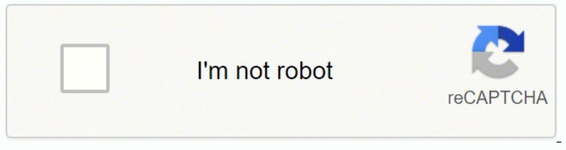

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A common assignment: if the current is entering the node, assign a negative “-“sign and if the current is leaving the node, assign a positive “+” sign. It is based on the principle of Conservation of Charge. where vn is the nth voltage. N is the number of branches. Do practice it now on the Testbook App through the free mock tests.Also, check the Types of Thermodynamic Processes in detail to boost your preparation.Kirchhoff’s Circuit Laws FAQsAns.1 According to this law, the algebraic sum of currents at any node of a circuit is zero. According to this law, the algebraic sum of voltage (or voltage drops) in any closed path of the network in a specific direction is zero.The sign while going moving in the loop totally depends on the user,If we consider while going from positive (+) to negative (–) (it depends on the user to consider) it acts as a drop or gain. View Solution Problem 2: Find V0 in the following circuit. Kirchhoff’s Current Law (KCL) Kirchhoff’s Voltage Law (KVL) The algebraic sum of all currents entering a node must always be zero where in is the nth current. This law is based on the Conservation of Charges.Ans.2 According to this law, the algebraic sum of voltage (or voltage drops) in any closed path of the network in a specific direction is zero.Ans.3 A Circuit is a closed path through which the current flows.Ans.4 A loop is a closed path in which elements are counted just once.Ans.5 A node is defined as a terminal or a junction at which two or more elements will be joined together and thus have a common point for more than one branch. At a node only one value of current is possibleSo, here violation of KCLSo, no current is possible in the circuit.Check Uniform Circular Motion article here.Memory TipKCL applies to any lumped network irrespective of the nature of the network; whether unilateral or bilateral, active or passive, linear or nonlinear.KCL does not apply to distributed networks.Current always travel in a less resistant path.KCL is always giving conservation of charge.The maximum amount of current is flowing in a short circuit because of zero resistance.There is no flow of current in an open circuit because of infinite resistance.Get the Eddy Current & Displacement Current in detail.The Second Law – Kirchhoff’s Voltage Law (KVL)Kirchhoff’s Voltage Law or the second law deals with the voltage drop in a circuit. Current goes from one point to another (positive to negative) and the voltage drop is taken as negative (-).While moving from EMF E2 current goes from positive to negative and drop is taken as –E2Similarly for R2 and R3Lastly while moving from E1 current goes from negative to positive and here gain is taken.-iR1 – E2 – iR2 + E1 = 0E1 – E2 = iR1 + iR2Q. In the 19th Century, the Scientist named Gustav Robert Kirchhoff contributed very much to this theory and provided a better understanding of electrical circuits. He contributed to the fundamental understanding of electrical circuits, spectroscopy, and the emission of black-body radiation by heated objects. N is the number of elements in the loop A common assignment: if the positive (+) side of the voltage is encountered first, assign a positive “+”sign to the voltage across the element. In the 19th Century, Gustav Robert Kirchhoff contributed very much to this theory and provided a better understanding of electrical circuits. He also discovered that the current flows at the speed of light in a conductor. He also discovered that the current flows at the speed of light in a conductor.The First Law – Kirchhoff’s Current Law (KCL)The first law of Kirchhoff deals with the current in the circuit. The total current entering a junction is exactly equal to the total current leaving the junction. Solve to find values of the currents and then voltages. The answer is unaffected by this sign.Suppose we consider it as a drop (-) when going from positive (+) to negative (-).Let’s start with Resistance R1. Find V3 and V5 in the following circuit Find Vx and Vy in the following circuit Find Vx , Vy and Vz in the following circuit Find the KCL node equations at nodes A,B,C, and D If I1=4A , I2 =5A, and I3 =3A, then using KCL find I4 and, I5 in the following circuit Answers: V3 =12V and V5=-2V Vx =12V and Vy=9V Vx =35V, Vy=5V, and Vz=15V At node A: At node B: At node C: At node D: I4=2A and I5=1A Kirchhoff’s Circuit Laws are considered as the heart of any electric circuit analysis. To get the details on Kinetic Theory of Gases, candidates can visit the linked article.Circuit TerminologyCircuit: It is a closed path through which the current flows.Path: A path is considered as a single line, which consists of circuit elements and sources.Node: A node is defined as a terminal or a junction at which two or more elements will be joined together and thus have a common point for more than one branch.Branch: A branch consists of elements like resistors and sources connected between two nodes.Loop: A loop is a closed path in which elements are counted just once.Mesh: A mesh is an open-loop and open path with no elements in it.If the elements are connected in series the current which flows through each one is the same. Find current I in the given circuit.Ans. There are two types of Kirchhoff’s Circuit Laws, which are, Kirchhoff’s Current Law and Kirchhoff’s Voltage Law. Examples: Example 2: Find the current i and voltage v over the each resistor. It is used in mesh and node analysis.Limitations of Kirchhoff’s LawThe laws of KCL and KVL are not suitable for AC circuits of high frequencies. This law is based on the Conservation of Charges.From the below image we can say that:\((i_2 + i_3 + i_5 + i_6 + i_7) = (i_1 + i_4 + i_8)\)∑ incoming = ∑ outgoingYou can also check details about Vector.Q. Find the current in the given circuit.Ans. This law is based on the Conservation of Energy. If the elements are connected in parallel the voltage across each component remains the same.For details on Distance and Displacement, refer to the linked article.Gustav Robert KirchhoffGustav Robert Kirchhoff was a German physicist born on March 12, 1824. If the negative (-) side of the voltage is encountered first, assign a negative “-”sign to the voltage across the element. So we cannot apply KVL when the magnetic field varies within a circuit.Read about the Atom & Nuclei here.Kirchhoff’s Circuit Laws: SummaryGustav Kirchhoff gives a better understanding of solving and application of electrical circuits.The first law of Kirchhoff states that the total current that enters a node or junction is equal to the total current or charge leaving the node. The total current entering at a junction is exactly equal to the total current leaving the junction. When current flows in a circuit, the magnitude of the current changes according to the product of current and resistance or emf by which it is connected in the circuit. According to this law, the algebraic sum of currents at any node of a circuit is zero. Check Power in AC Circuit for details here.Memory TipKVL applies to any lumped network irrespective of the nature of the network; whether unilateral or bilateral, active or passive, linear or nonlinear.KVL does not apply to distributed networks.The voltage drop across a short circuit is zero because of zero resistance.KVL is always conserving energy.A maximum amount of voltage is appeared across the open circuit because of infinite resistance.Voltage is constant in a parallel path and is divided into a series path.Applications of Kirchhoff’s LawKirchhoff’s law is used to find:The values of current, voltage and internal resistance in DC circuits.By applying this law we can also find the unknown resistance in the circuit.Wheatstone bridge is an important application of Kirchhoff’s law. With the help of these laws and the equation for individual components (resistor, capacitor, and inductor), we analyze circuits. View Solution Problem 4: Find I1,I2, I3in the following circuit View Solution Problem 5: Find the resistor R value in the following circuit. This is also known as the junction rule.The second law of Kirchhoff states that the sum of voltage drops is equal to the sum of voltage rise. Apply KVL in the given loop then we get,120 – 30 I – 2VA + VA = 0120 = 30 I + VA …….. (1)Also from ohms law at the output, we can getVA = – 15 I ……. View Solution Exercises: V1=8V, V2=-4V, V4=14V. (2)On solving equations (1) and (2) we getI = 8 Ampere.So, 8A current is flowing in the circuit. KVL equations for voltages Using Ohm’s Law Substituting into KVL equation Example 3: Find v1 and v2 in the following circuit (note: the arrows are signifying the positive position of the box and the negative is at the end of the box) Loop 1 Loop 2 Example 4: Find V1, V2, and V3. (note: the arrows are signifying the positive position of the box and the negative is at the end of the box) Loop 1 Loop 2 Loop3 Example 5: Find V1, V2, V3,and V4 (note: the arrows are signifying the positive position of the box and the negative is at the end of the box) Loop 1 Loop 2 Loop 3 Loop 4 Practice Problems: (Click image to view solution) Problem 1: Find V1 in the following circuit. For the following figure The node equation can be written as To use KCL to analyze a circuit, Write KCL equations for the currents Use Ohm’s law to write currents in terms of bode voltages (one equation for each resistor) Solve to find values of node voltage and current Example: Find the current through a 20Ω resistance, and current through a 40Ω resistance Write KCL at node x Write in the circuit using Ohm’s Law Apply last two equation into KCL at node x The current through a 20Ω resistance The current through a 40Ω resistance Kirchhoff’s Voltage Law (KVL): The algebraic sum of all voltage around the closed loop must be always zero. View Solution Problem 3: Find V1,V2, and V3 in the following circuit. Current law is applied only when the electric charge in a circuit is constant.Where KVL is applied in an assumption that magnetic fields do not change in a closed circuit. For the following figure To use KVL to analyze a circuit, Write KVL equations for voltages Use Ohm’s law to write voltages in terms of resistances and currents. This is also known as the loop rule.We hope the above notes on Kirchhoff’s Circuit Laws helped you in gaining a better understanding for the upcoming JEE and other competitive exams.

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