Problem Solutions

27.24 The beam travels through a quarter circle, so 1.18cm is $\frac{1}{4}(2\pi R)$, where R is the radius of the circular orbit. Find R from this and then use $B = mv/qR$ to calculate the magnetic field as 1.67×10^{-3} T.

27.12. Let us choose the normal to each surface to be directed outward from green volume shown (this choice was arbitrary, we could also have chosen it to be inward, and then all the answers below would be the negatives of the ones we now get).
(a) 0, because normal to surface is perpendicular to the field.
(b) $\Phi = \vec{B}\bullet\vec{A} = BA\cos(180^\circ) = -(0.128\text{T})(.300\text{m})(.300\text{m}) = -0.0115\text{Wb}$.
(c) $\Phi = \vec{B}\bullet\vec{A} = BA\cos(\phi) = (0.128\text{T})(.500\text{m})(.300\text{m})(3/5) = +0.0115\text{Wb}$
(d) The flux through the top and bottom surfaces is zero, because the normals to them are perpendicular to the field. The net flux through all five surfaces is zero.

28.28. The force on each wire is the sum of the forces due to the other two wires. On top wire, $\frac{F}{L} = \frac{\mu_0 I^2}{4\pi d}$ upwards. On middle wire, force is 0. On bottom wire, $\frac{F}{L} = \frac{\mu_0 I^2}{4\pi d}$ downwards.

28.66. The two straight segments produce zero field at P. Each semicircular segment produces a field of magnitude $\frac{1}{2}\left(\frac{\mu_0 I}{2R}\right)$ where I and R are its current and radius, respectively. The inner loop produces a field out of the page and the outer one into the page. The net field at P is therefore $B = \frac{\mu_0 I}{4}\left(\frac{1}{a} - \frac{1}{b}\right)$, out of the page.

28.76. At the center of the circular loop, the current I_2 produces a magnetic field of magnitude $\frac{\mu_0 I_2}{2R}$ into the page. The current in the straight wire must point to the right if it is to produce a field out of the page at the center of the circular loop and hence lead to zero field there. Equating the field due to the straight wire, $\frac{\mu_0 I_1}{2\pi D}$, to that due to the loop and solving for I_1 gives

$$I_1 = \frac{\pi D}{R} I_2$$