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Logged in as Jolie Cizewski, Instructor Help Log Out RUPHYS2272012 My Courses Course Settings (RUPHYS2272012) University Physics with Modern Physics, 13e Young/Freedman Course Home Assignments Roster Gradebook Item Library Instructor Resources eText Study Area H9 Chapter 28: Sources of Magnetic field, Ampere's law, Magnetic materials Overview Summary View Diagnostics View Print View with Answers [Edit] H9 Chapter 28: Sources of Magnetic field, Ampere's law, Magnetic materials Due: 11: 59pm on Monday, November 12, 2012 Note: You will receive no credit for late submissions. To learn more, read your instructor's Grading Policy Exercise 28. 2 In the Bohr model of the hydrogen atom, the electron moves in a circular orbit of radius with a speed of . Part A If we are viewing the atom in such a way that the electron's orbit is in the plane of the paper with the electron moving clockwise, find the magnitude of the electric field that the electron produces at the location of the nucleus (treated as a point). Express your answer using two significant figures. ANSWER: = 5. 1Ã—1011 Part B Find the direction of the electric field that the electron produces at the location of the nucleus (treated as a point). ANSWER: from the electron toward the electron out of the page into the page Part C Find the magnitude of the magnetic field that the electron produces at the location of the nucleus (treated as a point). Express your answer using two significant figures. ANSWER: = 13 Part D Find the direction of the magnetic field that the electron produces at the location of the nucleus (treated as a point). ANSWER: from the electron toward the electron out of the page into the page Exercise 28. 16 A square wire loop 11. 0 on each side carries a clockwise current of 15. 0 . Part A Find the magnitude of the magnetic field at its center due to the four 1. 20 ANSWER: = = 2. 38Ã—10âˆ’6 wire segments at the midpoint of each side. Part B Find the direction of this magnetic field. ANSWER: into the page out of the page Direction of the Magnetic Field due to a Wire Conceptual Question Find the direction of the magnetic field at each of the indicated points. For the following two questions consider the wire shown in the figure. . Part A What is the direction of the magnetic field at Point A? Hint 1. The magnitude of the magnetic field due to a long, straight, current-carrying wire The magnitude of the field is directly proportional to the current flowing in the wire and inversely proportional to the distance from the wire: . Hint 2. The direction of the magnetic field due to a long, straight, current-carrying wire The magnetic field surrounding a long, straight wire encircles the wire, as shown in the figure: The direction of the field is determined by a right-hand rule: Grasp the wire with the thumb of your right hand in the direction of the current flow. The direction in which your fingers encircle the wire is the direction in which the magnetic field encircles the wire. ANSWER: is out of the page. is into the page. is neither out of nor into the page and . . Part B What is the direction of the magnetic field ANSWER: is out of the page. is into the page. is neither out of nor into the page and . . at Point B? Part C What is the direction of the magnetic field at Point C? Hint 1. How to approach the problem To determine the direction of the magnetic field at Point C, you must determine the contribution to the field from both of the wires. The field at Point C is the vector sum of these two contributions. Keep in mind that if the magnetic fields are in opposite directions, the larger field will decide the direction of the net magnetic field. If they are the same size, the net magnetic field will be zero. Hint 2. Find the direction of the magnetic field at Point C due to wire 1 Is the magnetic field from wire 1 directed out of or into the screen at Point C? ANSWER: out of into Hint 3. Find the direction of the magnetic field at

Point C due to wire 2 Is the magnetic field from wire 2 directed out of or into the screen at Point C? ANSWER: out of into ANSWER: is out of the page. is into the page. is neither out of nor into the page and . . Part D What is the direction of the magnetic field at Point D? Hint 1. Find the direction of the magnetic field at Point D due to wire 1 Is the magnetic field from wire 1 directed out of or into the screen at Point D? ANSWER: out of into Hint 2. Find the direction of the magnetic field at Point D due to wire 2 Is the magnetic field from wire 2 directed out of or into the screen at Point D? ANSWER: out of into ANSWER: is out of the page. is into the page. is neither out of nor into the page and . . Part E What is the direction of the magnetic field at Point E? Hint 1. Find the direction of the magnetic field at Point E due to wire 1 Is the magnetic field from wire 1 directed out of or into the screen at Point E? ANSWER: out of into Hint 2. Find the direction of the magnetic field at Point E due to wire 2 Is the magnetic field from wire 2 directed out of or into the screen at Point E? ANSWER: out of into ANSWER: is out of the page. is into the page. is neither out of nor into the page and . . Exercise 28. 32 Two long, parallel wires are separated by a distance of 3. 40 and the wires repel each other. The current in one wire is 0. 680 . The force per unit length that each wire exerts on the other is 3. 90Ã—10âˆ’5 . , Part A What is the current in the second wire? ANSWER: = = 9. 75 Part B Are the two currents in the same direction or in opposite directions? ANSWER: In the same direction In opposite direction AmpÃ¨re’s Law Explained Learning Goal: To understand AmpÃ¨re’s law and its application. AmpÃ¨re’s law is often written . Part A The integral on the left is ANSWER: the integral throughout the chosen volume. the surface integral over the open surface. the surface integral over the closed surface bounded by the loop. the line integral along the closed loop.

the line integral from start to finish. Part B What physical property does the symbol ANSWER: The current along the path in the same direction as the magnetic field The current in the path in the opposite direction from the magnetic field The total current passing through the loop in either direction The net current through the loop represent? The positive direction of the line integral and the positive direction for the current are related by the right-hand rule: Wrap your right-hand fingers around the closed path, then the direction of your fingers is the positive direction for and the direction of your thumb is the positive direction for the net current. Note also that the angle the current-carrying wire makes with the surface enclosed by the loop doesn't matter. (If the wire is at an angle, the normal component of the current is decreased, but the area of intersection of the wire and the surface is correspondingly increased.) Part C The circle on the integral means that ANSWER: over a circle or a sphere. must be integrated along any closed path that you choose. along the path of a closed physical conductor. over the surface bounded by the current-carrying wire. Part D Which of the following choices of path allow you to use AmpÃ¨re’s law to find 1. The path must pass through the point . is constant along large parts of it. ? 2. The path must have enough symmetry so that 3. The path must be a circle. ANSWER: a only a and b a and c b and c Part E AmpÃ¨re’s law can be used to find the magnetic field around a straight current-carrying wire. Is this statement true or false? ANSWER: true false In fact AmpÃ¨re's law can be used to find the magnetic field inside a cylindrical conductor (i. e., at a radius wire,). In this case is just that current inside , not the current inside less than the radius of the (which is the total current in the wire). Part F AmpÃ¨re’s law can be used to find the magnetic field at the center of a square loop carrying a constant current. Is this statement true or false? ANSWER: true false The key point is that to be able to use AmpÃ¨re's law, the path along which you take the line integral of to allow you to pull the magnitude of must have sufficient symmetry outside the integral. Whether the current distribution has symmetry is incidental. Part G AmpÃ¨re’s law can be used to find the magnetic field at the center of a circle formed by a current-carrying conductor. Is this statement true or false? ANSWER: true false Part H AmpÃ¨re’s law can be used to find the magnetic field inside a toroid. (A toroid is a doughnut shape wound uniformly with many turns of wire.) Is this statement true or false? ANSWER: true false Therefore, though AmpÃ¨re’s law holds quite generally, it is useful in finding the magnetic field only in some cases, when a suitable path through the point of interest exists, typically such that all other points on the path have the same magnetic field through them. Exercise 28. 38 A solid conductor with radius a is supported by insulating disks on the axis of a conducting tube with inner radius central conductor and tube carry currents and correspondingly in the same direction. The currents are distributed uniformly over the cross sections of each conductor. Derive an expression for the magnitude of the magnetic field and outer radius (). The Part A at points outside the central, solid conductor but inside the tube Express your answer in terms of the variables ANSWER: = , , ( ), and appropriate constants (and). Part B at points outside the tube Express your answer in terms of the variables ANSWER: = , , ( ), and appropriate constants (and). Problem 28. 36 As a new electrical technician, you are designing a large solenoid to produce a uniform magnetic field with a magnitude of 0. 220 of the solenoid. You have enough wire for 4400 circular turns. This solenoid must have a length of 1. 45 and a diameter of

21. 0 near the center . Part A What current will you need to produce the necessary field? Use 1. 26Ã—10âˆ’6 ANSWER: = 57. 7 A for the permeability of free space. Problem 28. 39 A wooden ring whose mean diameter is 16. 0 is wound with a closely spaced toroidal winding of 560 turns. Part A Compute the magnitude of the magnetic field at the center of the cross section of the windings when the current in the windings is 0. 675 ANSWER: = 9. 45Ã—10âˆ’4 T . Problem 28. 43 A long solenoid with 52. 0 turns of wire per centimeter carries a current of 0. 100 core of silicon steel . The wire that makes up the solenoid is wrapped around a solid . (The wire of the solenoid is jacketed with an insulator so that none of the current flows into the core.) Part A For a point inside the core, find the magnitude of the magnetic field ANSWER: = 6. 53Ã—10âˆ’4 T due to the solenoid current. Part B For a point inside the core, find the magnitude of the magnetization ANSWER: . = 2. 70Ã—106 A/m Part C For a point inside the core, find the magnitude of the total magnetic field ANSWER: = 3. 40 T . Problem 28. 80 Long, straight conductors with square cross section, each carrying current , are laid side-by-side to form an infinite current sheet with current directed out of the plane of the page (see the figure). A second infinite current sheet is a distance sheet carries current into the plane of the page. Each sheet has conductors per unit length. below the first and is parallel to it. The second Part A Calculate the magnitude of the net magnetic field at point P (above the upper sheet). ANSWER: 0 Part B What is its direction? ANSWER: to the left to the right no field Part C Calculate the magnitude of the net magnetic field at point R (midway between the two sheets). ANSWER: Also accepted: Part D What is its direction? ANSWER: to the left to the right no field Part E Calculate the magnitude of the net magnetic field at point S (below the lower sheet).

ANSWER: 0 Part F What is its direction? ANSWER: to the left to the right no field Magnetic Materials Part A You are given a material which produces no initial magnetic field when in free space. When it is placed in a region of uniform magnetic field, the material produces an additional internal magnetic field parallel to the original field. However, this induced magnetic field disappears when the external field is removed. What type of magnetism does this material exhibit? ANSWER: diamagnetism paramagnetism ferromagnetism When a paramagnetic material is placed in a magnetic field, the field helps align the magnetic moments of the atoms. This produces a magnetic field in the material that is parallel to the applied field. Part B Once again, you are given an unknown material that initially generates no magnetic field. When this material is placed in a magnetic field, it produces a strong internal magnetic field, parallel to the external magnetic field. This field is found to remain even after the external magnetic field is removed. Your material is which of the following? ANSWER: diamagnetic paramagnetic ferromagnetic Very good! Materials that exhibit a magnetic field even after an external magnetic field is removed are called ferromagnetic materials. Iron and nickel are the most common ferromagnetic elements, but the strongest permanent magnets are made from alloys that contain rare earth elements as well. Part C What type of magnetism is characteristic of most materials? ANSWER: ferromagnetism paramagnetism diamagnetism no magnetism Almost all materials exhibit diamagnetism to some degree, even materials that also exhibit paramagnetism or ferromagnetism. This is because a magnetic moment can be induced in most common atoms when the atom is placed in a magnetic field. This induced magnetic moment is in a direction opposite to the external magnetic field. The addition of all of these weak magnetic moments gives the material a very weak magnetic field overall. This field disappears when the external magnetic field is removed. The effect of diamagnetism is often masked in paramagnetic or ferromagnetic materials, whose constituent atoms or molecules have permanent magnetic moments and a strong tendency to align in the same direction as the external magnetic field. Problem 28. 83 A piece of iron has magnetization 6. 80Ã—104 . The density of iron is and the atomic mass of iron is . Part A Find the average magnetic dipole moment per atom in this piece of iron. ANSWER: = = 8. 08Ã—10âˆ'25 Part B Express your answer in Bohr magnetons. ANSWER: = = 8. 72Ã—10âˆ'2