

TEST # 1. PHYS 204. SPRING 2003. 04/10/03

NAME:

1. Consider two long straight wires separated by a distance of 2 m as in the figure. The wires carry currents of 5 A in the same direction as shown.

(a) (15 points) Find the net magnetic field (magnitude and direction) at point A. Show the direction of the magnetic field of both wires and the total magnetic field in the diagram.

(b) (10 points) Relative to the wire 1, locate a point on the dashed line in the figure where the total magnetic field is zero.

2. A circular loop of wire is in a region of spatially uniform magnetic field as shown in the figure. The magnetic field is directed into the plane of the figure. Determine the direction (clock or counterclockwise or no current) of the induced current in the loop when (explain your reasoning):

(a) (5 points) B is increasing in time

(b) (5 points) B is decreasing in time

(c) (5 points) B is constant with value B_0

(d) (10 points) In the case of increasing magnetic field, calculate the magnitude of the induced emf if the loop has a radius of 10 cm, and the magnetic field goes from an initial value of 0T to a final value of 3T in a time interval of 0.1s.

3.1 (16 points) In the circuit below, the generator delivers 10 times as much current at very low frequencies than it does at very high frequencies. Find the ratio $R_1/(R_1 + R_2)$.

3.2 (9 points) In the following circuit:

(a) (3 points) Find the impedance at resonance.

(b) (3 points) Find the value of L if the resonance frequency is $f_0 = 100$ Hz.

(c) (3 points) Find the I_{rms} at resonance.

4.1 Consider a concave spherical mirror of focal distance 2m. An upright object of height 1.5 m is located at 2.5 m to the left of the mirror. Calculate:

(a) (5 points) The image distance

(b) (3 points) The magnification

(c) (2 points) Is the image upright or downright, virtual or real?

(d) (5 points) Draw the ray diagram.

2.2 (10 points) A point source of light is 54 cm below the surface of a body water. Find the diameter of the largest circle at the surface through which light can emerge from the water. (Hint: think in terms of total internal reflection. $n_{water} = 1.33$).