This print-out should have 14 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. The due time is Central time.

Please notice that for your homework to be considered towards your grade, it needs to be submitted one hour before the corresponding recitation starts. Work submitted after this time, but before the DUE DATE on top of this page, will be accepted but not graded.

PLEASE REMEMBER THAT YOU MUST CARRY OUT YOUR CALCULATIONS TO AT LEAST THREE SIGNIFICANT FIGURES. YOUR ANSWER MUST BE WITHIN ONE PERCENT OF THE CORRECT RESULT TO BE MARKED AS CORRECT BY THE SERVER.

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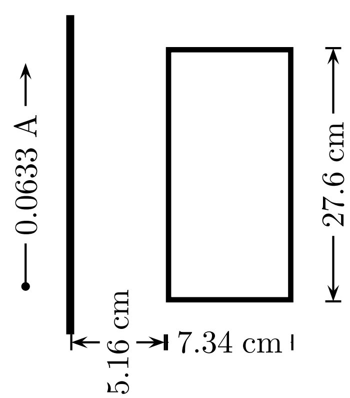
**001** (part 1 of 1) 6 points

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. Answer in units of Wb.

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**002** (part 1 of 2) 4 points

A 0.0886 A current is charging a capacitor that has square plates, 2.41 cm on a side.

The permitivity of free space is $8.85419 \times 10^{-12}\ \mathrm{C^2/N\,m^2}$.

If the plate separation is 2.33 mm find the time rate of change of electric flux between the plates. Answer in units of V m/s.

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**003** (part 2 of 2) 4 points

Find the displacement current between the plates. Answer in units of A.

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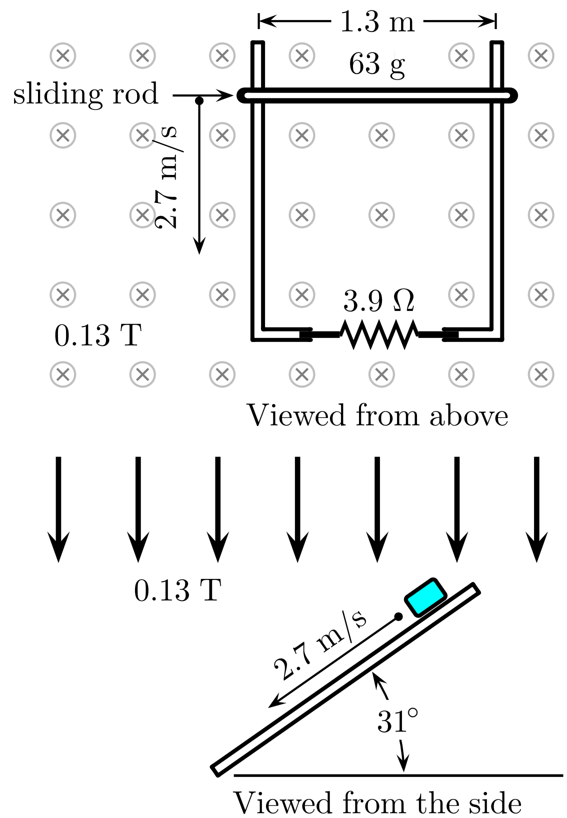
**004** (part 1 of 2) 4 points

A straight, horizontal rod slides along parallel conducting rails at an angle with the horizontal, as shown below. The rails are connected at the bottom by a horizontal rail so that the rod and rails forms a closed rectangular loop. A uniform vertical field exists throughout the region.

*Assume:* The rod remains in contact with the rails as it slides down the rails. The rod experiences no friction or air drag. The rails and rod have negligible resistance. The acceleration of gravity is $9.8\ \mathrm{m/s^2}$ .




If the velocity of the rod is 2.7 m/s, what is the current through the resistor? Answer in units of mA.

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**005** (part 2 of 2) 4 points

What is the terminal velocity of the rod? Answer in units of m/s.

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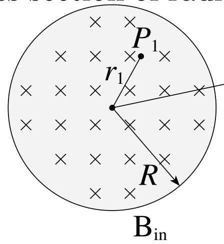
**006** (part 1 of 3) 5 points

A magnetic field directed into the page

changes with time according to

$$B = a + b\,t^2\,,$$

where $a = 1.55$ 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 $t = 3$ s and $r_1 = 2.33$ cm? Answer in units of mV/m.

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**007** (part 2 of 3) 3 points
What is the direction of the electric field?

**1.** Information is not sufficient to make a decision.

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

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

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

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

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**008** (part 3 of 3) 5 points
What is the magnitude of the electric field at point $P_2$ when $t = 3$ s and $r_2 = 3.27$ cm? Answer in units of mV/m.

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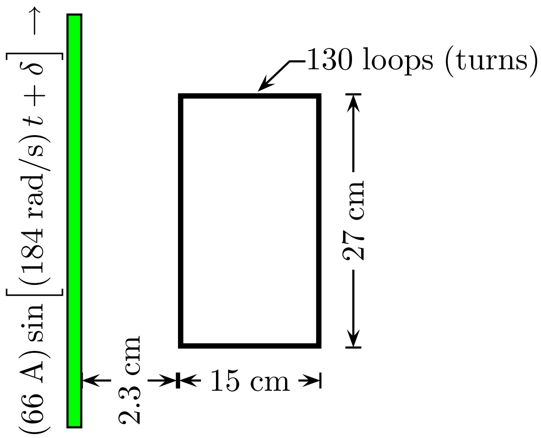
**009** (part 1 of 2) 4 points
A long, straight wire carries a current and lies in the plane of a rectangular loops of wire, as shown in the figure.




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

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**010** (part 2 of 2) 3 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 sense of current is not determined with the information given.

**3.** The current in the loop is clockwise.

**4.** The current in the loop is counter-clockwise.

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**011** (part 1 of 4) 2 points
Which equation best represents Gauss's Law for electrostatics?

**1.** $\oint \vec{E} \cdot d\vec{A} = \dfrac{Q}{\epsilon_0}$

**2.** $\oint \vec{B} \cdot d\vec{s} = 0$

**3.** $\oint \vec{B} \cdot d\vec{A} = \dfrac{Q}{\epsilon_0}$

**4.** $\oint \vec{B} \cdot d\vec{A} = 0$

**5.** $\oint \vec{B} \cdot d\vec{s} = \mu_0\, I + \mu_0\, \epsilon_0 \dfrac{\partial \Phi_E}{\partial t}$

**6.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}$

**7.** $\oint \vec{E} \cdot d\vec{s} = -\frac{\partial \Phi_B}{\partial t}$

**8.** $\oint \vec{E} \cdot d\vec{A} = -\frac{\partial \Phi_B}{\partial t}$

**9.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 I$

**10.** $\oint \vec{E} \cdot d\vec{s} = \frac{Q}{\epsilon_0}$

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**012** (part 2 of 4) 2 points

Which equation best represents Gauss's Law for magnetostatics?

**1.** $\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

**2.** $\oint \vec{B} \cdot d\vec{A} = 0$

**3.** $\oint \vec{B} \cdot d\vec{s} = \mu_0 I + \mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}$

**4.** $\oint \vec{B} \cdot d\vec{s} = 0$

**5.** $\oint \vec{E} \cdot d\vec{A} = -\frac{\partial \Phi_B}{\partial t}$

**6.** $\oint \vec{E} \cdot d\vec{s} = \frac{Q}{\epsilon_0}$

**7.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}$

**8.** $\oint \vec{E} \cdot d\vec{s} = -\frac{\partial \Phi_B}{\partial t}$

**9.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 I$

**10.** $\oint \vec{B} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

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**013** (part 3 of 4) 2 points

Which equation best represents Faraday's Law?

**1.** $\oint \vec{B} \cdot d\vec{s} = 0$

**2.** $\oint \vec{B} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

**3.** $\oint \vec{E} \cdot d\vec{A} = -\frac{\partial \Phi_B}{\partial t}$

**4.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}$

**5.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 I$

**6.** $\oint \vec{B} \cdot d\vec{A} = 0$

**7.** $\oint \vec{E} \cdot d\vec{s} = -\frac{\partial \Phi_B}{\partial t}$

**8.** $\oint \vec{E} \cdot d\vec{s} = \frac{Q}{\epsilon_0}$

**9.** $\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

**10.** $\oint \vec{B} \cdot d\vec{s} = \mu_0 I + \mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}$

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**014** (part 4 of 4) 2 points

Which equation best represents Ampere-Maxwell's Law?

**1.** $\oint \vec{B} \cdot d\vec{A} = 0$

**2.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}$

**3.** $\oint \vec{E} \cdot d\vec{s} = \frac{Q}{\epsilon_0}$

**4.** $\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

**5.** $\oint \vec{B} \cdot d\vec{A} = \mu_0 I$

**6.** $\oint \vec{B} \cdot d\vec{s} = 0$

**7.** $\oint \vec{E} \cdot d\vec{s} = -\frac{\partial \Phi_B}{\partial t}$

**8.** $\oint \vec{B} \cdot d\vec{s} = \mu_0 I + \mu_0 \epsilon_0 \frac{\partial \Phi_E}{\partial t}$

**9.** $\oint \vec{B} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

**10.** $\oint \vec{E} \cdot d\vec{A} = -\frac{\partial \Phi_B}{\partial t}$