This print-out should have 12 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

Flux Through a Loop 02

001 10.0 points
A rectangular loop located a distance from a long wire carrying a current is shown in the figure. The wire is parallel to the longest side of the loop.

Find the total magnetic flux through the loop.

Correct answer: $1.94196 \times 10^{-9}$ Wb.

Car Antenna

002 10.0 points
A car with a 1.47 m long radio antenna travels at 127 km/h in a place where the Earth’s magnetic field is $5.09 \times 10^{-5}$ T.

What is the maximum possible induced emf in the antenna as it moves through the Earth’s magnetic field?

Correct answer: 0.00263959 V.

Rectangular Loop and Wire 02

003 (part 1 of 2) 10.0 points
A long, straight wire carries a current and lies in the plane of a rectangular loops of wire, as shown in the figure.

Determine the maximum emf, $|\mathcal{E}|$, induced in the loop by the magnetic field created by the current in the straight wire.

Correct answer: 30.3639 mV.

004 (part 2 of 2) 10.0 points
If at $t = 0$, $\delta=0$, and a positive I denotes an upward moving current in the figure, then which statement below is correct at $t = 0$.

1. There is zero current in the loop.
2. The current in the loop is clockwise.
3. The sense of current is not determined with the information given.
4. The current in the loop is counterclockwise. correct

Circular Magnetic Field 02

005 (part 1 of 3) 10.0 points
A magnetic field directed into the page changes with time according to

$$B = a + bt^2,$$

where $a = 0.813$ T, $b = 0.03$ T/s$^2$, and $t$ is in seconds. The magnetic field pole has a circular cross section of radius $R = 2.8$ cm.
What is the magnitude of the electric field at point $P_1$ when $t = 1.8$ s and $r_1 = 2.45$ cm?

Correct answer: 1.323 mV/m.

006 (part 2 of 3) 10.0 points
What is the direction of the electric field?

1. The electric field is perpendicular to $r_1$ and directed clockwise.

2. The electric field is parallel to $r_1$ and directed away from the center of the magnetic field.

3. Information is not sufficient to make a decision.

4. The electric field is perpendicular to $r_1$ and directed counter-clockwise. **correct**

5. The electric field is parallel to $r_1$ and directed to the center of the magnetic field.

007 (part 3 of 3) 10.0 points
What is the magnitude of the electric field at point $P_2$ when $t = 1.8$ s and $r_2 = 3.15$ cm?

Correct answer: 1.344 mV/m.

Rod Sliding on Metal Rails 01S

008 (part 1 of 2) 10.0 points
A rod AD slides along a pair of parallel metal rails. The loop ABCDA has a resistance $R$. The magnetic field $B$ is into the paper, $L = AD$ is the length of the rod, and its speed is $v$.

Find the induced current.

1. $i_{\text{ind}} = \frac{R}{Bv}$

2. $i_{\text{ind}} = \frac{BvL}{R}$ **correct**

3. $i_{\text{ind}} = \frac{Bv}{R}$

4. $i_{\text{ind}} = \frac{R}{BL}$

5. $i_{\text{ind}} = \frac{R}{(BvL)^2}$

6. $i_{\text{ind}} = \frac{(BvL)^2}{R}$

7. $i_{\text{ind}} = \frac{BL}{R}$

8. $i_{\text{ind}} = \frac{vL}{R}$

9. $i_{\text{ind}} = \frac{R}{BvL}$

10. $i_{\text{ind}} = \frac{R}{vL}$

009 (part 2 of 2) 10.0 points
Determine the magnitude of the magnetic force, which the magnetic field $\vec{B}$ exerts on the rod (to be more precise exerts on the induced current in the rod) for the case where $R = 1.1 \, \Omega$, $B = 1.5 \, T$, $v = 2 \, m/s^2$, $L = 2 \, m$.

Correct answer: 16.3636 N.

Capacitor Current

010 10.0 points
The applied voltage across the plates of a 1.72 µF capacitor varies in time according to the expression

$$V_{\text{app}} = V_0 \left(1 - e^{-t/t_0}\right),$$

where $t$ is in seconds, $t_0 = 4.75$ s, and $V_0 = 8.59$ V.
Calculate the value of the displacement current at \( t = 4.75 \) s.

Correct answer: \( 1.14428 \times 10^{-6} \) A.

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**Tipler PSE5 30 15**

**011** (part 1 of 2) 10.0 points

A parallel-plate capacitor in air has circular plates of radius 2.4 cm separated by 1.4 mm. Charge is flowing onto the upper plate and off the power plate at a rate of 13 A.

Find the time rate of change of the electric field between the plates.

Correct answer: \( 8.1176 \times 10^{14} \) V/m \( \cdot \) s.

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**012** (part 2 of 2) 10.0 points

Compute the displacement current between the plates.

Correct answer: 13 A.