Basic Electronics

Assessed Problems 2

For online completion before your week 3 deadline.

APS2.1 An air-filled parallel-plate capacitor is connected to a 1 kV DC supply. The plates have an area of 10 cm^2 and are separated by a distance of 1 mm. How much charge is stored on each plate? [1 mark]

(a) 88.5 pC
(b) 8.85 nC
(c) 4.43 nC
(d) None

APS2.2 The 1 kV DC supply is disconnected and a 1 MΩ resistor is connected between the plates. How long does it take for the voltage across the plates to fall to 1 V ? [1 mark]

(a) 8.9 ms
(b) 31 μs
(c) 61 μs
(d) 368 ms

APS2.3 Two parallel metal plates of radius 30 cm are separated by 1 mm. It takes 6.25 mJ to raise the potential difference between the plates to 1 kV. What is the relative permittivity of the material between the plates? [1 mark]

(a) 8.85×10^{-12}
(b) 1
(c) 5
(d) 36

APS2.4 A current of 200 mA flows in an air-filled coil having 3182 turns, a diameter 10 cm and a length 50 cm. How much energy is stored? [1 mark]

(a) 1 mJ
(b) 4 mJ
(c) 8 mJ
(d) 4 J

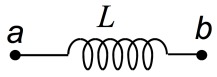
APS2.5 The potential at terminal *a* of an inductor (see figure below) is higher than the potential at terminal *b*. A current, in the conventional sense, flows in the inductor. Which of these statements is true? [1 mark]

(a) the current is constant with respect to time

(b) current measured in a sense from *a* to *b* is increasing, and current measured *b* to *a* is decreasing

(c) current measured in a sense from *a* to *b* is decreasing, and current measured *b* to *a* is increasing

(d) None of the above statements are true



APS2.6 The inductor shown above has a value $L = 0.26\,\text{H}$. A current, measured in the direction from *b* to *a*, is found to be changing at a rate of -0.019 A/s. Which of the following statements is true? [1 mark]

(a) The potential difference is about 5 mV and terminal *a* is at a higher electrical potential

(b) The potential difference is about 70 mV and terminal *b* is at a lower electrical potential

(c) The potential difference is about 5 mV and terminal *b* is at a higher electrical potential

(d) The potential difference is about 70 mV and terminal *a* is at a lower electrical potential

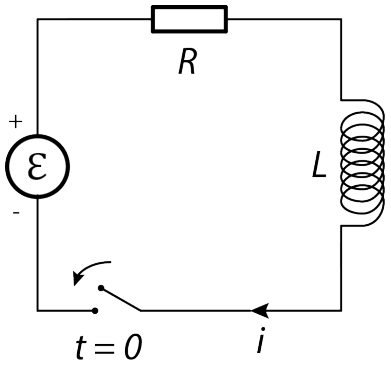
APS2.7 A circuit consists of an ideal voltage source of EMF 25 V connected by a switch to a $50\,\Omega$ resistor in series with a 1.25 mH inductor. At time $t = 0$ the switch is closed. Choose the best answer. [1 mark]

(a) The current in the circuit at time $t \to \infty$ is 500 mA

(b) The current reaches half this value 17.3 μs after the switch is closed

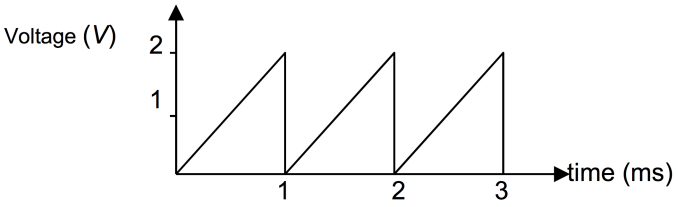
(c) The energy stored by the inductor reaches half its maximum value 30.7 μs after the switch is closed

(d) All of the above are true



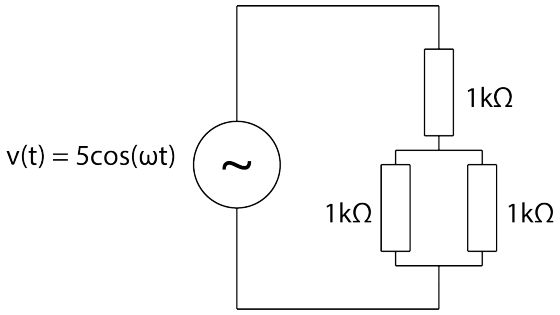
APS2.8 For the waveform shown below, which is the correct statement? [1 mark]

(a) The average value is zero volts and the RMS is 1 V
(b) The average value is 1 V and the RMS is 1.15 V
(c) The average value is 1.15 V and the RMS is 1.33 V
(d) None of the above are true



APS2.9 For the circuit shown below, which is the correct statement? [1 mark]

(a) The average power dissipation is zero and the peak power is 8.33 mW
(b) The average power dissipation is 8.33 mW and the peak power is 16.67 mW
(c) The average power dissipation is 8.33 W and the peak power is 16.67 W
(d) None of the above are true



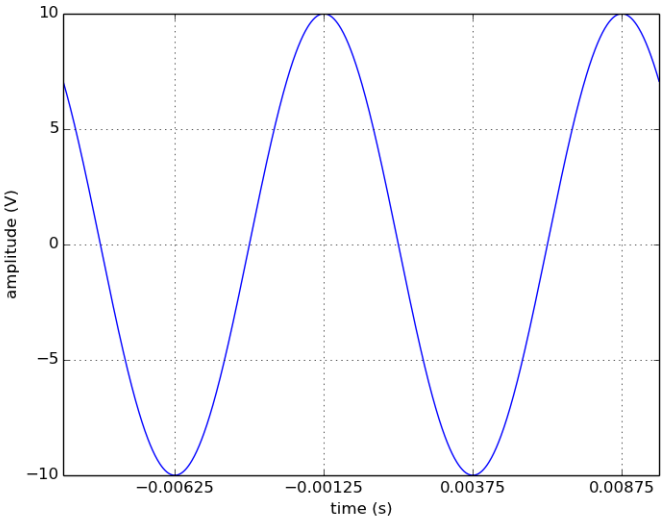
APS2.10 A sinusoidal waveform is measured on a 'scope as per the figure below. Which statement is true? [1 mark]

(a) The waveform has an amplitude 10 V and the frequency is 50 Hz

(b) The angular frequency is 200π rad/s and the phase angle is $\pi/6$ rad

(c) The RMS amplitude is $10/\sqrt{2}$ V and at time $t = 0$ the measurement is $10/\sqrt{2}$ V

(d) None of the above



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8-Jan-17

Basic Electronics

Tutorial Problems 2

These problems are for your week 3 tutorial.

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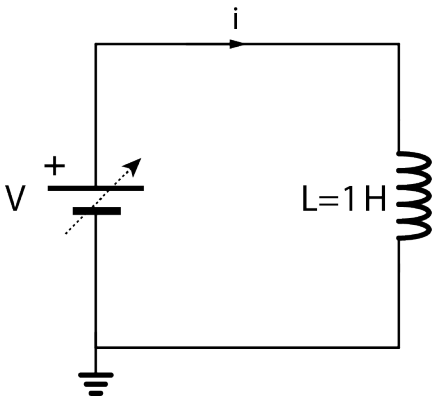
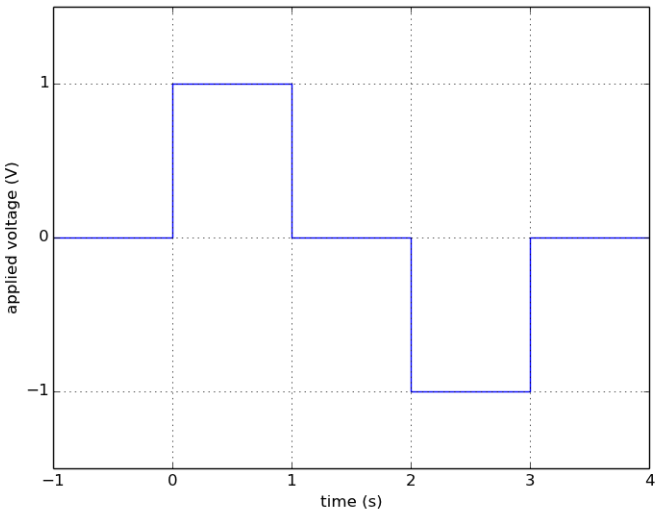
1. Inside the case of a 9 V 'PP3' battery (the rectangular type with press-clip contacts) there are six small AAAA-type cells connected in series, each having an EMF $\mathcal{E} = 1.5\,\text{V}$ and internal resistance of one-third of an ohm.
   (a) What is the Thévenin equivalent circuit of a PP3 battery?
   (b) A 2200 μF capacitor is connected across the terminals of a PP3 battery. How long does it take for the voltage across the capacitor to reach 4.5 V?
   (c) How much energy is stored by the capacitor when fully charged?
2. An ideal voltage source, with variable output, is connected to an ideal 1 H inductor. The circuit and supply voltage profile is shown in the figure below.
   (a) Sketch the current over the same time-period
   (b) At time $t = 1.5\,\text{s}$, how much energy is stored by the inductor?
   (c) After 4 s, how much energy has been expended by the voltage source?





Discussion Problems

2. A parallel plate capacitor is charged by being connected to a battery. The battery is then disconnected and the separation between the plates is doubled. What happens to the potential difference across the plates? Does the energy stored go up or down? Why?
3. In question 1(b), would the capacitor charging time be different if we used two PP3 batteries in parallel?
4. In question 1(c), is the capacitor ever truly 'fully-charged'?