Instructions:

- This quiz lasts 30 minutes. Answer all questions (on both sides of the sheet)
- You may have a 8.5" × 11" sheet of notes (hand in your notes with the quiz) and a non-network-connected calculator

Q1a: (5 marks) Consider an electronic bathroom scale for which measures body impedance by sending a 10 mA current at 100 kHz into the body through the feet.

Answer, and briefly (one sentence each) explain:

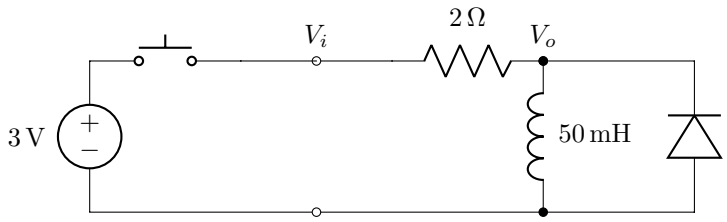
(a) Is this a macro or a microshock scenario?
(b) Does this current pose any risks?

Q2a: (5 marks) Consider a circuit using an optoisolator to provide electrical isolation.

(a) Sketch (and label) a diagram of its internal components
(b) Explain (1–2 sentences) how it provides electrical isolation

Q3a: (10 marks) The figure shows the input to a relay. Initially, the push button is open. At $t = 0\,\text{ms}$, it turns on, and at $t = 100\,\text{ms}$, it turns off.

(a) Calculate any relevant time constants.
(b) Sketch the V_o and current i through the inductor as a function of time.
(c) Explain (briefly, one sentence) the role of the diode.



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Q1b: (5 marks) Consider an electronic bathroom scale for which measures body impedance by sending a 10 mA current at 100 kHz into the body through the feet.

Answer, and briefly (one sentence each) explain:

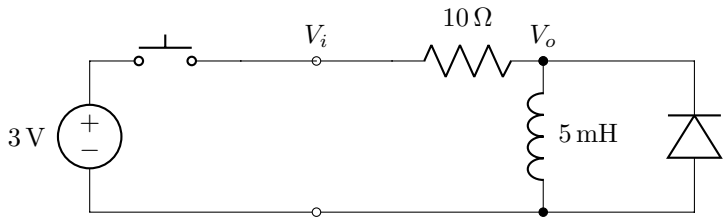
(a) Can this current be felt?
(b) How does the safety of current at this frequency compare to that of current at 60 Hz?

Q2b: (5 marks) Consider a circuit using an optoisolator to provide electrical isolation.

(a) Sketch (and label) a diagram of its internal components
(b) The specifications give a minimum current into the input to turn on the device. What happens if a current smaller than this minimum flows into the input?

Q3b: (10 marks) The figure shows the input to a relay. Initially, the push button is open. At $t = 0\,\text{ms}$, it turns on, and at $t = 10\,\text{ms}$, it turns off.

(a) Calculate any relevant time constants.
(b) Sketch the V_o and current i through the inductor as a function of time.
(c) Explain (briefly, one sentence) the role of the diode.



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Q1c: (5 marks) Consider an electronic bathroom scale for which measures heart rate by measuring the ECG with electrodes on the feet. The input amplifiers have a DC leakage current of 10 mA.

Answer, and briefly (one sentence each) explain:

(a) Is this a macro or microshock?
(b) Does this current pose any risks?

Q2c: (5 marks) Consider a circuit using a relay to provide electrical isolation.

(a) Sketch (and label) a diagram of its internal components
(b) Explain (1–2 sentences) how it provides electrical isolation

Q3c: (10 marks) The figure shows the input to an RC circuit. Initially, $V_i = 0\,\text{V}$. At $t = 0\,\text{ms}$, $V_i = 3\,\text{V}$, and at $t = 500\,\text{ms}$, $V_i = 0\,\text{V}$. The diode is not connected (until part (c)).

(a) Calculate any relevant time constants.
(b) Sketch the voltage V_o as a function of time; calculate the peak values.
(c) If the diode is connected will current flow at any time? (The diode has forward voltage of 0.7 V)