Physics II

Chapter 21 Practice

Spring 2020

IMPORTANT: Except for multiple-choice questions, you will receive no credit if you show only an answer, even if the answer is correct. Always show in the space on your answer sheet some sketches, words, or equations which clearly justify your answer. Show the equations you use and the values substituted into them whenever equations are necessary. If you go from a formula directly to an answer without showing the values used, you will lose points. Points will also be deducted for missing or erroneous units.

Each individual answer is weighted roughly evenly throughout the exam.

- I will not lie, cheat, or steal in any of my academic endeavors.
- I will forthrightly oppose each and every instance of academic dishonesty.
- I will not request, receive, or give aid in examinations/tests/quizzes.

☐ Yes. I am abiding by the Honor Code.

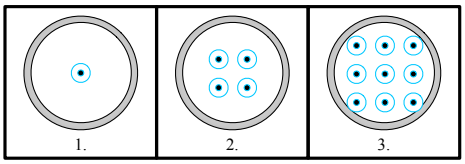
☐ No. I do not agree to abide by the Honor Code.

$$\mathcal{E} = N\frac{\Delta\Phi}{\Delta t} \qquad \frac{N_1}{N_2} = \frac{V_1}{V_2}$$

$$\Phi = BA\cos\theta \qquad P = iV \qquad V = iR \qquad W = F\Delta x\cos\theta$$

$$P = \frac{W}{\Delta t} \qquad \mathbf{F} = i\mathbf{l}\times\mathbf{B}$$

Name _____

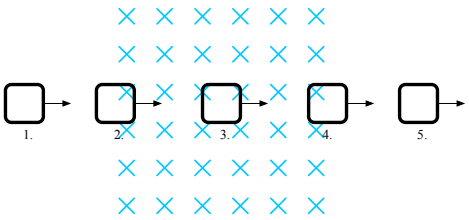


1. The three frames above show a wire loop and the changing magnetic field from an external magnet. In which direction does the induced conventional current flow in this loop?

   (a) clockwise
   (b) counterclockwise
   (c) clockwise at first and then counterclockwise
   (d) There is no induced current in this situation.

2. What's the difference between AC and DC current? Why does APS provide AC to our homes rather than DC?

For the next three items



A wire loop is moved with a constant velocity through a uniform magnetic field as shown above. Which choice best represents the current that will flow in this wire loop?

3. In which position(s) will the loop have no current? 1, 3, 5

4. In which position(s) will the loop have a clockwise current? 4

5. In which position(s) will the loop have a counterclockwise current? 2

6. Electrical power is transmitted at high voltage over long distances because

   (1) a larger amount of energy can be transmitted per unit charge.
   (2) a smaller current is required for a fixed amount of power delivered.
   (3) less power is lost through heating during transmission.

   (a) (1), (2) and (3)
   (b) (1) and (2) only
   (c) (2) and (3) only
   (d) (1) only
   (e) (3) only

7. A magnet is moved toward a sheet of copper. Which of the following statements is/are correct?

   (1) Eddy currents flow in the sheet.
   (2) Temperature of the sheet increases.
   (3) Repulsive force is experienced by the magnet.

   (a) (1), (2) and (3)
   (b) (1) and (2) only
   (c) (2) and (3) only
   (d) (1) only
   (e) (3) only

For the next three items

A transformer consisting of a primary coil of 50 turns and a secondary coil of 2000 turns is wound on an iron core. It is used to operate an electric sign.

8. If an alternating emf of 120 V is applied to the primary coil, the emf output to the sign is

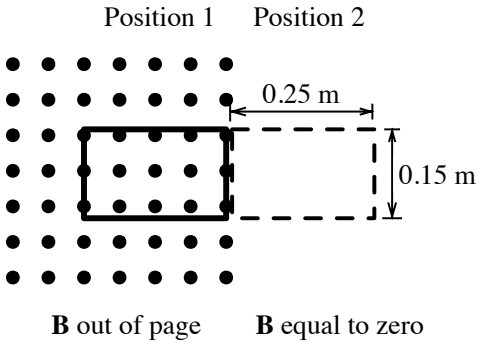
   (a) 3 V.
   (b) 120 V.
   (c) 4800 V.
   (d) 6000 V.

9. The current received by the electric sign from this transformer is 0.002 amp. Therefore, the input current to the transformer must be

   (a) 0.1 amp.
   (b) 4 amps.
   (c) 0.08 amp.
   (d) 0.002 amp.

10. How much power is received by this transformer?

    (a) 9.6 W
    (b) 0.24 W
    (c) 384 W
    (d) 480 W



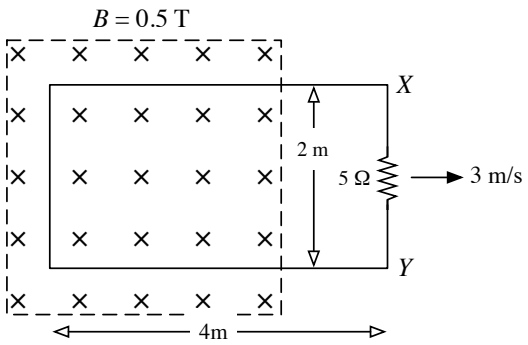
11. A 20-turn nichrome wire coil in the shape of a rectangle, 0.25 m by 0.15 m, has a resistance of 5.0 Ω. In Position 1 shown above, the loop is within a uniform magnetic field of strength $B = 0.20$ T. The field is directed out of the page, perpendicular to the plane of the loop. The loop is pulled to the right at a constant velocity, reaching Position 2 in 0.50 s, where $B = 0$.

    (a) Calculate the average emf induced in the 20-turn coil during this period of time.

    $emf = N\Delta\Phi/\Delta t = N\Delta BA/\Delta t = (20)(0.2)(0.15)(0.25)/0.5 = 0.3$ V

    (b) Calculate the magnitude of the current induced in the 20-turn coil, and state whether the current flows in a clockwise direction or a counterclockwise direction.
    $V = iR$ or $i = V/R = 0.3/5 = 0.06$ A

    (c) Calculate the power dissipated in the 20-turn coil.
    $P = iV = (0.06)(0.3) = 0.018$ (0.3 Joules lost per Coulomb flowing around the circuit times 0.06 Coulombs flowing per second)



12. A wire loop, 2 meters by 4 meters, of negligible resistance is in the plane of the page with its left end in a uniform 0.5 tesla magnetic field directed into the page, as shown above. A 5 ohm resistor is connected between points X and Y. The field is zero outside the region enclosed by the dashed lines. The loop is being pulled to the right at 3 m/s while the left end of the loop is still in the field, and points X and Y are not in the field.

(a) Determine the potential difference induced between points X and Y.
Use Faraday's Law: $emf = N\Delta\Phi/\Delta t = N\Delta BA/\Delta t = N\frac{B\ell\Delta x}{\Delta t} = NB\ell v = (1)(0.5)(2)(3) = 3$ V

3 V

(b) On the figure above show the direction of the current induced in the resistor.

Use Lenz's Rule: Decreasing flux into the page from the external field results in induced flux into the page.
Clockwise

(c) Find how much current will flow in this loop.

$V = iR$ where emf $= V$ tells us $i = 0.6$ Amp.