

THIRD MIDTERM

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Discussion Section # _____

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REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

- (a) Calculate the cyclotron frequency for an electron in a magnetic field of 1.22 T.

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$$f = \frac{qB}{2\pi m} = \frac{1.6 \times 10^{-19} \times 1.22}{2 \times 3.14 \times 9.11 \times 10^{-31}} \approx 3.41 \times 10^{10} \text{ s}^{-1}$$

- (b) Take the direction of the earth's magnetic field as being exactly N-S. If its value is 0.550 gauss, what is the force, magnitude and direction, on one meter of wire carrying 150 amperes from west to east (the direction of the conventional current).

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$$F = I\ell B = 150 \times 1 \times 0.55 \times 10^{-4} = 8.25 \times 10^{-3} \text{ N, direction = up}$$

- (c) Calculate the radius of the orbit of a proton in a magnetic field of 0.300 T, if the velocity of the proton is $v = 2.4 \times 10^4$ m/s. The plane of the orbit is perpendicular to the magnetic field.

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$$r = \frac{mv}{qB} = \frac{1.67 \times 10^{-27} \times 2.4 \times 10^4}{1.6 \times 10^{-19} \times 0.3} = 8.35 \times 10^{-4} \text{ m}$$

- (d) Calculate the time constant for a simple RC circuit if $R = 450 \text{ k}\Omega$ and $C = 670 \text{ pF}$.

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$$\tau = RC = 450 \times 10^3 \times 670 \times 10^{-12} = 3.02 \times 10^{-4} \text{ s}$$

- (e) Calculate the magnetic field, in Tesla, needed for a velocity selector for electrons if the velocity desired is 2.00×10^3 m/s and the electric field is 4.00×10^4 V/m.

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$$B = \frac{E}{v} = \frac{4 \times 10^4}{2 \times 10^3} = 20 \text{ T}$$

result : 4

unit : 1