

Physics 10164 - Exam 2B

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work even if you get the right answer. Clearly indicate your answer with a circle or a box and remember to include correct units and significant figures.

1. (30 pts) A household circuit contains a 120 Volt battery and a main wire with a 5.0 Amp circuit breaker. How many 60 Watt light bulbs can be connected in parallel on this circuit before the circuit breaker is triggered?

$$60 \text{ W} = \frac{(120)^2}{R}$$

$$R = 240 \Omega$$

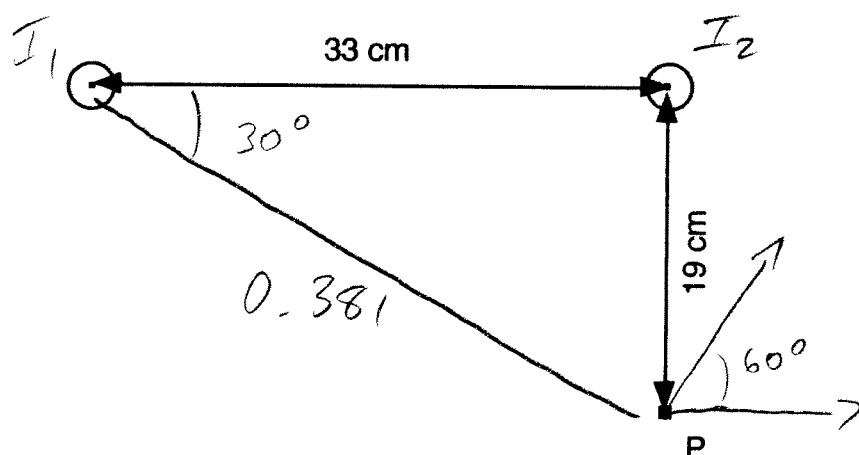
$$I = \frac{4V}{R} = 0.5 A$$

If I in each branch is $0.5 A$,

$$\text{then } I_{\text{tot}} = I_1 + I_2 + \dots = 5.0 A$$

gives 10 bulbs before
circuit breaker goes.

2. (40 pts) Two wires carrying 5.0 Amps of current are oriented so that their currents are pointed out of the page as shown below. Find the magnitude and direction of the resulting magnetic field at point P.



$$|B_1| = \frac{\mu_0 (5)}{2\pi (0.381)} = 2.6 \times 10^{-6} T$$

$$|B_2| = \frac{\mu_0 (5)}{2\pi (0.19)} = 5.3 \times 10^{-6} T$$

$$B_{1x} + B_{2x} = 2.6 \cos 60 + 5.3$$

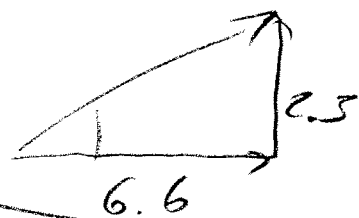
$$= 6.6 \mu T$$

$$B_{1y} + B_{2y} = 2.6 \sin 60 + 0$$

$$= 2.3 \mu T$$

$$|\vec{B}| = \sqrt{6.6^2 + 2.3^2} = 7.0 \mu T$$

$$\theta = \tan^{-1}\left(\frac{2.3}{6.6}\right) = 19^\circ \text{ above } +x$$



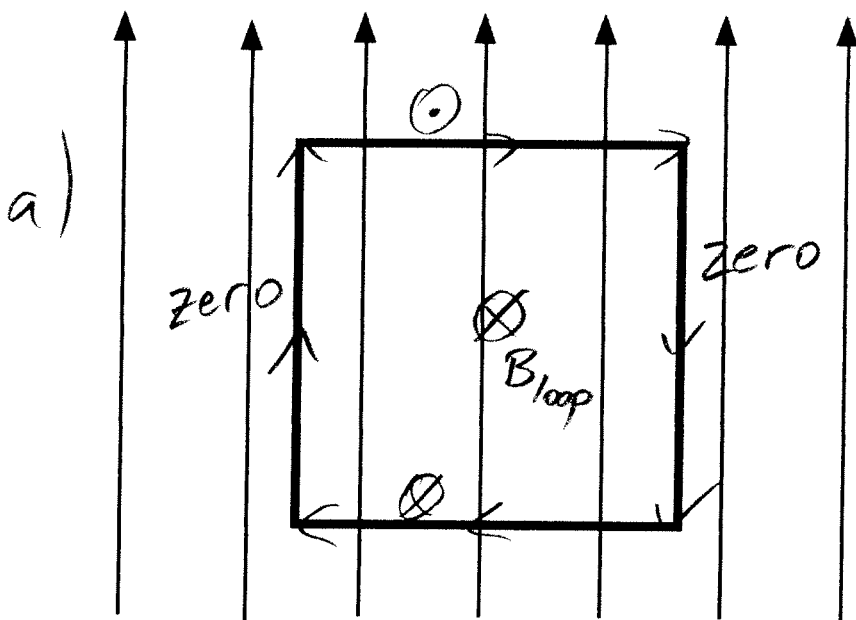
3. (30 pts) A square loop, 15 cm on a side, carries a current of 3.0 Amps in a clockwise direction. The loop is in the plane of the page as shown below.

There is a magnetic field from an external ^{source} ~~force~~ that is also in the plane of the page. The field is uniform with a magnitude of a 5.0 Tesla and directed toward the top of the page.

a) On the diagram below, indicate with appropriate symbols the direction of magnetic force on each of the four sides of the loop (or write "zero" if there is no force).

b) What is the magnitude of the torque acting on the loop?

c) What is the direction of the magnetic field due to the loop itself, inside the loop?



b) $\tau = BIA \sin \theta$

$$= (5.0)(3.0)(.15)^2 \sin 90^\circ$$

$$= \boxed{0.34 \text{ N}\cdot\text{m}}$$

c) RHR says $B_{\text{loop}} = \otimes$