解答七

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28.41 . Identify:   Apply Ampere’s law.

Set Up:   To calculate the magnetic field at a distance *r* from the center of the cable, apply Ampere’s law to a circular path of radius *r*. By symmetry,  for such a path.

Execute:   (a) For 

(b) For  the enclosed current is zero, so the magnetic field is also zero.

Evaluate:   A useful property of coaxial cables for many applications is that the current carried by the cable doesn’t produce a magnetic field outside the cable.

 Identify:   Apply Ampere’s law to calculate 

(a) Set Up:   For  the end view is shown in Figure 28.46a.

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| --- | --- | --- |
| 97066_28_F46a |  | Apply Ampere’s law to a circle of radius *r*, where  Take currents  to be directed into the page. Take this direction to be positive, so go around the integration path in the clockwise direction. |
| Figure 28.46a |  |  |

Execute:   



Thus 

(b) Set Up:    See Figure 28.46b.

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| --- | --- | --- |
| 97066_28_F46b |  | Apply Ampere’s law to a circle of radius *r*, where  Both currents are in the positive direction. |
| Figure 28.46b |  |  |

Execute:   



Thus 

Evaluate:   For  the field is due only to the current in the central conductor. For  both currents contribute to the total field.

28.58. Identify:   Find the vector sum of the magnetic fields due to each wire.

Set Up:   For a long straight wire  The direction of  is given by the right-hand rule and is perpendicular to the line from the wire to the point where the field is calculated.

Execute:   (a) The magnetic field vectors are shown in Figure 28.68a.

(b) At a position on the *x*-axis  in the positive 

(c) The graph of *B* versus  is given in Figure 28.68b.

Evaluate:   (d) The magnetic field is a maximum at the origin, 

(e) When 

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| --- |
| 97066_28_F68a97066_28_F68b |
| Figure 28.68 |

28.69. Identify:   Use what we know about the magnetic field of a long, straight conductor to deduce the symmetry of the magnetic field. Then apply Ampere’s law to calculate the magnetic field at a distance *a* above and below the current sheet.

Set Up:   Do parts (a) and (b) together.

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| 97066_28_F83a |  | Consider the individual currents in pairs, where the currents in each pair are equidistant on either side of the point where  is being calculated. Figure 28.83a shows that for each pair the *z*-components cancel, and that above the sheet the field is in the  and that below the sheet it is in the  |
| Figure 28.83a |  |  |

Also, by symmetry the magnitude of  a distance *a* above the sheet must equal the magnitude of  a distance *a* below the sheet. Now that we have deduced the symmetry of  apply Ampere’s law. Use a path that is a rectangle, as shown in Figure 28.83b.

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| --- | --- | --- |
| 97066_28_F83b |  |  |
| Figure 28.83b |  |  |

*I* is directed out of the page, so for *I* to be positive the integral around the path is taken in the counterclockwise direction.

Execute:   Since  is parallel to the sheet, on the sides of the rectangle that have length   On the long sides of length  is parallel to the side, in the direction we are integrating around the path, and has the same magnitude, on each side. Thus  *n* conductors per unit length and current *I* out of the page in each conductor gives  Ampere’s law then gives 

Evaluate:   Note that *B* is independent of the distance *a* from the sheet. Compare this result to the electric field due to an infinite sheet of charge (Example 22.7).