Key

Formulas for this section

$$B = \frac{\mu_0 I}{2\pi r} \qquad F = qvBsin(\theta) = BILsin(\theta)$$

$$B = \frac{\mu_0 NI}{L} \qquad \tau = NIABcos(\theta)$$

Constants

$\mu_0 = 4\pi \cdot 10^{-7}$ $\quad q_e = 1.6 \cdot 10^{-19} C$ $\quad m_e = 9.11 \cdot 10^{-31} kg$

P14. A vertical electric wire carries a dc current of 60.0 A downward. Find the strength of the magnetic field at a point 6.29 cm due south of the wire.

A) 191 μT
B) 8.85 mT
C) 65.2 mT
D) 466 mT
E) 1.04 T

$I = 60 A$
$r = .0629$
$B = ?$

$B = \frac{\mu_0 60}{2\pi(.0629)} = .000191 T$

P14. A coil of wire consists of 100 circular loops, each with a radius of 6.52 cm. A current of 2.88 A flows through the wire. The coil is placed in a uniform 0.357-T magnetic field. Find the maximum torque the magnetic field can exert on the coil.

A) 1.05 N·m
B) 1.37 N·m
C) 1.69 N·m
D) 2.10 N·m
E) 2.42 N·m

$N = 100$
$r = .0652 m$
$I = 2.88 A$
$B = .357 T$
$\tau = ?$

$\tau = NIAB\cancel{\cos(\theta)}$
$\tau = 100(2.88)(\pi(.065)^2)(.357)$
$= 1.37 Nm$

P14. A solenoid consists of 200 turns of wire and it has a length of 12.2 cm. Find the magnetic field inside the solenoid, near the center, when it carries a current of 1.68 A.

A) 5.14 mT
B) 4.72 mT
C) 4.30 mT
D) 3.88 mT
E) 3.46 mT

$N = 200$
$L = .122m$
$B = ?$
$I = 1.68A$

$$B = \frac{\mu_0 NI}{L} = \frac{\mu_0 (200)(1.68)}{.122}$$
$$= .0034T$$

P14. The magnetic field inside a solenoid is measured to be 0.570 T when a current of 50.0 A flows through the solenoid. The radius of the solenoid is 3.00 cm and the length of the solenoid is 12.0 cm. How many turns (loops) of wire make up the solenoid?

A) 272 turns
B) 1090 turns
C) 1710 turns
D) 6840 turns
E) 9072 turns

$B = .570T$
$I = 50A$
$r = .03m$
$L = .12m$

$$B = \frac{\mu_0 NI}{L}$$
$$N = \frac{BL}{\mu_0 I} = \frac{(.57)(.12)}{\mu_0 (50)} = 1088$$

P17. You are a space colony construction worker who has been assigned to run an electric cable horizontally between two buildings. The buildings are separated by 320.0 m and the maximum current that will be carried in the cable is 250.0 A. Unfortunately, the planet on which you are working has a very large magnetic field of 11.8 T. In your colony's location, the magnetic field is oriented at 30° with respect to the cable's path. What will be the magnetic force on the cable when it is carrying maximum current?

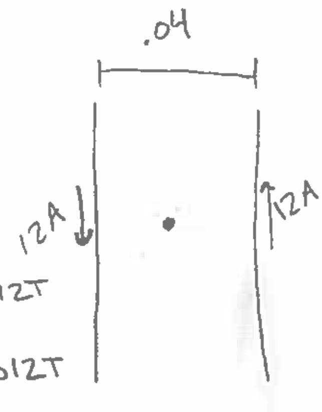
A) 472,000 N
B) 545,000 N
C) 818,000 N
D) 944,000 N
E) 1,640,000 N

$L = 320m$
$I = 250A$
$B = 11.8T$
$\theta = 30°$

$$F = BIL\sin(\theta)$$
$$= 11.8(250)(320)\sin(30)$$
$$= 472{,}000N$$

P14. Two long parallel wires are 4.00 cm apart and each carries a current of 12.0 A, but in opposite directions. Find the magnetic field at a point halfway between them.

A) 0.000
B) 120 μT
C) 240 μT
D) 360 μT
E) 480 μT



r = .02m

I = 12A

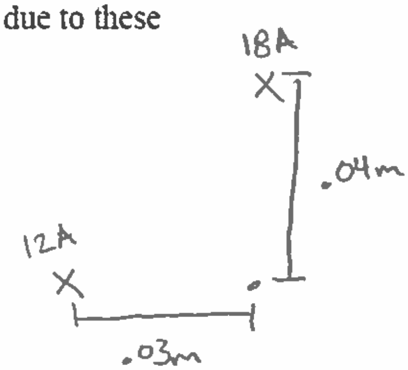
$B_1 = \frac{\mu_0 I}{2\pi r} = .00012T$

$B_2 = \frac{\mu_0 I}{2\pi r} = .00012T$

they work togethe .00012 + .00012 = .00024T

P19. Two long straight wires carry currents in the +z direction (out of the page). The first wire, carrying 12.0 A, passes through (-3.00cm, 0). The second wire, carrying 18.00 A, passes through (0, +4.00cm). What is the magnitude of the magnetic field at the origin (0,0) due to these currents?

A) 10.0 μT
B) 80.0 μT
C) 90.0 μT
D) 120 μT
E) 170 μT



$B_1 = \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 (12)}{2\pi(.03)} = 7.9\times10^{-5}\,T$

$B_2 = \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 (18)}{2\pi(.04)} = 8.9\times10^{-5}\,T$

work together

$7.9\times10^{-5} + 8.9\times10^{-5} =$

.00017T

P14. An electron is traveling horizontally at a speed of 7,250,000 m/s when it enters a region in which there is a 2.47-T magnetic field that is oriented vertically upward. The electron begins to travel in a circle with a radius of ______________.

A) 16.7 µm
B) 288 µm
C) 3.44 mm
D) 49.5 mm
E) 612 mm

$v = 7.25\times10^{6}$

$B = 2.47\,T$

$r = ?$

$q_e = 1.6\times10^{-19}$

$m_e = 9.11\times10^{-31}$

Circle $F_c = \frac{mv^2}{r}$

$F = qvB\cancel{\sin(\theta)}$

$\frac{mv^2}{r} = qvB$

$r = \frac{mv^2}{qvB} = \frac{mv}{qB} = \frac{(9.11\times10^{-31})(7.25\times10^{6})}{(1.6\times10^{-19})(2.47)}$

$= 16.7\times10^{-6}$

P14. A charged particle is traveling in a circular path that is perpendicular to a 1.12-T magnetic field. The charge to mass ratio of the particle is 9.59 x 10^7. Find the time required for the particle to make one complete revolution.

A) 7.05 x 10^{-10} s
B) 6.90 x 10^{-9} s
C) 5.85 x 10^{-8} s
D) 5.70 x 10^{-7} s
E) 5.55 x 10^{-6} s

$B = 1.12\,T$

$\frac{q}{m} = 9.59\times10^{7}\,\frac{C}{kg}$

$T = ?$

$F_c = F_m$

$\frac{mv^2}{r} = qvB\cancel{\sin(\theta)}$

$mv^2 = qvBr$

$mv = qBr$

$v = \frac{qBr}{m}$

$v = \frac{2\pi r}{T} \longrightarrow \frac{2\pi r}{T} = \frac{qBr}{m}$

$2\pi r m = TqBr$

$T = \frac{2\pi \cancel{r} m}{qB\cancel{r}} = \frac{2\pi m}{qB} = \frac{2\pi}{9.59\times10^{7}(1.12)} = 5.85\times10^{-8}$