This print-out should have 10 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

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001 (part 1 of 2) 10.0 points

A solenoid has 101 turns of wire uniformly wrapped around an air-filled core, which has a diameter of 10 mm and a length of 10.7 cm. The permeability of free space is \( 1.25664 \times 10^{-6} \text{ N}/\text{A}^2 \).

Calculate the self-inductance of the solenoid.

Answer in units of H.

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002 (part 2 of 2) 10.0 points

The core is replaced with a soft iron rod that has the same dimensions, but a magnetic permeability of \( 800 \mu\mu_0 \).

What is the new inductance?

Answer in units of H.

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003 10.0 points

A spring has a radius of 3.8 cm and an inductance of 180 \( \mu \)H when extended to a length of 3 m.

Find an approximate value for the total number of turns in the spring. The permeability of free space is \( 1.25664 \times 10^{-6} \text{ N}/\text{A}^2 \).

Answer in units of turns.

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004 10.0 points

At times prior to \( t = 0 \), the switch is open. The switch is closed at \( t = 0 \).

When \( I = 19 \text{ mA} \), what is the potential difference across the inductor?

Answer in units of V.

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005 (part 1 of 3) 10.0 points

An inductor and a resistor are connected with a double pole switch to a battery as shown in the figure.

The switch has been in position \( b \) for a long period of time.

If the switch is thrown from position \( b \) to position \( a \) (connecting the battery), how much time elapses before the current reaches 112 mA?

Answer in units of ms.

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006 (part 2 of 3) 10.0 points

What is the maximum current in the inductor a long time after the switch is in position \( a \)?

Answer in units of A.

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007 (part 3 of 3) 10.0 points

The switch has brushes within it so that the switch can be thrown from \( a \) to \( b \) without internal sparking. Now the switch is smoothly thrown from \( a \) to \( b \), shorting the inductor and resistor.

How much time elapses before the current falls to 100 mA?

Answer in units of ms.

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008 10.0 points

In an RL series circuit, an inductor of 3.49 H and a resistor of 6.78 \( \Omega \) are connected to a 24.7 V battery. The switch of the circuit is initially open. Next close the switch and wait for a long time. Eventually the current reaches its equilibrium value.

At this time, what is the corresponding energy stored in the inductor?

Answer in units of J.

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009 (part 1 of 2) 10.0 points

The switch in the figure is closed at \( t = 0 \).
Find the time constant of the circuit if \( L = 26.5 \text{ mH} \), \( \mathcal{E} = 12.8 \text{ V} \), \( R = 4.95 \Omega \).
Answer in units of ms.

\[ 010 \text{ (part 2 of 2) 10.0 points} \]
Calculate the current in the circuit at \( t = 2.4 \text{ ms} \).
Answer in units of A.