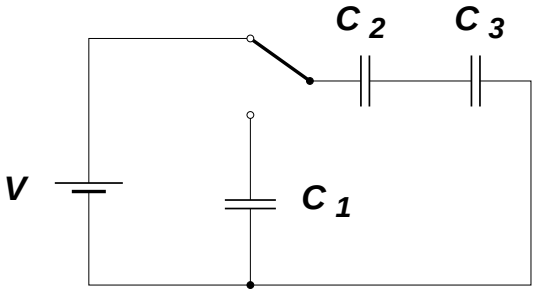
2. The voltage on a planar capacitor filled by an insulator is $V_1 = 30\ V$. If the insulator is removed the voltage will be increased to $V_2 = 120\ V$. How large is the dielectric constant of the insulator? 10 points

3. A small charge of $q = 10^{-5}\ C$ is moved from point **A** to point **B** in the presence of the electric field of the point charges Q_1 and Q_2. How much work had to be done? 10 points

$$Q_1 = 10^{-4}\ C \qquad a = 0.3\ m \qquad b = 0.3\ m$$
$$Q_2 = -2 \times 10^{-4}\ C \qquad c = 0.6\ m$$

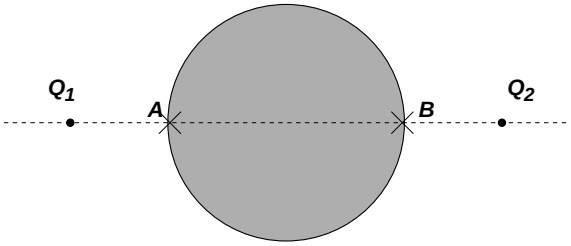


4. A network of capacitors is shown by the figure. In the first case C_2 and C_3 are charged by the battery. Give the voltages and the charges on each capacitors after turning the switch. 15 points



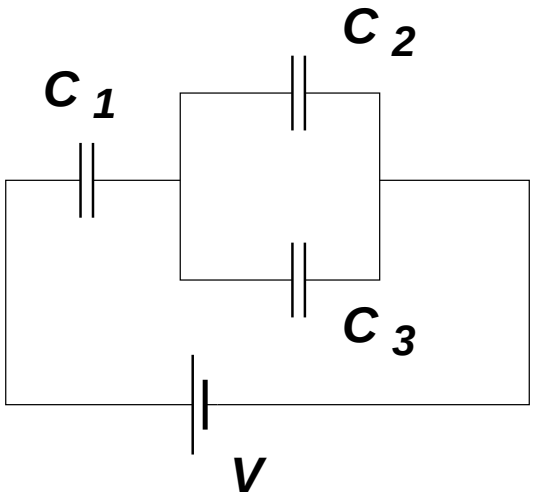
$$C_1 = 10\ \mu F$$
$$C_2 = 30\ \mu F$$
$$C_3 = 60\ \mu F$$
$$V = 12\ V$$

5. A system of two point charges and a metal sphere is shown by the figure. Give the potential difference between points **A** and **B**! 5 pints



$$Q_1 = 10^{-4}\ C$$
$$Q_2 = 2 \times 10^{-4}\ C$$

6. Give the voltages and the charges stored in the capacitors for the following system! 15 points



$$C_1 = 30\ \mu F$$
$$C_2 = 20\ \mu F$$
$$C_3 = 40\ \mu F$$
$$V = 12\ V$$

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0 - 20	21 - 28	29 - 36	37 - 43	44 - 50
1	2	3	4	5