DOWNLOAD PDF ELECTRICAL AND MAGNETIC CALCULATIONS

Chapter 1 : Magnetic circuit - Wikipedia

Electrical and Magnetic Calculations For the Use of Electrical Engineers and Artisans, Teachers by Albert Algernon Atkinson Direct-Current Machine Design Being Instructions for the Design of Motors and Generators by Francis Bacon Crocker.

The electric force - Felect - joins the long list of other forces that can act upon objects. The analysis usually begins with the construction of a free-body diagram in which the type and direction of the individual forces are represented by vector arrows and labeled according to type. The magnitudes of the forces are then added as vectors in order to determine the resultant sum, also known as the net force. The net force can then be used to determine the acceleration of the object. In some instances, the goal of the analysis is not to determine the acceleration of the object. Instead, the free-body diagram is used to determine the spatial separation or charge of two objects that are at static equilibrium. Electric Force and Acceleration Suppose that a rubber balloon and a plastic golf tube are both charged negatively by rubbing them with animal fur. Suppose that the balloon is tossed up into the air and the golf tube is held beneath it in an effort to levitate the balloon in midair. This goal would be accomplished when the spatial separation between charged objects is adjusted such that the downward gravity force Fgrav and the upward electric force Felect are balanced. This would present a difficult task of manipulation as the balloon would constantly move from side to side and up and down under the influences of both the gravity force and the electric force. When the golf tube is held too far below the balloon, the balloon would fall and accelerate downward. This would in turn decrease the separation distance and lead to an increase in the electric force. As the Felect increases, it would likely exceed the Fgrav and the balloon would suddenly accelerate upward. And finally, if the point of charge on the golf tube is not directly under the point of charge of the balloon a likely scenario , the electric force would be exerted at an angle to the vertical and the balloon would have a sideways acceleration. The likely result of such an effort to levitate the balloon would be a variety of instantaneous accelerations in a variety of directions. Suppose that at some instant in the process of trying to levitate the balloon, the following conditions existed: Like any problem involving force and acceleration, the problem would begin with the construction of a free-body diagram. There are two forces acting upon the balloon. The force of gravity on the balloon is directed downward. The electric force on the balloon is exerted upward since the balloon and golf tube are like-charged and the golf tube is held below the balloon. These two forces are shown in the free-body diagram at the right. The second step involves determining the magnitude of these two forces. The force of gravity is determined by multiplying the mass in kilograms by the acceleration of gravity. As shown below, the appropriate unit on charge is the Coulomb C and the appropriate unit on distance is meters m. Use of these units will result in a force unit of the Newton. The upward and downward forces are added together as vectors. The acceleration is the net force divided by the mass in kilograms. The next analysis involves a case in which two objects are in a state of static equilibrium. Electric Force and Static Equilibrium Suppose that two rubber balloons are hung from the ceiling by two long strings such that they hang vertically. Then suppose that each balloon is given 10 average-strength rubs with animal fur. The balloons, having a greater attraction for electrons than animal fur, would acquire a negative charge. The balloons would have the same type of charge and they would subsequently repel each other. The result of their repulsion is that the strings and suspended balloons would now make an angle with the vertical. The angle of the string with the vertical would be mathematically related to the quantity of charge on the balloons. As the balloons acquire a greater quantity of charge, the force of repulsion between them would increase and the angle that the string makes with the vertical would also increase. Suppose that the following conditions existed. They are then rubbed ten times with animal fur to impart an identical charge Q to each balloon. The balloons repel each other and each string is observed to make an angle of 15 degrees with the vertical. Determine the electric force of repulsion, the charge on each balloon assumed to be identical , and the quantity of electrons transferred to each balloon as a result of 10 rubs with animal fur. Because of the complexity of the physical situation, it would be wise to represent it using a diagram. The diagram will serve as a means of identifying the known information for this situation. The diagram below depicts the two balloons with the string of length L and the angle "theta". The mass m of the balloons is known; it is expressed here in kilogram the standard unit of mass. The vertical line extending from the pivot point on the ceiling is drawn; this vertical line is one side of a right triangle formed by the horizontal line connecting the balloons and the string extending from balloon to ceiling. This right triangle will be useful as we analyze the situation using vector principles. There are three forces acting upon the balloons: These three forces are represented for the balloon on the right. Note that the tension force is directed at an angle to the vertical. In physics, such situations are treated by resolving the force vector into horizontal and vertical components. This is shown below; the components are labeled as Fx and Fy. These components are related to the angle that the string makes with the vertical by trigonometric functions. Since the balloon is at equilibrium, the forces that act upon the balloon must balance each other. This would mean that the vertical component of the tension force Fy must balance the downward force of gravity Fgrav. And the horizontal component of the tension force Fx must balance the rightward electrostatic force Felect. Since the mass of the balloon is known, the force of gravity acting upon it can be determined. The Fy component is related to the Fx component and the angle theta by the tangent function. This relationship can be used to determine the horizontal component of the tension force. The work is shown below. It is assumed that the balloons have the same quantity of charge since they are charged in the same manner with 10 average-strength rubs. Since Q1 is equal to Q2, the equation can be rewritten as This equation can be algebraically rearranged in order to solve for Q. The steps are shown below. This demands that the right triangle be analyzed in order to determine the length of the side opposite the degree angle. This length is one-half the distance d. Since the length of the hypotenuse is known, the sine function is used. Now substitutions can be made in order to determine the value of Q. Using the charge of a single electron Configurations of Three or More Charges In each of the examples above, we have explored the interaction of two charged objects. But what if there are three or more charges present? Does the law for electric force have to be rewritten to account for a Q3? Electrical forces result from mutual interactions between two charges. In situations involving three or more charges, the electric force on a single charge is merely the result of the combined effects of each individual charge interaction of that charge with all other charges. If a particular charge encounters two or more interactions, then the net electric force is the vector sum of those individual forces. As an example of this approach, suppose that four charges A, B, C, and D are present and that they are spatially arranged to form a square. Charges A and D are both negatively charged and occupy opposite corners of the square and Charges B and C are both positively charged and occupy the remaining two corners as shown. If one is concerned with the net electric force acting upon charge A, then the electric forces between A and each of the other three charges must be calculated. But Charge D repels A since they are a pair of like-charged objects. The direction of the individual forces are determined by applying the rules of charge interactions. And once the magnitude and direction of the three force vectors are known, the three vectors can be added using rules of vector addition in order to determine the net electric force. This is illustrated in the diagram above.

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Chapter 3 : Newton's Laws and the Electrical Force

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Excerpt from Electrical and Magnetic Calculations: For the Use of Electrical Engineers and Artisans, Teachers The *following pages, both in plan and material, are the outgrowth of several years of experience in teaching young men the rudiments of electricity.*

Chapter 5 : Electrical and Magnetic Calculations

Throughout this site, we use "EMFs" to stand for "Electric and Magnetic Fields". The electric field and the magnetic field are separate physical entities - EMFs means we are considering both of them.

Chapter 6 : Calculation of electro magnetic field (EMF) around T&D overhead lines | EEP

The power of modern personal computers makes fully three-dimensional finite-element calculations of electric and magnetic fields a practical reality for any scientist or engineer. Rough estimates can be replaced with numerically-exact values for complex geometries and material responses.

Chapter 7 : What is magnetic flux? (article) | Khan Academy

electric field at a point near a transmission calendrierdelascience.com coordinates of the line conductors are (x i,y i) where i=1 to n, n is the number of phases of transmission.

Chapter 8 : Physics equations/Magnetic field calculations - Wikiversity

Calculating and measuring fields from power lines If you know the geometry of the line and the currents (or voltages for electric fields) it is possible to calculate fields quite accurately (download a tutorial on how to calculate the fields from a three-phase circuit).

Chapter 9 : Electric, magnetic and electromagnetic

Magnetic fields are created only when there is an electric current, the motion of electric charges (electrons) in a conductor, such as a wire []. The magnitude of a magnetic field is proportional to the current flow through an.